

**Michigan Forest Inventory
4th Statewide Inventory
Fieldwork 10/77 - 5/81**

NORTH CENTRAL FOREST SURVEY FIELD INSTRUCTIONS

by

Burton L. Essex, Arnold J. Ostrom,
Jerold T. Hahn and James E. Apgar

MICHIGAN, 1980

ALSO USED IN KANSAS
N. and S. DAKOTA

June 1967

Revised September 1977

Supplement to Forest Survey Handbook FSH 4813.1

MICHIGAN FIELD MANUAL

New Plot Measurement

Contents

001	INTRODUCTION
002	FIELD EQUIPMENT LIST
40	INVENTORY FIELD PROCEDURES
41	DETERMINING SAMPLE LOCATION
41.1	Planning Travel
41.2	Establishment of Reference Line
41.3	Starting Point
41.4	Photograph Azimuth
41.5	Photograph Distance
41.7	Travel to Location
42	ESTABLISHMENT OF SAMPLE LOCATION
42.1	Establishing Center of New Location
42.2	Location Correction
42.4	Nonforest Locations
42.5	Noncommercial Forest Locations
42.6	Commercial Forest Locations
42.7	Witness Trees
42.8	Ten-Point Cluster
42.9	Substitute Points
43	LOCATION IDENTIFICATION
43.2	State
43.3	Survey Unit
43.4	County
43.5	Sample Number

43.6 Sample Kind

43.7 Date of Survey

44 AREA CLASSIFICATION

44.1 Land Use

44.11 Land Use, Dot and PI

44.12 Land Use, Ground

44.13 Land Use Trend

44.2 Owner Class

44.25 Owner Tenure

44.3 National Forest

45 TREE IDENTIFICATION

45.1 New Plots

45.11 Fixed-Plot Tally for Trees 1.0 to 5.0 Inches
Diameter Breast High (Plot Radius 6.8 Feet
Encompassing 1/300 Acre)

45.11a Plot Points 1, 2, and 3

45.11b Plot points 4 through 10

45.12 Variable-Plot Tally for Trees 5.0 Inches Diameter
Breast High and Larger

45.13 Fixed-Plot Tally for Seedlings or Other Cover
(Plot Radius 6.8 Feet Encompassing 1/300 Acre)

45.14 Fixed-Plot Tally for Stumps (Plot Radius 16.5 Feet
Encompassing 1/50 Acre)

45.3 Azimuth

45.4 Distance

45.5 Point Number

45.6 Tree Number

45.7 Tree History

45.8 Species

46 TREE MEASUREMENTS

46.1 Tree Diameter Breast High

46.11 Stump Diameter at New Locations

46.3	Bole Length
46.31	Stump Height
46.35	Bole Length Top D.O.B.
46.4	Cubic-Foot Cull
46.5	Saw Log Length
46.6	Saw Log Top Diameter Outside Bark
46.7	Board-Foot Cull
47	TREE CLASSIFICATION
47.05	Log Grade
47.1	Surface Defect
47.11	Softwoods for Eastern United States
47.13	Hardwoods for Entire United States
47.2	Internal Defect
47.3	Total Volume Loss
47.31	Sweep and Crook
47.4	Relative Bole Length
47.5	Crown Ratio
47.6	Crown Class
47.7	Damage, Cause of Death
47.71	Damage
47.72	Cause of Death
47.8	Tree or Cover Class
47.81	Tree Class
47.82	Cover Class
48	AREA DESCRIPTION
48.1	Stand Origin
48.2	Site Class
48.3	Site Index
48.31	Site Tree Selection
48.32	Site Tree Data

- 48.4 Physiographic Class
- 48.5 Stand Age
- 48.6 Seed Source
- 48.7 Forest Type
- 49.1 Sample Location and Optional Items
- 49.21 Stand-size Class
- 49.22 Basal Area Per Acre
- 49.24 Point Occupancy
- 49.25 Stocking Percent
- 49.29 Aspect, Position and Slope
- 49.31 Stand History
- 49.32 Stand Area
- 49.33 Combination
- 49.33a Distance to Water
- 49.33b Distance to Roads
- 49.33c Conifer Understory
- 49.34 Photo Age
- 49.35 Nonforest--black walnut inventory (Kansas only)
- 49.36 Nonforest--wooded strip ground plot design (Kansas only)

APPENDIX

Tree Species Codes
 (with asterisk indicating a noncommercial species)

001 - INTRODUCTION

This manual provides Forest Survey field instructions for the North Central Forest Experiment Station, National Forest System and other cooperating organizations in establishing and measuring field sample plots for the Survey in the North Central Region.

It contains procedures as given in the Forest Service Handbook FSH 4809.11, February 1972 Amendment No. 6 with local supplements and abridged codes for convenience and efficiency in field work.

002 - FIELD EQUIPMENT LIST

The following equipment will be needed to measure required items at field locations. Each field person should check to make sure he/she has this equipment and it is in good working order.

- Pocket Stereoscope
- 37.5 Factor Prism
- Hand Axe
- Compass (Suunto)
- Increment Borer
- Diameter Tape
- Plot Tape (100 ft. woven type)
- Clinometer (Suunto)
- Photo Holder
- Clip Board (With Tatum Guides and Photo Scales)
- Telescopic Height Pole (30 ft.)
- Wheeler Pentaprism
- Cruiser's Vest
- Tree Marking Scribe
- Tree Paint
- Two Yellow Stakes
- Ten Metal Pins
- Flagging
- Safety Pin
- Mini-Caliper

40 - INVENTORY FIELD PROCEDURES

Uniform measuring and recording methods are provided to ensure comparability of the resource data compiled by different units and efficiency in the collection of timber resource statistics.

Forest Survey is faced with the problem of remeasuring and recovering information from plot systems other than the standard 10-point cluster plot specified in this chapter. No attempt will be made in this handbook to outline remeasurement procedures. Appropriate supplements to this handbook will be prepared covering remeasurement procedures.

Precise measurements and classifications are essential to keep field-technique errors to a minimum. Errors in area classification of tree measurements will be expanded several hundred times in the processing phase of the Forest Survey, and an accumulation of even small errors may lead to erroneous inventory results.

An emphasis on limiting predictions of the future needs to be made clear. Potential product use of seedlings, saplings, and small poletimber, based on site index, will not enter into tree class determinations. Poor form on seedlings and small saplings should not be used to classify them as cull trees. Predicting death should only enter into tree class determinations in most severely damaged situations.

Item captions and information to be recorded mentioned in this handbook refer to items on the Forest Inventory Sample Record in exhibit 1.

41 - DETERMINING SAMPLE LOCATION

41.1 - Planning Travel. Field crews will be supplied with road maps and aerial photographs with sample locations marked. Field crews should select the field sample locations to be visited each day and plan travel to field sample locations using the maps, photographs, and other information on local travel conditions.

41.2 - Establishment of Reference Line. The first step in locating the forest sample location is to draw a straight reference line between two features visible on the photograph and easily located on the ground. Whenever possible these two features should be at least 10 chains apart to help minimize error. Select such features as straight road sections, drainage ditches, or field edges. Avoid using railroads or power lines, since they influence the compass reading. A line drawn between two well-spaced buildings or other easily identifiable landmarks may also serve as a reference line.

Next draw the reference line on the back of the photograph with an arrow at one end of the line to indicate the azimuth direction. Measure the azimuth with a compass to the nearest degree and record it on the back of the photograph. Disregard magnetic declination.

41.3 - Starting Point. Select a landmark readily identifiable on the ground and on the photograph and as close to the sample location as possible. Select landmarks which can be readily identified on resurveys, such as intersections or sharp bends in roads, streams or drainage ditches, field corners and prominent trees.

Pinprick the starting point on the aerial photograph on which the sample location is pinpricked. Label the pinprick "SP" on the back of the photograph.

In the field mark the starting point with paint. Paint "SP" facing direction of normal approach in letters about 4" high located at D.B.H. and a 3" high "SP" near ground level.

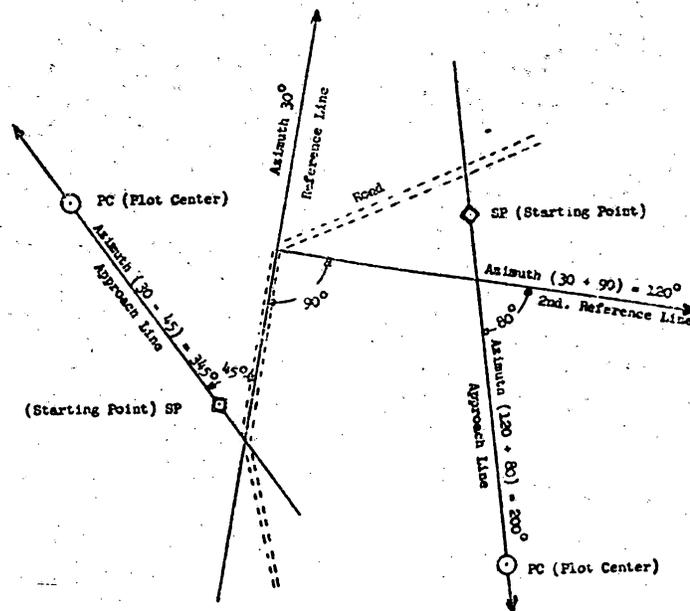
Describe the starting point on the back of the sample record under starting point description.

41.4 - Photograph Azimuth. Draw a straight line on the back of the photograph through the center of the starting point pinprick and the center of the sample location pinprick. - Extend this line to intersect the reference line or an extension of it. Lines should extend well beyond the intersection to allow reading the backsight off the 360 degree protractor to check the accuracy of the angle being measured.

If the reference line and the line to the sample location, or extensions of those lines, do not intersect on the photograph, draw a straight line that will intersect the reference line and the course to sample location line. Indicate the directions of the sample location line and the reference line by putting an arrow at the end of each line.

Measure the angle between these lines, starting from the reference line. Obtain the azimuth of the sample location line by inverting the transparent photo scale and aligning the 360 degree protractor over the azimuth of the reference line. Once the azimuth of the reference line is correctly aligned on the inverted protractor the azimuth of the sample location line can be directly read off the protractor. This is because all azimuths are reversed 180 degrees when working on the back of the photographs. Repeat this procedure if an additional line was needed to intersect the course to sample location. To minimize error check the backsights of both reference and course to sample location lines. This is a check to see if straight lines have been drawn.

AZIMUTH CALCULATIONS



41.5 - Photograph Distance. Measure on the photograph the distance from the starting point to the plot center to the nearest 20 feet (or 3/10 chain) by using a transparent scale.

41.7 - Travel to Location. Using compass and tape, run a course on the computed azimuth for the scaled distance from starting point to sample location. Record this information on the back of the photograph and on the Forest Inventory sample record under course to sample location.

Distance correction for slope will be necessary when slope exceeds ten percent. Using the suunto clinometer the slope correction can be quickly determined and added by the tallyman after the cruiser has run out the line. Making adjustments for differences in the height of crew partners, the tallyman can sight on the cruiser and directly read the percent scale on the clinometer, taking the percent slope and using the following table, the correct adjustment to whatever length line was run can be added.

Slope Correction Table

<u>Percent</u>	<u>66'</u>	<u>70'</u>	<u>99'</u>
10	.6	.7	.9
16	.9	.9	1.2
21	1.5	1.6	1.9
27	2.4	2.5	3.0
32	3.4	3.6	4.1
38	4.7	5.0	5.8
44	6.4	6.7	7.4
51	8.4	8.6	9.6
58	10.2	11.0	12.8
65	19.0	20.0	24.6

<u>Chains</u>	<u>Feet</u>
1/6	11.0
1/4	16.5
1/3	22.0
1/2	33.0
2/3	44.0
3/4	49.5
5/6	55.0

42 - ESTABLISHMENT OF SAMPLE LOCATION

42.1 - Establishing Center of New Location. If the sample location is being established for the first time, place a permanent stake at the end of the computed course. Check to make sure that photograph location agrees with ground location.

42.2 - Location Correction. If the ground location is clearly not the point pinpricked on the photograph, and the correct location can be determined on the site, place a second pin at the correct location. Note the azimuth and distance from the initial pin to the relocated pin and record these items on the back of the Forest Inventory Sample Record under course to sample location and remove the first pin. This second pin becomes the location of point one of the 10-point cluster.

42.4 - Nonforest Locations. A certain number of locations interpreted as questionable on aerial photographs will require a field check in accordance with an improved sampling design. In addition, a certain number of locations interpreted as forest on aerial photographs, upon field examination will turn out to be nonforest.

If point one of the location falls on nonforest land, refer to section 44.12 to find what items to record.

42.5 - Noncommercial Forest Locations. If point one of the location falls on noncommercial forest land, refer to section 44.12 to find what items to record.

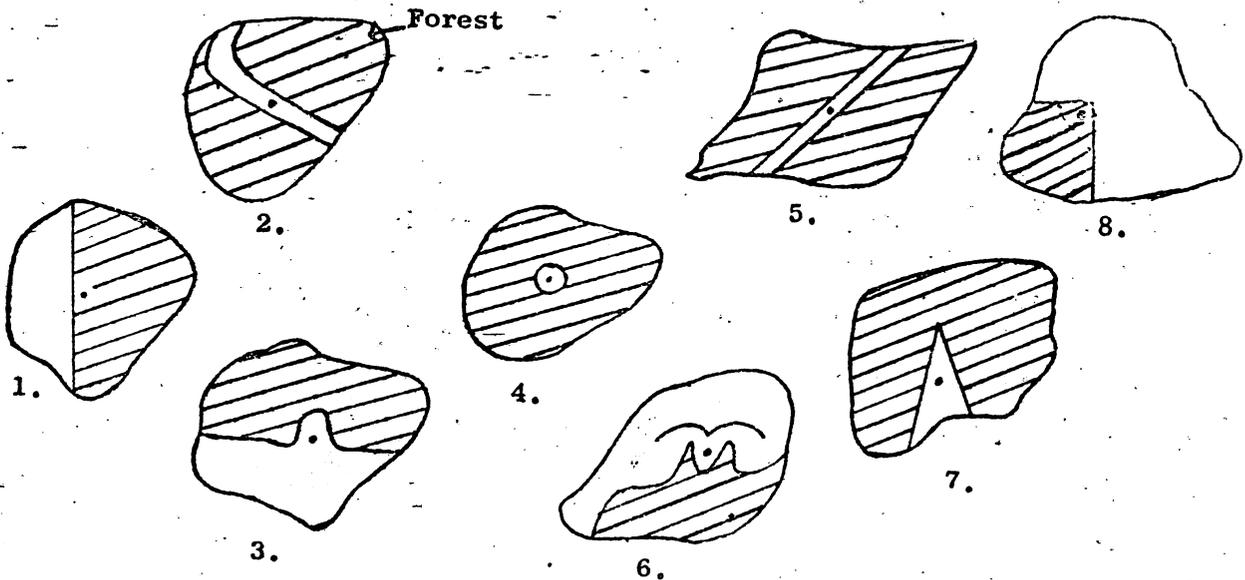
If point one falls in a forest of marginal productivity site index will be measured first. All commercial species found within the plot area must be measured and determined unproductive before classifying the plot as noncommercial unproductive forest land. The tallyman must use his judgment when determining whether the productive area is over one acre in size; if it is not, the area is classified as unproductive. Refer to section 48.3, Site Index, to find the minimum productive site indexes for all commercial species.

This category of land includes both unproductive forest land and productive forest land withdrawn from commercial timber use, including land used for Christmas tree production. (See section 44.12, codes 45 and 46).

42.6 - Commercial Forest Locations. If point one of the sample location falls on land that qualifies as commercial forest land, establish the sample location and record information for all required tally items on the Forest Inventory sample record (see section 43.6, Sample Kind) and Tatum Guide # 4 in the Appendix.)

In this and the following sections dealing with plot location, it should be remembered that the location center (as defined by the pinprick on the photo) determines the land class, provided the area surrounding the pinprick is at least 1 acre and 120 feet in width. Forest boundaries are measured on the ground at the point where a vertical line is dropped from the outside edge of the forest crown since the accurate location of the bole cannot be seen by the photo-interpreter. This is not to be confused with the line of shadows cast from the edge of the crowns. Often when uneven boundaries exist the tallyman must use an imaginary line to distinguish forest from nonforest. A one-acre circle is printed on the transparent photo scales issued. These can be helpful in determining forest and nonforest areas. One acre is 43,560 square feet; this requires a strip of land 120 feet wide to be over 350 feet long, a square area needs to be 210 feet on a side, and a circular area needs to be 235 feet in diameter.

In the following examples hatched areas represent forest lands.



1. Forest--dot falls on forest land larger than 1 acre in size.
2. & 3. Forest--dot falls on strip of nonforest land (less than 120 feet in width) that is bounded by forest land on at least 2 sides.
4. Forest--dot falls on nonforest land (less than 1 acre in size) that is surrounded by forest land.
5. Nonforest--dot falls in improved road less than 120 feet wide. Improved roads and power line clearings of any width are nonforest.
6. Forest--dot falls in area of more than two adjacent strips of clearly defined forest and nonforest land (each strip less than 120 feet in width). As the band of strips in the acre is comprised of more forest than nonforest, the classification is forest.
7. Forest--dot falls on nonforest land (less than 120 feet in width). If point had fallen in area 120+ wide the classification would be nonforest.
8. Forest--dot falls in a forest land area less than 120 feet in width, but it is classified as forest. This is a special case to handle corners (in the vicinity of 90 degrees) of forest land that have man-created boundaries adjoining them to nonforest lands. An example would be a farm woodlot over 120 feet in width and one acre in size that was bordered by a field.

The above rules apply equally but in reverse manner if the location of forest and nonforest land is reversed.

42.7 - Witness Trees. Reference point one with at least three witness trees if possible. They should preferably be (1) close to the pin and spaced approximately at right angles from the pin, (2) not likely to die or be cut within 10 years, (3) species easily located in the stand, and (4) at least 5 inches in diameter at D.B.H. (at least 2 inches in diameter if no trees 5 inches and over are available). If adequate witness trees are not present on point one, any other point within seventy feet of point one can be witnessed (See Exhibit 3). Points 3, 4, and 10 should only be used when none of the other points have adequate witness trees. Rocks or other permanent features may be used when trees are not present. Record the point number and the following witness tree data on the back of the Sample Record under Witness Trees:— (1) species, (2) D.B.H. to the nearest 1/10th inch, (3) azimuth from pin to center of the tree, and (4) slope distance to the nearest 1/10th foot, from pin to center of the tree at its base. Mark each witness tree above D.B.H. and at the base with a painted "X" on the side of the tree facing plot center. All plots that are established and measured will be witnessed. A permanent stake will be left to mark the center of the point which is witnessed, as well as a permanent stake at point 1.

42.8 - Ten-Point Cluster. After point one has been established, and providing it falls on commercial forest land, the other nine points should be located and marked with wire pins, metal stakes or treated-wood stakes. The entire 10 points should be restricted to commercial forest land as shown in the following tabulation.

The grid pattern of sample points is designed to obtain a uniform distribution of points over approximately 1 acre. Use spacing and orientation as follows:

10-point cluster design

Azimuth and Distance from Point to Point

0°	70 feet	1	2
0°	70 feet	2	3
120°	70 feet	3	4
180°	70 feet	4	5
180°	70 feet	5	6
240°	70 feet	6	7
300°	70 feet	7	8
0°	70 feet	8	9
0°	70 feet	9	10

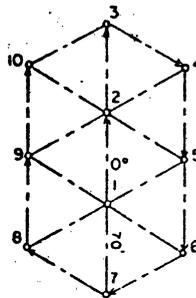
The above spacing and orientation results in 10 equilateral triangles with sides 70 feet in length between points (exhibit 3). Modifications of this standard cluster design should be made only with Washington Office approval except for selection of substitute points as described below. Distance correction for slope will be necessary when slope exceeds ten percent (see section 41.7).

If point one or any other of the 10 points at a sample location falls within a tree trunk, shift the point location back along the approach line a distance of 2 feet from the edge of the tree trunk and mark with a pin or stake. Measure distance to the next point from the pin or stake.

42.9 -- Substitute Points. If point 1 falls on commercial forest land, and any of the points 2 through 10 fall on nonforest or noncommercial forest land area more than 1 acre in size and more than 120 feet in width, locate a substitute point on commercial forest land and mark with pins or stakes.

--Exhibit 3.

TEN-POINT CLUSTER DESIGN



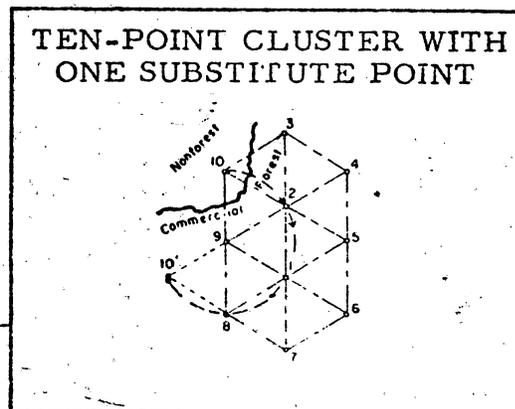
(Points falling on noncommercial forest or nonforest land smaller than 1 acre in size or less than 120 feet in width, will be considered commercial forest land and no substitute points will be required.) Also locate substitute points when any of points 2 through 10 fall on improved roads, railroads, pipelines, powerlines, and adjoining clearings. Such clearings will be considered nonforest land regardless of width.

A substitute point should be located by starting at zero azimuth from the highest-numbered regular point qualifying for tally and rotating clockwise to locate the first qualifying point forming additional equilateral triangle of points. When more than one substitute point is required, continue this rotation, selecting in turn other qualifying points forming additional triangles. If necessary, repeat this procedure at next highest-numbered regular points in turn and then at each previously selected substitute point in turn.

Where substitute points are selected, show their location on the back of the sample record on the 10-point cluster layout diagram provided. Also show a number with a prime superscript for each substitute point as indicated in exhibits 4 and 5.

In exhibit 4 a substitute for point 10 is located at 10 feet by rotating around point 9 (the highest numbered regular point qualifying for tally) to locate the first possible additional equilateral triangle of point.

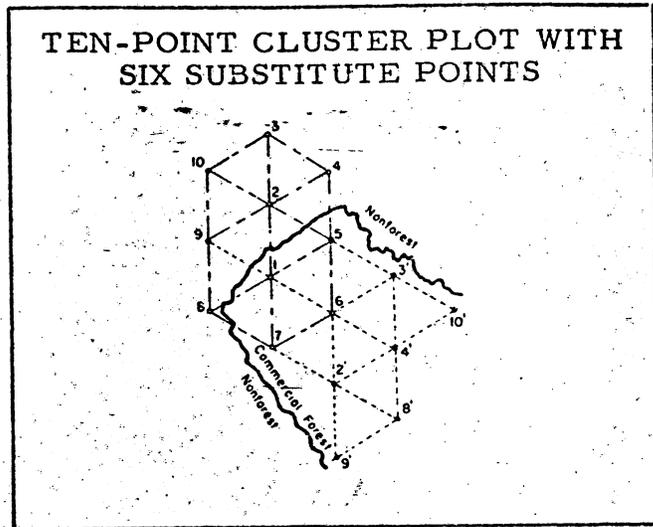
Exhibit 4



In exhibit 5 substitutes must be located in turn for points 2, 3, 4, 8, 9, and 10. The first substitute point, 2', is located by rotating from zero azimuth around point 7 (the highest-numbered regular point qualifying for tally in commercial forest) to form the first possible additional equilateral triangle of points. Further rotation around point 7 yields no more qualifying substitute points; this rotation procedure is repeated around point 6 (the next highest-numbered regular point below 7 qualifying in commercial forest). This yields substitute points 3' and 4'. Rotation around the next highest-numbered regular point qualifying, 5', yields no additional substitutes; thus rotation around the first-selected substitute point 2', is used to select two more substitutes, 8' and 9'. Rotation around the second-selected substitute, 3', must be used to locate the last required substitute, point 10'.

43 - LOCATION IDENTIFICATION. Field measurements and observations should be recorded on the Forest Inventory Sample Record (exhibit 1). Data are recorded to facilitate preparation of punchcards and items are numbered in the sequence in which normally recorded.

Exhibit 5



State Code for Michigan = 26

<u>Units</u>		<u>Unit code</u>	<u>County code</u>	<u>County name</u>	
Unit 1	Eastern Upper Peninsula				
Unit 2	Western Upper Peninsula	2	05	Iron	
Unit 3	Northern Lower Peninsula	3	15	Isabella	
Unit 4	Southern Lower Peninsula	4	15	Jackson	
		4	16	Kalamzaoo	
<u>County</u>		3	16	Kalkaska	
		4	17	Kent	
<u>Unit code</u>	<u>County code</u>	<u>County name</u>			
		2	06	Keweenaw	
		3	17	Lake	
3	01	Alcona	4	18	Lapeer
1	01	Alger	3	18	Leelanau
4	01	Allegan	4	19	Lenawee
3	02	Alpena	4	20	Livingston
3	03	Antrim	1	04	Luce
3	04	Arenac	1	05	Mackinac
2	01	Baraga	4	21	Macomb
4	02	Barry	3	19	Manistee
3	05	Bay	2	07	Marquette
3	06	Benzie	3	20	Mason
4	03	Berrien	3	21	Mecosta
4	04	Branch	1	06	Menominee
4	05	Calhoun	3	22	Midland
4	06	Cass	3	23	Missaukee
3	07	Charlevoix	4	22	Monroe
3	08	Cheboygan	4	23	Montcalm
1	02	Chippewa	3	24	Montmorency
3	09	Clare	4	35	Muskegon 24
4	07	Clinton	3	25	Newaygo
3	10	Crawford	4	24	Oakland
1	03	Delta	3	26	Oceana
2	02	Dickinson	3	27	Ogemaw
4	08	Eaton	2	08	Ontonagon
3	11	Emmet	3	28	Osceola
4	09	Genesee	3	29	Oscoda
3	12	Gladwin	3	30	Otsego
2	03	Gogebic	4	25	Ottawa
3	13	Grand Traverse	3	31	Presque Isle
4	10	Gratiot	3	32	Roscommon
4	11	Hillsdale	4	26	Saginaw
2	04	Houghton	4	27	St. Clair
4	12	Huron	4	28	St. Joseph
4	13	Ingham	4	29	Sanilac
4	14	Ionia	1	07	Schoolcraft
3	14	Iosco	4	30	Shiawassee
			4	31	Tuscola
			4	32	Van Buren
			4	33	Washtenaw
			4	34	Wayne
			3	38	Wexford

43.2 - State. Record the appropriate two-digit code from the list of standard codes. (See supplement code list.)

43.3 - Survey Unit. Record appropriate one-digit code from code list of survey units. (See supplement code list.)

43.4 - County. Record appropriate two-digit code from code list of counties. (See supplement code list.)

43.5 - Sample Number. The appropriate four-digit code will be recorded by a photo interpreter to correspond to card number on the stereo-classification record for each sample plot within each county. All forest dots and questionable forest checks that appear on the stereo-classification record are assigned a card number but not all become sample plots.

Sequential plot number. The appropriate four-digit code will be recorded by a photo interpreter to identify consecutive plot number within each unit. All plots, both forest and questionable forest, permanent and temporary, office and field, will be numbered consecutively across each unit. Sequential plot number will be used to identify sample plots on aerial photographs and county road maps.

43.6 - Sample Kind. This is a one-digit code recorded by the photo interpreter from the following list of standard codes:

Code

- 1 New 10-point cluster. A new 10-point permanent cluster established without reference to any previous inventory. Full measurement.
- 2 Remeasurement of previously-measured plot.
- 7 New 10-point partial permanent cluster where heights are not measured.
- 4 New partial permanent plot on wooded strips (Kansas only)

On forest locations designated as partial plots, the following data items will not be recorded: bole length (with the exception of stump height) through total volume loss.

43.7 - Date of Survey. Record a four-digit code to show the month by the first two digits, followed by a code showing the year in which the sample location is measured, using the following standard codes:

<u>Code</u>	<u>Month</u>	<u>Code</u>	<u>Year</u>
01	January	77	1977
02	February	78	1978
03	March	79	1979
04	April	80	1980
05	May	81	1981
06	June	82	1982

<u>Code</u>	<u>Month</u>	<u>Code</u>	<u>Year</u>
07	July	83	1983
08	August	84	1984
09	September	85	1985
10	October	86	1986
11	November	87	1987
12	December	88	1988

For example, January 1977 would be coded 0177.

44 - AREA CLASSIFICATION

44.1 - Land Use

44.11 - Land Use, Dot and PI. This is a two-digit land-use code as estimated by photo interpretation, using the following codes:

Code

10	Forest land
30	Questionable forest
40	Unproductive forest land - Black spruce bogs - utilized for Christmas tree production.
50	Nonforest land with trees - wooded strips less than 120 feet wide.
60	Nonforest land without trees
80	Noncensus water
90	Census water

44.12 - Land Use, Ground. Record present land classification as determined from ground examination. Use one of the following two-digit codes.

Forest land - At least 16.7 percent stocked by forest trees of any size or formerly having such tree cover, and not currently developed for nonforest use.

Code

20	Commercial forest land. (stocked - more than 16.7 percent stocking in growing-stock trees) (nonstocked - less than 16.7 percent stocking in growing-stock trees)
21	Pastured commercial forest land - more than 25 percent stocked with growing-stock trees
40	Noncommercial forest land - unproductive - (forest land incapable of producing 20 cubic feet per acre of industrial wood under natural conditions, because of adverse site conditions) (based on site index - under 35 for all species except under 25 for eastern redcedar, under 20 for black spruce and tamarack, and under 15 for northern white cedar.

Code

- 45 Noncommercial forest land - [productive] reserved land withdrawn from commercial use through statute or administrative designation (such as a state park)
- 46 Noncommercial forest land - productive reserved land withdrawn from commercial use for Christmas tree production as indicated by annual shearing.

For a noncommercial forest land plot record the following entries on the inventory sample record: State, unit, county, dot number, sample kind, date of survey, dot land use, PI land use, ground land use, use trend, ownership class, forest type, stand-size class, aspect, position, slope, BA/acre, stand history, stand area, photo age. A visual estimate of forest type, stand-size class, and BA/acre can be used. Site index will be recorded for unproductive plots.

Nonforest land. - Land that has never supported forests and lands formerly forested where use for timber management is precluded by development for other uses.

All ground checks that turn nonforest and have a ground land use under the category Nonforest with Trees, record the following entries on the inventory sample record: State, unit, county, dot number, sample kind, date of survey, dot land use, PI land use, ground land use, use trend, forest type, stand-size class, aspect, position, slope, BA/acre, stand history, stand area, and photo age. A visual estimate of forest type and stand-size class and BA/acre, can be used.

A PLOT SHEET MUST BE COMPLETED FOR ALL GROUND PLOTS--FOREST AND NONFOREST.

Nonforest with Trees

Code

- 51 Cropland with trees.
- 52 Improved pasture and natural range land with trees (less than 16.7 percent stocked with all trees).
- 53 Wooded strips--acre or more of continuous forest land that would otherwise meet the survey standards for commercial forest land except that it is less than 120 feet wide.
- 54 Idle farmland with trees (not tended within the last 2 years and less than 16.7 percent stocked with all trees).
- 55 Marsh with scattered trees (less than 16.7 percent stocked with all trees).

- 57 Planted or natural stand of trees more than 120 feet wide and greater than one acre in size used for the protection of buildings. If buildings are no longer in use, this land use does not apply (establish a plot).
- 58 Windbreak--either less than 120 feet wide or smaller than one acre in size or both.
- 59 Wooded pasture--improved pasture with more than 16.7 percent stocking in all trees, but less than 25 percent stocking in growing-stock trees. Area currently improved for grazing by cultivation, seeding, irrigation, ponds, or clearing of trees or brush. Other evidence may be severe compaction of the soil from grazing and heavy browsing of the herbaceous understory. The above should indicate that the primary use of the land is something other than wood production or protection of buildings (establish a plot).

Ground Land use 53, 57, 59 are the only nonforest plots that are established and all required tally items for a partial permanent plot.

53 KANSAS ONLY

Nonforest without Trees. All ground checks that turn nonforest and have a ground land use under the category Nonforest without Trees, record the following entries on the inventory sample record: State, unit, county, date of survey, ground land use, land use trend and photo age.

- 61 Cropland without trees.
- 62 Improved pasture and natural rangeland without trees.
- 64 Idle farmland without trees (not tended within the last 2 years).
- 65 Marsh.
- 66 Other farmland.
- 67 Urban ^{nonforest} ~~and other~~ (residential, industrial and recreational areas). (Also includes railroads, improved roads, powerlines, and pipelines, regardless of width).
- 80 Noncensus water (more than 120 feet wide or 1 acre in area).
- 90 Census water (more than 10 chains in width or 40 acres in area).

44.13 - Use Trend (3 digits). The first two digits describe the land class change that took place between surveys or the change since the date of photography. Codes to be used for the first two digits are divided into the following two categories:

When land class is not commercial forest on both occasions:

First two Digits--The first digit is the code for the present land class. The second digit is the code of the land class at the time of the last survey or the date of photography.

- 1 Commercial forest
- 2 Productive reserved forest
- 3 Unproductive forest
- 4 Cropland
- 5 Pasture
- 6 Idle farmland
- 7 Wooded pasture
- 8 Urban, recreation, wooded strips, other
- 9 Water and marsh

For commercial forest land on both occasions:

First two Digits--Use the codes as they appear to indicate any major changes in the stand since the last survey or the date of photography.

If there has been a disturbance in the sampling area since the date of photography but it has not been to the extent of changing the forest type or stand size class it will be recorded as no change. This disturbance could be recorded under stand history.

- 10 No change
- 01 Forest type change
- 02 Stand-size change
- 03 Forest type and size change

Third Digit--Indicate the process that caused the change with one of the following codes:

- 0 No change
- 1 Definition
- 2 Legislation
- 3 Natural
- 4 Herbicide
- 5 Clearing (land cleared but timber not utilized)
- 6 Clearcut (includes land clearing where timber is utilized)
- 7 Partial cut
- 8 Planting
- 9 Other man (includes fencing to exclude livestock)

For example, 168 means commercial forest now. At the previous occasion the land class was idle farmland. Finally, the last digit means the change resulted from planting.

44.2 - Owner Class. Ownership class should be obtained from county tax and ownership records for private land. Current ownership maps or ownership records are generally available for Federal land and most public lands at local offices. Fieldmen will visit county offices to obtain ownership of field locations falling on private land. The photo interpreters will complete ownership for public land or specifically refer this task to the fieldmen for particular field locations. Owner, size of ownership, length of tenure, and address will be determined from county courthouse records and recorded later on the Forest Inventory Sample Record, except in situations where ownership can be determined easily in the field. Record ownership using the following two-digit codes:

<u>Code</u>	
11	National Forest
12	Bureau of Land Management
13	Indian
14	Miscellaneous federal
15	State
16	County and municipal
20	Forest industry
40	Farmer
50	Farmer-owned leased
60	Miscellaneous private-corporate
70	Miscellaneous private-individual
80	Miscellaneous private-corporate leased
90	Miscellaneous private-individual leased

In ownership codes 20 through 90, use the second digit to indicate size of ownership (commercial forest land) in the United States by the following codes:

<u>Code</u>	<u>Acres</u>
1	1-4
2	5-9
3	10-19
4	20-49
5	50-99
6	100-499
7	500-2499
8	2500-4999
9	5000+

44.3 - National Forest

Ottawa National Forest--907

44.35 - National Forest Ranger District

Ottawa Ranger Districts:

Bergland	01
Bessemer	02
Iron River	03
Kenton	04
Ontonagon	05
Watersmeet	06

44.25 - Owner Tenure. How long present owner has owned commercial forest area that plot falls in. Fieldmen will visit county offices to obtain owner tenure from county tax and ownership records for private land. Owner tenure for federal land and most public lands can be obtained from local field offices. Record owner tenure using the one-digit codes.

<u>Code</u>	<u>Period of Ownership</u>
1	1-4 years
2	5-9 years
3	10-19 years
4	20+ years

44.3 - National Forest - On National Forest lands record a three-digit code for this item. The first digit indicates National Forest Region and the last two digits the National Forest. Zero out this item for sample locations on other lands. (See supplement page for necessary codes).

45 - TREE IDENTIFICATION

45.1 - New Plots

45.11 - Fixed - Plot Tally for Trees 1.0 to 5.0 inches diameter breast height (Plot radius 6.8 feet encompassing 1/300 acre). The fixed plot radius is the horizontal distance measured at ground level from the pin to the center of the stem at the base.

45.11a - Plot Points 1, 2, and 3. Record data for all live saplings from 1.0 to 5.0 inches D.B.H. within the fixed plot for entries: Azimuth through D.B.H. and entries: crown ratio through point occupancy. Record total height of tree in bole length column.

45.11b - Plot Points 4 through 10. Record data on all live trees over 5.0 inches D.B.H. If 16.0 percent stocking has been reached, all saplings can be ignored. The most dominant saplings will be recorded when needed to complete 16.0 percent stocking (See section 49.25, Stocking Percent). Azimuth and distance are not recorded for saplings on points 4-10. Those saplings that qualify are counted in basal area, even if they are not recorded on the plot sheet. Keep basal area tree count in the extreme right hand column. Entry should be made across from first entry on each point. Two digits can be used when necessary.

45.12 - Variable-plot Tally for Trees 5.0 Inches Diameter Breast High and Larger. On points 1 through 10, all trees 5.0 inches D.B.H. and larger that are alive, dead and qualify as mortality, or dead and qualify as salvable, will be recorded, if they fall within the limiting distance of the 37.5 basal area factor designated for the Eastern States.

Exhibit 8 summarizes limiting distances. Limiting distances can also be found in the Appendix Tatum Guide #3.

Limiting distance for various basal factors is the horizontal distance from the pin to the center of a tree at D.B.H. For example, the limiting distance for a tree with a D.B.H. of 14.6 inches, using a basal area factor of 37.5, is 20.7 feet. Limiting distance correction for slope can be determined using the variable plot radii by D.B.H. and percent slope table on Tatum Guide #5 in the Appendix. For example, on a slope of 30 percent, between the point center and the tree, the limiting distance for a tree with a D.B.H. of 14.6 inches, using a basal area factor of 37.5, is 20.8 plus .9, or 21.7 feet.

45.13 - Fixed-plot Tally for Seedlings or Other Cover (Plot Radius 6.8 Feet Encompassing 1/300 Acre). The fixed plot radius is the slope distance measured at ground level from the pin to the center of the stem at the base. If no live trees 5.0 inch D.B.H. or larger are recorded at a point or if not enough saplings are recorded to reach 16 percent stocking record enough seedlings to reach 16 percent.

Using the following order of preference record the most dominant (tallest) seedling-sized trees:

1. 10 and 20 class commercial tree species.
2. 30 and 40 class commercial tree species.
3. noncommercial tree species.

Use all seedlings under number one before using those in number two, and then number three to reach 16 percent stocking on a point. For seedlings record entries: point number through D.B.H. and entries: damage through point occupancy. Record D.B.H. for seedlings as 000. A tree must be one inch D.B.H. or larger to qualify for basal area tree count.

Softwood seedlings must be one-half foot tall and hardwood seedlings must be one foot tall.

When no live trees of any size are recorded on a point, record point number and cover class.

45.14 - Fixed-plot Tally for Stumps (Plot Radius 16.6 Feet Encompassing 1/50 acre). The fixed plot radius is the slope distance measured at ground level from the pin to the center of the stump. On each point for all stumps of trees cut within the last three years record entire point number through species, record the stump diameter in the D.B.H. column, and record the stump height in the hole length column. Stump diameters and heights are recorded at the same place on the stump so that the volume of product removals can be computed. (Note: Beaver--cut trees are recorded as mortality, never as stumps.)

45.3 - Azimuth. Record azimuth from the pin to the center of the base of all tally trees 1.0 inch D.B.H. and larger on points 1, 2, and 3. On all other points record azimuth for trees 5.0 inches D.B.H. and larger only. Zero degree azimuth should not be used, also two trees on the same point can not have the same azimuths. Record one before the other, for example, record one as 59 degrees and the other as 60 degrees.

45.4 - Distance. Record slope distance to the nearest foot from the point center to the face of each tree at its base. Record distance for each tree for which an azimuth is recorded.

45.5 - Point Number. Record point number 1 through 10, recording 0 for point 10. For each point there will be at least one line of entries. If no trees are tallied at a point, check the fixed-radius plot for stockability and nontree cover, and record the cover class.

45.6 - Tree Number. Record a two-digit code for each live or dead tree tallied. On new locations proceed from 0 degree azimuth in a clockwise direction. Begin with number 01 at each point.

If tree 01 has zero degree azimuth, record it as 1 degree azimuth, because the computer will not accept zero.

On all new sample locations, also record a number for each stump estimated to have been cut within the past 3 years on a 1/50-acre plot (radius of 16.6 feet) centered on each point, using the same consecutive numbering system used for trees.

45.7 - Tree History. All trees and stumps recorded will require a two-digit tree history code.

Code

New Sample Locations

Live Trees

01

All live trees. Generally, presence of live cambium can be used as a guide to identify live trees when in question. In special cases where the life supporting systems of a tree have recently been cut off the tree can be recorded as dead even if live cambium is present. For example, certain wind-thrown species will not produce sprouting, but will shortly die. Tallyman must use wise judgment in these cases.

Dead Trees

All dead trees less than 5.0 inches D.B.H. will not be recorded. Tree class will be projected back to the time of death on all dead trees. For salvable dead trees required tree measurements will be taken as if the tree in its present condition is given a tree class and considered alive. Remember the tree class recorded will be projected back to the time of death. Tree measurements on mortality trees will not reflect present condition, but be projected back to the existing condition and tree class at the time of death. Again, required tree measurements recorded will have the same requirements as if the tree were alive. All dead trees 5.0 inches D.B.H. or larger that would qualify for basal area will be blazed so they can be readily identified at future remeasurements. This includes dead trees not even tallied because they did not qualify as mortality. See Tatum Guide #4 in the Appendix for required items to tally on all types of dead trees.

- 04 Dead tree qualifying as salvable dead. See definition in the Appendix. Regional standards specify a minimum salvable volume as a four-foot section 50 percent sound. (Note: Do not tally nonsalvable dead trees dying prior to mortality period.) Mortality period being within the past three years.
- 05 Dead tree qualifying as mortality tree. (Mortality period--within the past three years). If a dead tree qualifies both as salvable dead and mortality, complete separate entries for each tree history. Salvable mortality trees will have two entries on the plot sheet, but the tree number will remain the same. Remember tree measurements on salvable dead trees are taken at present while tree measurements on mortality trees are projected back to the time of death.
- 08 Stump of live tree cut within past 3 years utilized for products. (To be recorded on 1/50 acre fixed-radius plot at each point.)
- 09 Stump of live tree cut within past 3 years and not utilized for products. (To be recorded on 1/50 acre fixed-radius plot at each point.)

TREE HISTORY CODES (2-DIGIT)

on Chippewa

For Remeasurement and Non-Remeasurement Plotwork in Minnesota and South Dakota (1980)

REMEASUREMENT PLOTS-First digit describes previous tree class, second digit current tree class.

NON-REMEASUREMENT PLOTS-First digit is always "0", second digit is current tree class.

- 0=No status
- 1=growing stock live
- 2=cull live
- 3=ingrowth
- 4=dead (salvable)
- 5=dead (mortality)
- 6=ongrowth
- 7=stump (salvaged dead)
- 8=stump (utilized)
- 9=stump (not utilized)

Note: 3-is only valid as the first digit of the 2-digit code (i.e. ingrowth to cull is coded "32").

6-is only valid as the first digit of the 2-digit code (i.e. ongrowth to growing stock is coded "61").

0-is only valid as the first digit of tree history on non-remeasurement plots and the second digit on remeasurement plots that have currently been denied access or are no longer commercial forest land, (i.e. "01" is a live growing stock tree on a non-remeasurement plot, "20" is a cull tree at the time of the previous remeasurement survey which is currently on denied access or non-commercial forest land).

↗ on prism count in current survey

ON-GROWTH: too small on previous survey - now large enough

IN-GROWTH: NEW TREES < 1" DBH last survey

↘ not on prism count in current survey

10

Stump of dead tree cut within past 3 years.
(Qualifies as salvaged mortality. To be recorded
on 1/50 acre fixed-radius plot at each point.)

97

SITE COMPANION STUDY

99

Site tree [not recorded on a point.]

45.8 - Species. Record a three-digit species code for all live trees, dead trees, and stumps. (See supplement page for species codes.)

46 - TREE MEASUREMENTS. Measurements and observations recorded are those required to compute volume, growth and quality.

46.1 - Tree Diameter Breast High. For each tree to be tallied record a three-digit code for diameter at breast height to the last 0.1 inch. The 6.1-inch diameter class coded as 061, for example, should include trees 6.10 inches in diameter up to but not including trees 6.20 inches in diameter. Record code 000 for tree with D.B.H. less than 1.0 inch.

Since trees will be determined as in or out of the tally, depending on their D.B.H. and distance from the point center, and since identical trees should be remeasured on resurveys, it is highly important that D.B.H. be accurately determined. Proper measuring procedures are illustrated in exhibits 10 and 11.

In case of irregularities at D.B.H. such as swellings, bumps, depressions, and branches, measure diameter immediately above the irregularity at the place where it ceases to affect the normal stem form. Never estimate D.B.H. because of an irregularity. If a measurement can not be taken above an irregularity, scribe the tree in the least abnormal spot, measure, and record the diameter directly below the scribe mark. Naturally swell-butted trees, such as cypress and tupelo, should be measured at a point 1.5 feet above the end of the pronounced swell or bottleneck if the bottleneck is more than 3 feet high.

If the stem forks immediately above D.B.H., measure diameter below the swell at the place where the fork ceases to affect the normal stem form. When the stem forks below D.B.H., consider the tree as two trees and measure diameter at 3 and one-half feet above the fork (use rule only once per tree).

On salvable dead trees that have had their bark slough off, etc. estimate the diameter outside bark at time of death.

Place a 2-inch horizontal paint mark just above the upper tape at the point where D.B.H. is measured on the side facing plot center. Place another 2-inch vertical paint mark at the base of the tree. Dead trees tallied must be marked additionally so they can be easily identified at future remeasurements.

LAKE STATES SPECIES GROUPS

For Use in Michigan, Minnesota and Wisconsin

SOFTWOODS

Species Group	Species Code	Scientific Name
1 White pine	129	Pinus strobus
2 Red pine	125	Pinus resinosa
3 Jack pine	105	Pinus banksiana
4 White spruce	094	Picea glauca
5 Black spruce	095	Picea mariana
6 Balsam fir	012	Abies balsamea var. balsamea
7 Hemlock	261	Tsuga canadensis
8 Tamarack	071	Larix laricina
9 Northern white cedar	241	Thuja occidentalis
10 Other softwoods	068	Juniperus virginiana
	130	Pinus sylvestris
	011 - 299	All other softwoods

HARDWOODS

11 White oak	802	Quercus alba	
	804	Quercus bicolor	
	823	Quercus macrocarpa	
	826	Quercus muehlenbergii	
	832	Quercus prinus	
12 Select red oak	833	Quercus rubra	
	834	Quercus shumardii	
	806	Quercus coccinea	
13 Other red oak	809	Quercus elipsoidea	
	830	Quercus palustris	
	837	Quercus velutina	
	14 Hickory	402	Carya cordiformis
		403	Carya glabra
405		Carya laciniata	
407		Carya ovata	
409		Carya tomentosa	
15 Yellow birch	371	Betula alleghaniensis	
16 Hard maple	314	Acer nigrum	
	318	Acer saccharum	
	17 Soft maple	316	Acer rubrum var. rubrum
317		Acer saccharinum	
18 Beech		531	Fagus grandifolia
19 Basswood	951	Tilia americana	
20 White-green ash	541	Fraxinus americana	
	544	Fraxinus pennsylvanica	

HARDWOODS (continued)

<u>Species Group</u>	<u>Species Code</u>	<u>Scientific Name</u>
22 Balsam poplar	741	Populus balsamifera
23 Cottonwood	742	Populus deltoides
24 Paper birch	375	Betula papyrifera var. papyrifera
25 Bigtooth aspen	743	Populus grandidentata
26 Quaking aspen	746	Populus tremuloides
27 Select hardwoods		
Butternut	601	Juglans cinerea
Black walnut	602	Juglans nigra
Black cherry	762	Prunus serotina
Yellow poplar	621	Liriodendron tulipifera
28 Elm	972	Ulmus americana
	974	Ulmus pumila
	975	Ulmus rubra
	977	Ulmus thomassii
29 Other hardwoods		
Box elder	313	Acer negundo
Ohio buckeye	331	Aesculus glabra
River birch	373	Betula nigra
American chestnut	421	Castanea dentata
Nor. catalpa	452	Catalpa speciosa
Hackberry	462	Celtis occidentalis
Flowering dogwood	491	Cornus florida
Honeylocust	552	Gleditsia triacanthus
Red mulberry	682	Morus rubra
Black tupelo	693	Nyssa sylvatica var. sylvatica
American sycamore	731	Platanus occidentalis
Black locust	901	Robinia pseudoacacia
Black willow	922	Salix nigra
Sassafras	931	Sassafras albidum
All other hardwoods	300 - 998	
30 Noncommercial species		
Striped maple	315	Acer pensylvanicum
Mountain maple	319	Acer spicatum
Ailanthus (tree of heaven)	341	Ailanthus altissima
American hornbeam	391	Carpinus caroliniana
Eastern redbud	471	Cercis canadensis
Hawthorn	500	Crataegus
Osage orange	641	Maclura pomifera
Apple	660	Malus
Eastern hophornbeam	701	Ostrya virginiana
Pin cherry	761	Prunus pensylvanica
Common chokecherry	763	Prunus virginiana
Mountain ash	851	Sorbus americana
Peachleaf willow	921	Salix amygdaloides
Diamond willow	923	Salix eriocephala

Exhibit 8

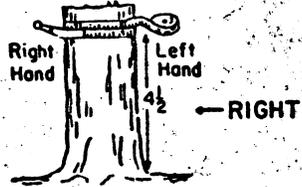
VARIABLE PLOT LIMITING DISTANCE-RADII, BY D.B.H. AND BASAL AREA FACTOR, USING ZERO SLOPE.					
D.B.H. (INCHES)	----- BASAL AREA FACTOR -----				
	37.5	40	75	80	250
	----- LIMITING DISTANCE IN FEET -----				
0.1	0.14	0.14	0.10	0.10	0.05
0.2	0.28	0.27	0.20	0.19	0.11
0.3	0.43	0.41	0.30	0.29	0.16
0.4	0.57	0.55	0.40	0.39	0.22
0.5	0.71	0.69	0.50	0.49	0.27
0.6	0.85	0.82	0.60	0.58	0.33
0.7	0.99	0.96	0.70	0.68	0.38
0.8	1.14	1.10	0.80	0.78	0.44
0.9	1.28	1.24	0.90	0.88	0.49
5.0	7.10	6.88	5.02	4.86	2.75
6.0	8.52	8.25	6.02	5.83	3.30
7.0	9.94	9.63	7.03	6.81	3.85
8.0	11.36	11.00	8.03	7.78	4.40
9.0	12.78	12.38	9.04	8.75	4.95
10.0	14.20	13.75	10.04	9.72	5.50
11.0	15.62	15.13	11.05	10.69	6.05
12.0	17.04	16.50	12.05	11.67	6.60
13.0	18.46	17.88	13.05	12.64	7.15
14.0	19.88	19.25	14.06	13.61	7.70
15.0	21.30	20.63	15.06	14.58	8.25
16.0	22.72	22.00	16.07	15.56	8.80
17.0	24.14	23.38	17.07	16.53	9.35
18.0	25.56	24.75	18.07	17.50	9.90
19.0	26.98	26.13	19.08	18.47	10.45
20.0	28.40	27.50	20.08	19.45	11.00
21.0	29.82	28.88	21.09	20.42	11.55
22.0	31.24	30.25	22.09	21.39	12.10
23.0	32.66	31.63	23.10	22.36	12.65
24.0	34.08	33.00	24.10	23.33	13.20
25.0	35.50	34.38	25.10	24.31	13.75
26.0	36.92	35.75	26.11	25.28	14.30
27.0	38.34	37.13	27.11	26.25	14.85
28.0	39.76	38.50	28.12	27.22	15.40
29.0	41.18	39.88	29.12	28.20	15.95
30.0	42.60	41.25	30.12	29.17	16.50
31.0	44.02	42.63	31.13	30.14	17.05
32.0	45.44	44.00	32.13	31.11	17.60
33.0	46.86	45.38	33.14	32.08	18.15
34.0	48.28	46.75	34.14	33.06	18.70
35.0	49.70	48.13	35.15	34.03	19.25
36.0	51.12	49.50	36.15	35.00	19.80
37.0	52.54	50.88	37.15	35.97	20.35
38.0	53.96	52.25	38.16	36.95	20.90
39.0	55.38	53.63	39.16	37.92	21.45
40.0	56.80	55.00	40.17	38.89	22.00
41.0	58.22	56.38	41.17	39.86	22.55
42.0	59.64	57.75	42.17	40.84	23.10
43.0	61.06	59.13	43.18	41.81	23.65
44.0	62.48	60.50	44.18	42.78	24.20
45.0	63.90	61.88	45.19	43.75	24.75
46.0	65.32	63.25	46.19	44.72	25.30
47.0	66.74	64.63	47.20	45.70	25.85
48.0	68.16	66.00	48.20	46.67	26.40
49.0	69.58	67.38	49.20	47.64	26.95
50.0	71.00	68.75	50.21	48.61	27.50

Exhibit 8--Continued

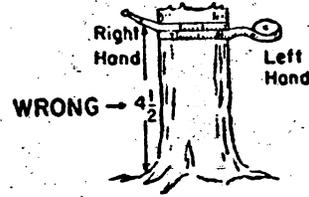
D.B.H. (INCHES)	----- BASAL AREA FACTOR -----				
	37.5	40	75	80	250
	----- LIMITING DISTANCE IN FEET -----				
51.0	72.42	70.13	51.21	49.59	28.05
52.0	73.84	71.50	52.22	50.56	28.60
53.0	75.26	72.88	53.22	51.53	29.15
54.0	76.69	74.25	54.22	52.50	29.70
55.0	78.11	75.63	55.23	53.47	30.25
56.0	79.53	77.00	56.23	54.45	30.80
57.0	80.95	78.38	57.24	55.42	31.35
58.0	82.37	79.75	58.24	56.39	31.90
59.0	83.79	81.13	59.25	57.36	32.45
60.0	85.21	82.50	60.25	58.34	33.00
61.0			61.25	59.31	33.55
62.0			62.26	60.28	34.10
63.0			63.26	61.25	34.65
64.0			64.27	62.23	35.20
65.0			65.27	63.20	35.75
66.0			66.27	64.17	36.30
67.0			67.28	65.14	36.85
68.0			68.28	66.11	37.40
69.0			69.29	67.09	37.95
70.0			70.29	68.06	38.50
71.0			71.30	69.03	39.05
72.0			72.30	70.00	39.60
73.0			73.30	70.98	40.15
74.0			74.31	71.95	40.70
75.0			75.31	72.92	41.25
76.0			76.32	73.89	41.80
77.0			77.32	74.86	42.35
78.0			78.32	75.84	42.90
79.0			79.33	76.81	43.45
80.0			80.33	77.78	44.00
81.0			81.34	78.75	44.55
82.0			82.34	79.73	45.10
83.0			83.35	80.70	45.65
84.0			84.35	81.67	46.20
85.0			85.35	82.64	46.75
86.0			86.36	83.62	47.30
87.0			87.36	84.59	47.85
88.0			88.37	85.56	48.40
89.0			89.37	86.53	48.95
90.0			90.37	87.50	49.50
91.0			91.38	88.48	50.05
92.0			92.38	89.45	50.60
93.0			93.39	90.42	51.15
94.0			94.39	91.39	51.70
95.0			95.40	92.37	52.25
96.0			96.40	93.34	52.80
97.0			97.40	94.31	53.35
98.0			98.41	95.28	53.90
99.0			99.41	96.25	54.45
100.0			100.42	97.23	55.00

Exhibit 10

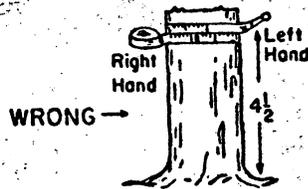
USING THE DIAMETER TAPE



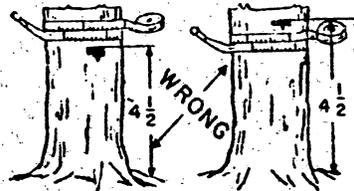
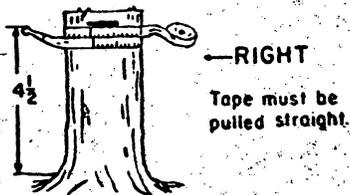
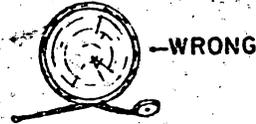
LEFT HANDED - Right hand crossed under.



LEFT HANDED - Right hand crossed over.



RIGHT HANDED - Left hand crossed over.



Always assume that the 4 1/2 ft. D.B.H. point is of the top of lower tape at this point.

The tape must be at right angles to the lean of the tree.



Don't place tape at abnormal place on the bole.

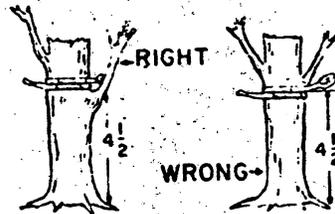
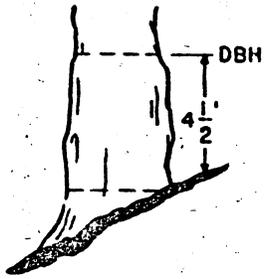
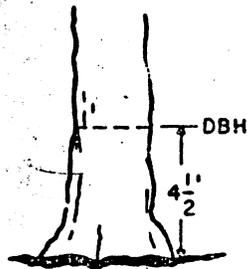


Exhibit 11

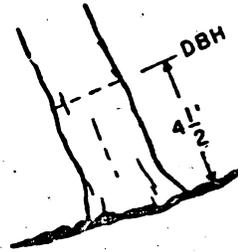
**DIAMETER BREAST HIGH MEASUREMENT
IN A VARIETY OF SITUATIONS**



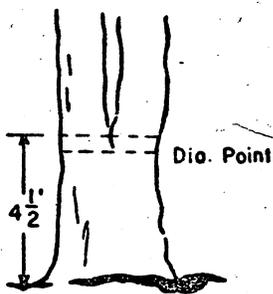
1. Tree on slope



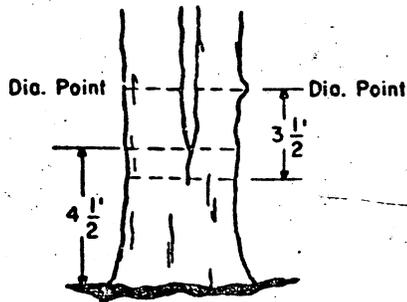
2. Tree on level ground



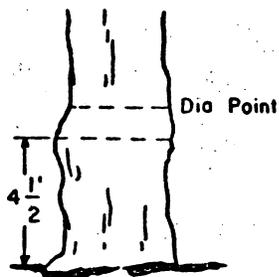
3. Leaning tree



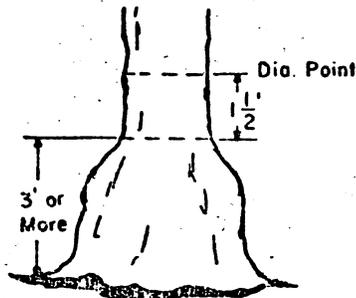
4. Tree forking at or above 4 1/2 feet



5. Tree forking below 4 1/2 feet



6. Tree deformed at 4 1/2



7. Bottleneck tree

46.11 - Stump Diameter at New Locations. For each stump of sawtimber- or poletimber-sized trees record average diameter outside bark to the last 0.1 inch at the top of the stump in the D.B.H. column. When uneven stumps are encountered, the diameter recorded should be at the same place the stump height is recorded. (See section 46.31 for explanation.)

46.3 - Bole Length. Bole length of all cull trees 5.0 inches D.B.H. and larger should be measured between the one-foot stump and the 4.0-inch diameter outside the bark, ignoring all stoppers. Never zero out bole length even if no merchantable volume is present. ~~Height will be measured at points 1, 2, and 3 only, for all readings.~~ Enter total height in the bole length column on the plot sheet. Merchantable bole length of all growing-stock trees 5.0 inches D.B.H. and larger should be determined between the top of a one-foot stump and 4.0-inch diameter outside bark, or the point on the bole above which no merchantable pulpwood section exists. Merchantable section refers to a section that meets pulpwood specifications. (See section 46.4 for sections that do meet pulpwood specifications.)

Stoppers are: 1. a limb with a diameter outside the knot collar greater than the stem diameter at that point, or 2. several limbs over 2 inches D.O.B. within a one-foot span with an aggregate diameter outside the knot collar greater than the stem D.O.B. of the section, or 3. any four-foot section of bole so crooked that a line drawn between the center of the ends falls outside the bark at any point.

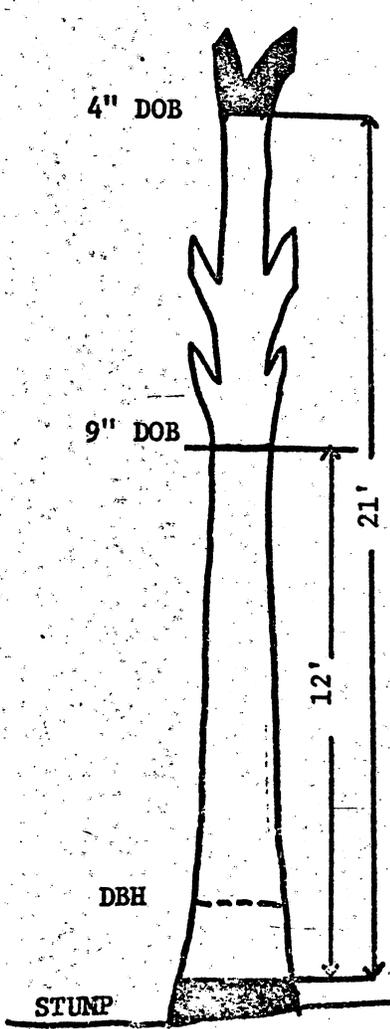
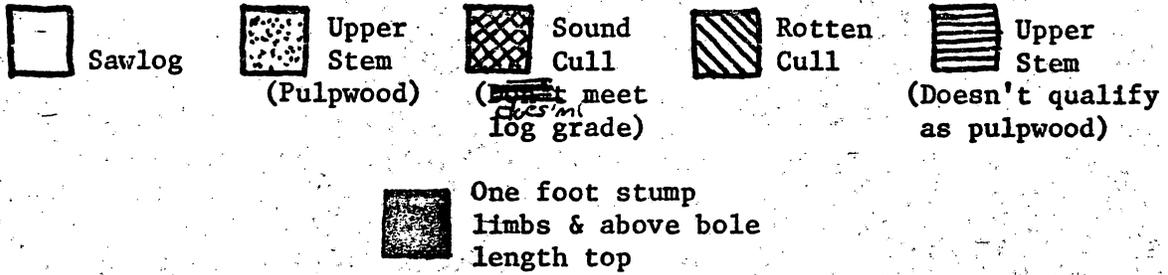
In situations where limbs are a factor in determining merchantable length, measurement will be taken to the point where a line drawn along the center of a limb intersects the main bole at the surface.

Minimize limb limitations by logical log making aimed at obtaining maximum bole and saw log lengths. For example, bucking between staggered limbs within a one-foot span that exceeds the bole D.O.B. at point of occurrence.

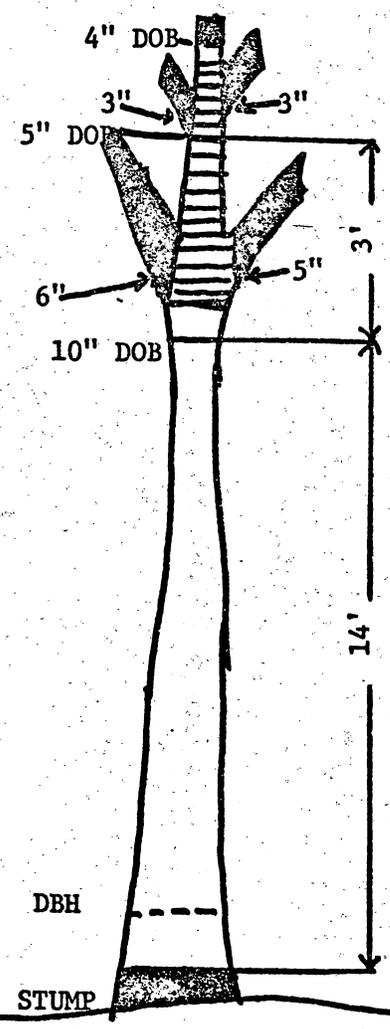
Record length to the last whole foot using a three-digit code. For example, a bole length of 23 feet would include lengths of 23.0 feet up to, but not including, 24.0 feet and would be coded 023. See exhibit 12.

Exhibit 12

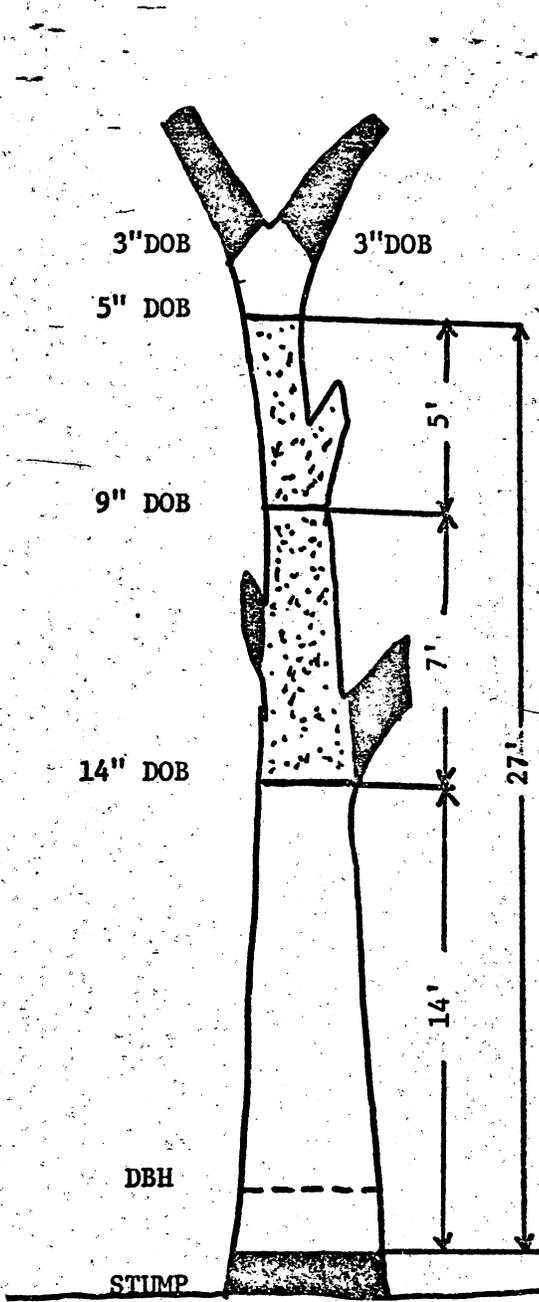
HOW TO HANDLE TREE MEASUREMENTS
FOR ALL TREE CLASSES



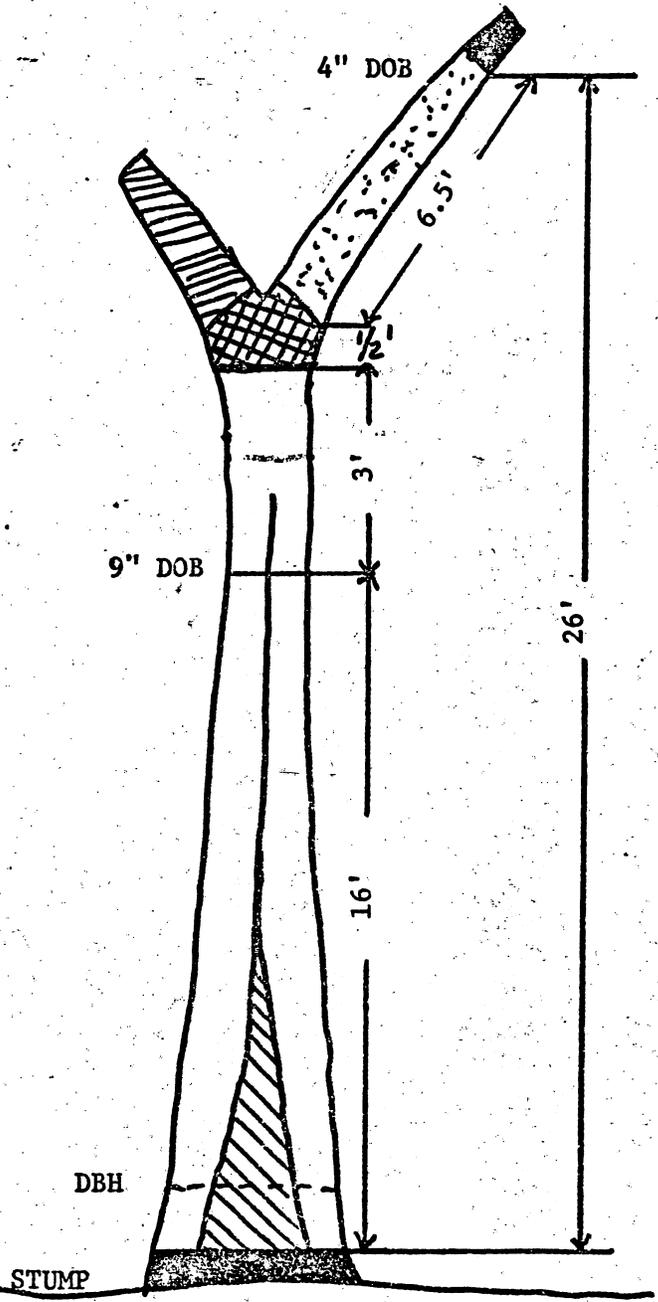
1.



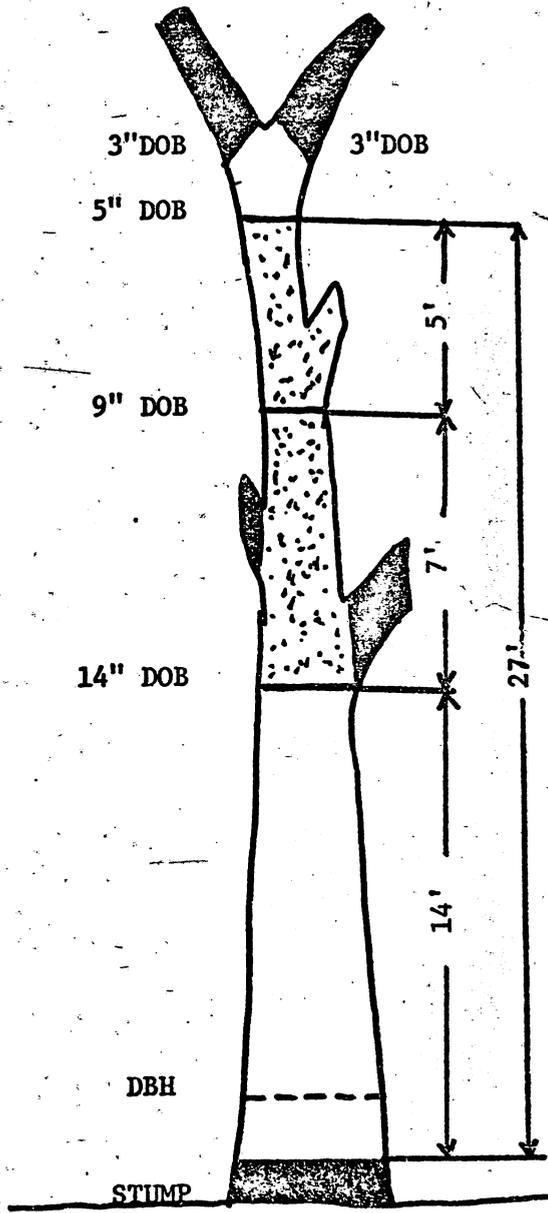
2.



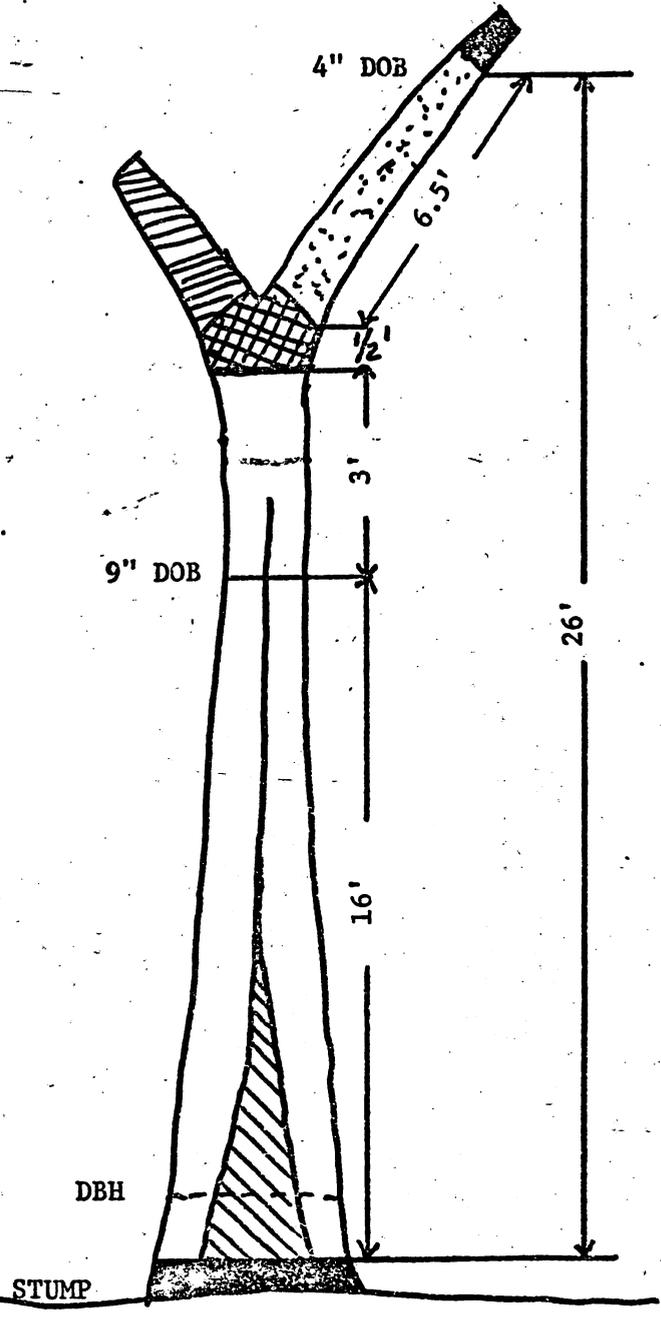
3.



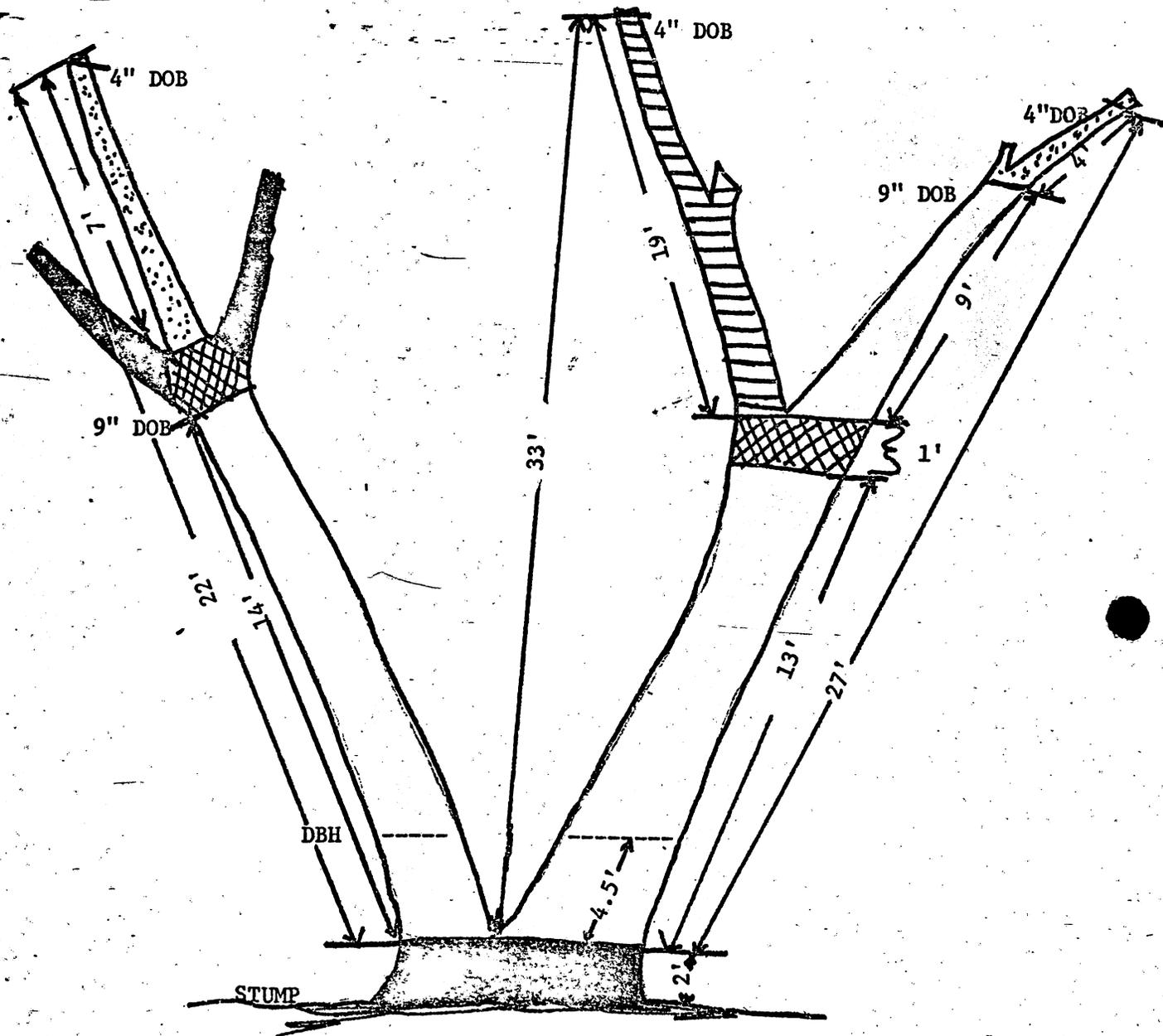
5.

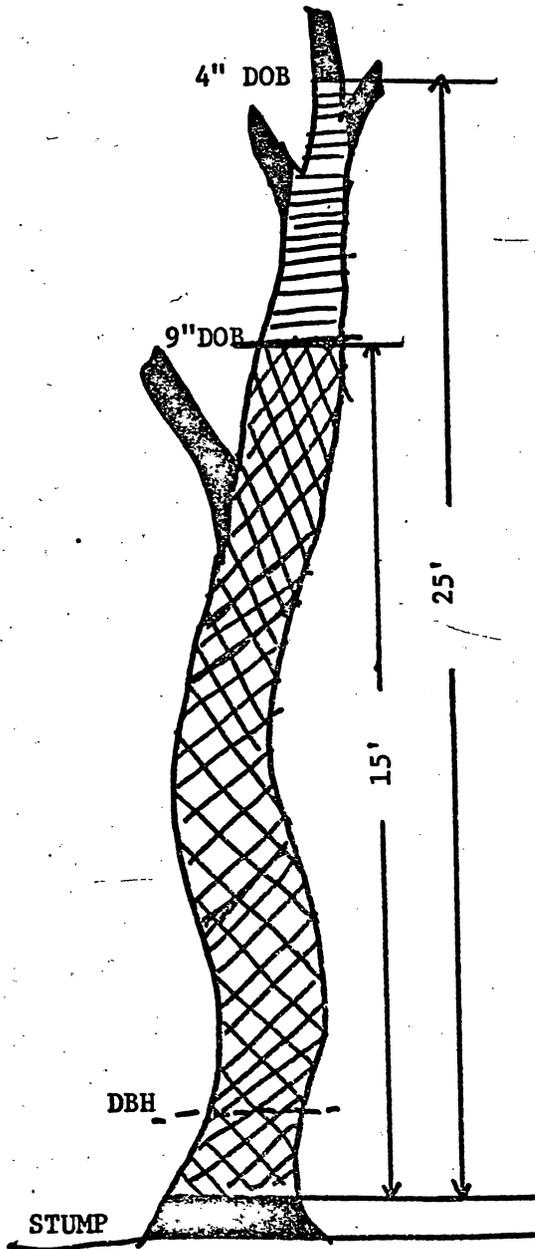


3.

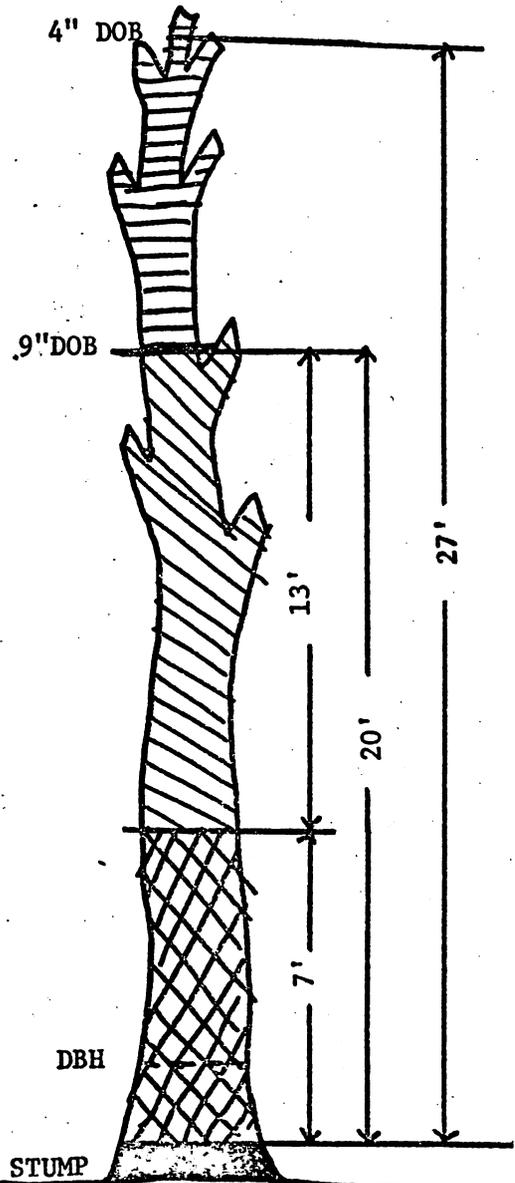


5.

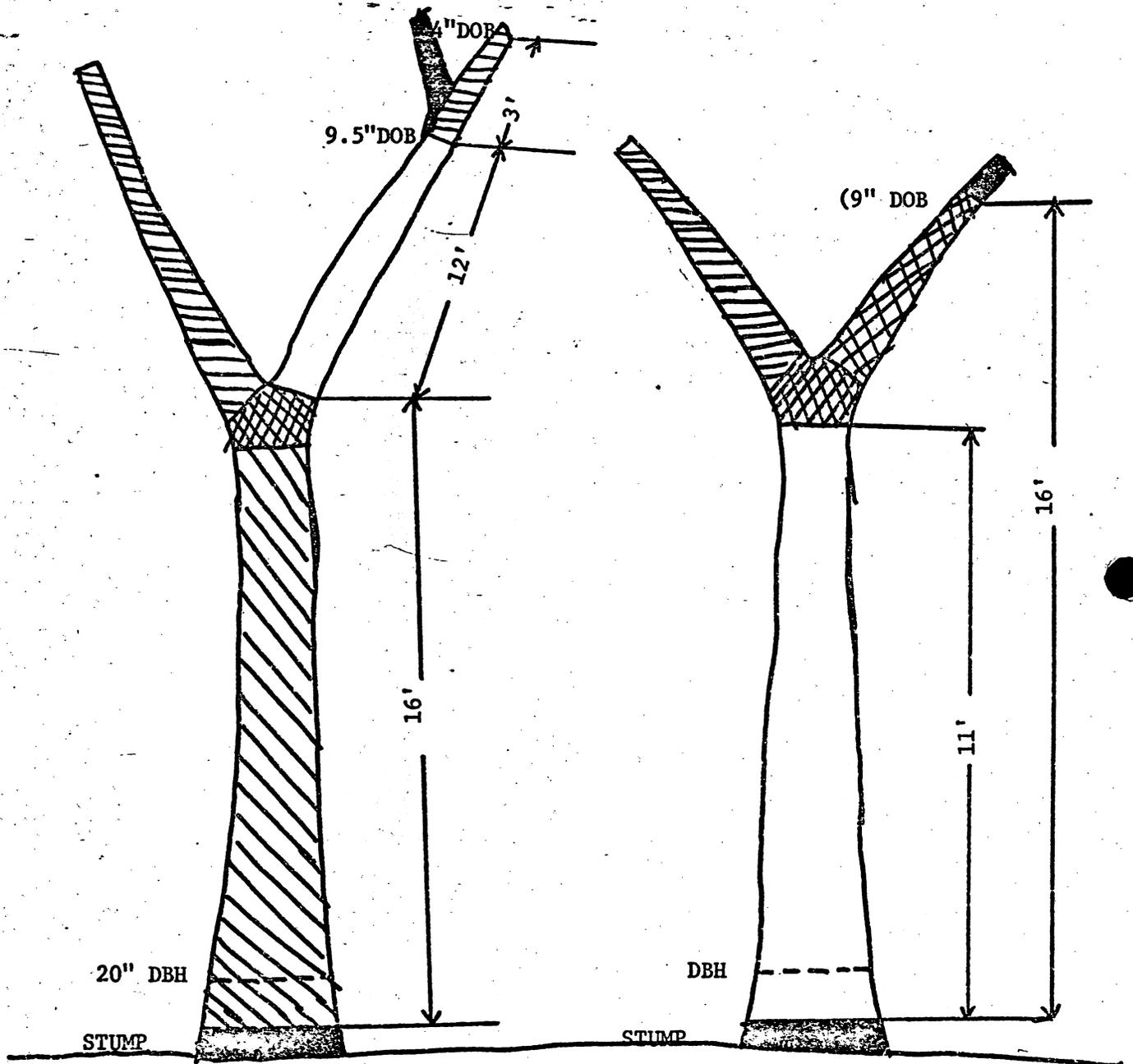




6.



7.



8.

9.

46.31 - Stump Height. On new locations for all stumps on the 1/50-acre fixed-radius plot record height of stump to the last tenth foot using a three-digit code. For example, a stump height of 1.86 feet should be coded 018. The stump height will be measured at the point where the saw made its most level cut; in the case of the slanting cut, at the average point; in the case of a stump on a hillside, at the uphill side. Enter stump height in the bole length column on the plot sheet.

46.35 - Bole Length Top D.O.B. Using a three-digit code record bole top D.O.B. to the last 1/10 inch for all trees with an entry under bole length except stumps. Bole length top D.O.B. is measured at the smallest point before the bole length terminates. If the bole length is taken into the bottom of a fork or the flare from a limb, the smallest diameter immediately below the swell is recorded.

46.4 - Cubic-Foot Cull.

For 10- and 20-class live and dead trees, cubic-foot cull is the cubic foot volume of decayed or missing wood in merchantable sections and the total cubic-foot volume in sections that do not meet pulpwood specifications. A section meets pulpwood specifications unless:

1. It is less than 4 feet long.
2. It has a diameter less than 4 inches D.O.B.
3. It is a fork.
4. A limb has a knot collar greater than the stem diameter at that point, or several limbs over 2 inches D.O.B. within a one-foot span have an aggregate knot collar diameter greater than the stem D.O.B. of the section.
5. A four-foot section of bole is so crooked that a line drawn between the center of the ends falls outside the bark at any point.
6. A rotten section is unusable for industrial products. Regional standards are a four-foot section less than 50 percent sound.

For 30-, 31- and 40-class live or dead trees that were cull trees at time of death, record only the volume of decayed or missing wood. Ignore all stoppers! Cubic foot cull may be computed by determining the length of the section affected, and the midpoint D.O.B. The volume of the section can then be looked up in the Tatum Guide #5 "Cubic Foot Volumes of Short Logs" found in the Appendix. Using a four-digit code, estimate and record cull to the last 1/10 cubic foot (0.1 cubic feet would be recorded as 0001).

Explanation

Growing-stock trees (tree class 10 and 20)

All growing-stock trees of sawtimber size must meet the following three specifications; poletimber, Saplings and seedlings must reflect a potential of meeting these specifications at the time they will reach sawtimber size:

1. Must contain at least one 12-foot saw log or two non-contiguous saw logs, each 8 feet or longer.
2. Must meet minimum saw log grade specifications as shown in the Appendix Tatum Guide on log grades.
3. Must contain 33 percent or more of gross board-foot volume (International 1/4-inch rule) in sound material within merchantable saw logs.

Bole length and saw log length on growing-stock trees are terminated after the highest merchantable pulpwood or saw log section. A merchantable pulpwood or saw log section is a section that meets pulpwood or saw log grade specifications, respectively (see sections 46.4 and 46.5). Board foot cull includes the unusable board foot volume in merchantable saw logs and the total board foot volume of sections that are below the merchantable saw log top. Cubic foot cull is the same, including the unusable cubic foot volume in merchantable pulpwood sections and the total cubic foot volume in sections that do not meet pulpwood specifications that are below the merchantable bole length top. Saw log information is lined out on poletimber-sized trees.

that do not meet sawlog specifications

Hardwood trees are pictured in the examples, but softwoods can also be applied using a minimum 7.0 inch saw log top D.O.B.

1. A growing-stock hardwood sawtimber tree. Saw log length terminates at 9-inch top D.O.B. The saw log meets both minimum log grade specifications and the minimum 12-foot qualification for a growing-stock tree. The upper stem portion contains no cull and terminates at 4 inches D.O.B. Saw log length is recorded as 12 feet; bole length as 21 feet.
2. A hardwood grades 1, 2, and 3 or softwood sawtimber tree. Saw log portion is terminated by limbs creating a full diameter stopper. Each limb is over 2 inches in diameter and their sum exceeds the diameter of the stem at that point (10 inches D.O.B.). The saw log contains no cull and meets minimum grade specifications. Both bole length and saw log length are 14 feet. Again, two limbs each over 2 inches in diameter whose sum exceeds the diameter of the stem at that point (5 inches D.O.B.) create a full diameter bole length stopper. The portion between the whorls of limbs is large enough in diameter, but not in length to meet pulpwood specifications (i.e., is less than 4 feet long). Also, the section above the stopper is not 4 feet to the 4-inch top D.O.B. Cull board feet and cull cubic feet are zero.

3. A growing-stock hardwood grade 4 sawtimber tree. There are no saw logs in the 22-foot saw log portion that have minimum clear panel length to meet hardwood factory log grade 3 specifications, but the bottom 14 feet contains no rot or sweep and will meet hardwood construction grade 4 specifications. The saw log terminates at 14 feet, because the 5-inch diameter limb creates a one-third diameter stopper for hardwood construction grade 4 and only a 7-foot section is left above the 1-foot saw log stopper. Log grade specifications require a minimum saw log length of 8 feet. Since bole length stoppers must be full diameter the entire portion between the saw log top at 14 feet and the 5-inch top meet pulpwood specifications. Bole length is terminated at 27 feet with a 5-inch top D.O.B. because of a fork with 2 3-inch diameter limbs. Cull board feet and cull cubic feet are zero.

4. Two hardwood sawtimber trees. Since the lowest fork is below D.B.H., each fork is appraised and recorded as a separate tree. The lower 14 feet of the left-hand fork (or left-hand tree) meets log grade specifications. A 7-foot section meets pulpwood specifications above a full diameter stopper created by two large limbs. The bole length is 22 feet and the saw log length 14 feet. Cull board feet is zero and the total cubic foot volume of the one-foot stopper section is recorded for cubic foot cull

In the right-hand tree, a 13-foot merchantable saw log plus a 9-foot merchantable saw log in the right-hand fork (with an intervening one-foot section of sound cull) is recorded as 23 feet of saw log length. A 4-foot section of the right-hand fork meets pulpwood specifications making the bole length 27 feet. Cull board feet and cull cubic feet will both reflect the total volume of the one-foot fork. When a tree forks above D.B.H. measurements are recorded on one fork only. Merchantable bole length should be recorded continuing up the same fork that has the highest merchantable saw log length. In this illustration the left-hand fork on the right-hand tree had a higher merchantable bole length at 33 feet, but the right-hand fork on the same tree had a higher merchantable saw log length, so the bole length is recorded as 27 feet using the right-hand fork.

5. A hardwood sawtimber tree. The saw log length is 16 feet to the 9-inch D.O.B. The bottom 2 feet are over 50 percent rotten and do not meet log grade specifications. The next 14-foot section meets minimum factory log grade specifications, but contains some cull due to a frost crack and a narrow cone of rot extending up from the bottom. A 6-1/2-foot section above a 1/2-foot fork at 19-1/2 feet terminates the bole length at 26 feet. Board foot cull will include the entire board foot volume in the bottom 2 feet, and the unusable board foot volume in the next 14 feet. Cubic foot cull will include the total cubic foot volume in the bottom 2 feet, only the cubic foot volume loss due to rot in the next 14 feet, and the total cubic foot volume in the 1/2-foot fork.

Cull trees (tree class 30, 31, and 40)

Tree classes 30 and 40 - All sawtimber-sized trees that do not have any merchantable saw logs are 30- or 40-class trees. Sawlog information is zeroed out, log grade is dashed, pulpwood specifications are ignored so bole length is always taken to a 4-inch top (when it exists), and cubic foot cull is recorded for rot only. When over one half of the board foot volume in the saw log portion (length between the one-foot stump and the 9-inch D.O.B. hardwoods and 7-inch D.O.B. softwoods) is cull due to rot, it is a 40-class tree, or rotten cull; and conversely, when over one half the board foot volume in the saw log portion is due to sound cull, it is a 30-class tree, or rough cull.

On poletimber ^{sized} trees line out saw log information. Other tree measurements are recorded in the same manner as on cull sawtimber trees. See section 47.81 for explanation on determining tree class on poletimber cull trees.

6. A rough hardwood sawtimber tree. Saw log portion is 15 feet long. There is no saw log present that will meet minimum hardwood log grades 1-4. Minimum clear panel length is not present for grade 3 and sweep plus a 1/3 diameter limb stopper prevents grade 4. Since more than 1/2 the board foot volume is lost as sound cull, it is a rough tree (tree class 30). Zero out saw log information. Bole length is taken 25 feet to the 4-inch D.O.B. ignoring all bole length stoppers (pulpwood specifications).

7. A rotten hardwood sawtimber tree. The saw log portion is 20 feet long. The entire volume of a 13-foot section is cull, because it will not meet log grade specifications due to excessive rot. This creates a 7-foot sound cull section beneath, because there is not a minimum saw log length of 8 feet. Since there is no saw log that will meet minimum log grade specifications, the tree is cull. Because more than 1/2 the board foot volume loss is due to rot, the tree is a rotten cull (tree class 40). Zero out saw log information and dash log grade. Bole length is 27 feet and cubic foot cull would represent only the rotten cubic foot volume within the 13-foot rotten section.

Tree class 31

Trees that do not meet all three specifications for growing-stock trees (see explanation in the beginning of this section), but still contain a merchantable saw log are tree class 31's. Saw log length is recorded to the top of the merchantable saw log. Board foot cull includes the entire board foot volume if unmerchantable saw log sections below the saw log length recorded plus any unusable board foot volume within the merchantable log itself. A poletimber tree can be a tree class 31, if it is projected to fall into this category at the moment it reaches sawtimber size at D.B.H. ~~These poletimber trees will be assigned tree class 30 or 40 depending on whether over 1/2 the cull board foot volume in the potential saw log portion is due to rot or is due to sound cull.~~ The two inch diameter rule can be applied to project the potential saw log portion of the tree (see section 47.81 for explanation).

8. A tree class 31. The saw log portion is 28 feet and stops at a point just below where the tree forks for a second time at a 9.5-inch D.O.B. The first 16 feet do not meet minimum log grade specifications, but there is a 12-foot merchantable saw log above the first fork. Since over 2/3 of the total board foot volume between the one-foot stump and the top of the merchantable saw log is cull, this is a cull tree, but since the tree contains a merchantable saw log it is a tree class 31. Use Tatum Guide #5 to compute the board foot volumes of the sections listed. For this example the saw log information is recorded as saw log length 028, saw log top D.O.B. 095, and board foot cull is the total board foot volume in the 16-foot cull section. Bole length and cubic foot cull are handled the same as in other cull trees (tree class 30 and 40) ignoring all stoppers and culling only for rot.

9. A tree class 31. The saw log portion is 16 feet to the 9.0 D.O.B., but a fork at 11 feet prevents the tree from meeting number one of the specifications for growing-stock trees. It does not contain at least a 12-foot merchantable saw log or two noncontiguous saw logs, each 8 feet or longer. This classifies the tree into the cull category and since it contains a merchantable saw log at least 8 feet or longer it is a tree class 31. Saw log length is recorded as 011, saw log top D.O.B. 100 and board foot cull 0000. Bole length and cubic foot cull are handled the same as on other cull trees (tree classes 30 and 40) ignoring all stoppers and culling only for rot.

Dead trees - Tree class is projected back to the time of death for all dead trees that are tallied. Record the tree measurements for dead trees using the rules applied for live trees in the previous examples 1- 9 for each appropriate tree class.

Mortality trees - Tree measurements should reflect the tree's condition at the time it died. This will be the best projection the tallyman can make.

Salvable dead trees - Tree measurements should reflect the tree's present condition, however tree class will always be projected back to the time of death. If the tree class has changed during the period elapsed between the death of the tree and the time it is measured, tree measurements will be applied using the rules for the current tree class, not the tree class recorded on the plot sheet.

46.5 - Saw Log Length. Record saw log length for softwood trees 9.0 inches D.B.H. and larger and hardwood trees 11.0 inches D.B.H. and larger that qualify as growing-stock sawtimber.

Measure saw log length from a 1-foot stump to the point on the bole above which no merchantable saw log can be produced, because of excessive limbs or other defects, or to a minimum top of 7.0 inches diameter outside bark (D.O.B.) for softwoods and 9.0 inches D.O.B. for hardwoods. A merchantable saw log refers to a saw log that meets minimum saw log grade specifications.

To qualify as growing-stock sawtimber, a tree must:

1. Contain at least one 12-foot saw log now or prospectively, or two noncontiguous saw logs, each 8 feet or longer.
2. Meet minimum saw log grade specifications as shown in Appendix Tatum Guide on log grades.
3. Contain 33 percent or more of gross board-foot volume (International 1/4-inch rule) in sound material.

Saw log length should not extend above a large fork, excessive limbs or other defects or a section of the tree bole that does not meet minimum log grade specifications unless the tree has at least 8 feet of saw log length above the limitation (12 feet if this is the only log in the tree). Limitations for hardwoods grades 1, 2, and 3 and for all softwoods are any limb or group of 2.0 inch or larger limbs within a one-foot span whose sum exceeds D.O.B. at that point. Limitations for grade 4 hardwoods only include any limb or group of limbs within a one-foot span with a diameter or sum of diameters greater than 1/3 the stem D.O.B. of that section.

In situations where limbs are a factor in determining merchantable length, measurement may be taken to the point where a line drawn along the center of a limb intersects the main bole at the surface.

Minimize limb limitations by logical log making aimed at obtaining maximum bole lengths and sawlog lengths. For example, bucking between staggered limbs within a one-foot span that exceeds the bole D.O.B. at point of occurrence.

Record saw log length to the last whole foot of the bole of sawtimber-sized trees, using a three-digit code. For example, a saw log length of 14.5 feet should be recorded as 014.

If no saw log is present, zero out saw log length.

46.6 - Saw Log Top Diameter Outside Bark. For each sawtimber-sized tree record saw log top D.O.B. to the last 0.1 inch, using a three-digit code. For example, record 7.0 inches as 070. The minimum top D.O.B. recorded for softwoods will be 7.0 inches and 9.0 inches for hardwoods. For trees with saw log length terminating before reaching minimum top D.O.B., record D.O.B. at the point where saw log length terminates. If the saw log length is taken into the bottom of a fork or the flare from a limb, the smallest diameter immediately below the swell is recorded. When no saw log is present in sawtimber-sized trees, zero out this item.

46.7 - Board-Foot Cull. Board-foot cull is the volume within the saw log portion of trees containing saw logs which cannot be recovered for use as lumber because of rot, sweep, crook, forks or other defect. Board foot measure is computed from a squared off section within the circular form of a log. This is the only portion which contains lumber. Therefore, shallow defects that are expected to be cut out in slabbing for lumber and rounding for veneer are ignored. Cull volume includes the entire volume of tree sections which do not meet minimum log grade requirements plus cull volume within saw logs.

Cull volume includes:

1. Hardwoods grades 1, 2 and 3 and Softwoods - any limb or group of 2.0-inch or larger limbs within a one-foot span whose sum exceeds D.O.B. at that point.
2. Hardwoods, grade 4 - any limb or group of limbs within a one-foot span with a diameter or sum of diameters greater than $1/3$ the stem D.O.B. of that section.

Determine the board foot cull volume in logs and/or cull sections by estimating the length and D.O.B. at midpoint and looking up the board foot volume in the "Board-foot Volume of Short Logs" table in the Appendix. In determining cull due to sweep and crook, minimize the defect by logical log-making aimed at obtaining maximum high-grade material. Sweep and crook tables along with guides for determining the proportion of cull are also found in the Appendix.

Use a four-digit code to record cull volume, to the last board foot. When no saw log is present, zero out Board-Foot Cull on sawtimber-sized trees.

47 - TREE CLASSIFICATION. Entries log grade, surface defect, internal and total volume loss, relative bole, crown ratio, crown class, and damage are tree classification codes. These codes provide the basis for systematically classifying trees into classes that reflect their vigor and suitability for timber products now or prospectively. Tree classes used permit relating inventories and growth to area condition, which in turn provides a basis for rating harvesting and management opportunities. Theoretically, after proceeding from left to right on the plot sheet, the tree class is determined. This theory should be stressed when training new employees. Once employees understand how to measure and record data, efficiency in taking these measurements will be stressed.

A systematic procedure to determine tree class will be carefully explained to promote better understanding. In deriving tree class first, some information will no longer need to be figured on cull trees, and therefore cut down the time spent on each cull tree.

Upon the first observation of a tree the saw log portion on a sawtimber tree and the potential saw log portion on a poletimber tree should be screened using criteria which would place it into one of two categories; one category being growing stock, the other being cull. The first criteria to evaluate is the presence of a saw log section. This is defined under Section 46.5 Saw Log Length. If all three of these saw log section requirements are met, the tree is considered growing stock. From this point accurate determinations of surface defect, internal and total volume loss, relative bole, crown ratio, crown class, and damage will be recorded. These items will be used to distinguish a 10-class tree from a 20-class tree. In evaluating the potential saw log portion of pole-sized trees only rot or large limbs may be used to disqualify the tree as growing-stock, site index of the plot is not a consideration in determining tree class.

If any one of the saw log section requirements is not met, the tree is considered cull. If a saw log is present, the tree class is 31 and an accurate estimation of internal defect shall be determined and saw log information recorded. If no saw log is present, proceed to accurately determine whether over one-half the cull in the saw log portion is due to rot or whether over one-half the cull in the saw log portion is due to being rough. Tree classes 30 and 40 can be assigned accordingly. An internal defect code does not need to be accurately determined, but an estimation can be recorded. Be sure the code used fits the definition requirement of internal defect for either a 30- or 40-class tree found on Forest Survey Tatum Guide #4 or under Section 47.81 Tree Class in the manual. This is an internal code of 0-5 for 30-class trees and codes 4-9 for 40-class trees. Under cull trees total volume loss will be an automatic code of 9, relative bole 0 and a damage code other than 00 will be required. On 40-class trees a damage code reflecting rot 20-27 will be required. Any code can be placed in surface defect since an automatic has not been established.

For seedlings and saplings unless a specific damage is observed, they should be considered growing-stock trees. Excessive sweep and crook will not be considered a specific damage code on seedlings and small saplings.

Note.--The advantages are that once a tree has been determined as growing stock or cull it may not be necessary to do surface defect. Since surface defect is only important on 10- and 20-class trees and since log grade must be done first by the cruiser this procedure will not circumvent procedures to establish 10- and 20-class trees. Also, time figuring internal defect on cull trees will be saved.

47.05 - Log Grade. Grade the first saw log in each live sawtimber tree according to log grade rules in the Appendix. If a tree does not have one 12-foot or two 8-foot sawlogs that meet minimum log grade requirements, it is a cull tree. Record a one-digit code corresponding to the log grade numbers. Grade hardwood trees by either the best 12 feet of the first 16-foot section or the best 12-foot upper section if the butt log does not meet minimum log grade standards. Grade the first merchantable 16-foot log in softwood trees, or shorter lengths down to 12 feet if a 16-foot log is not present. Grading 8-foot logs in hardwood and softwood trees will only be done when longer logs are not present. Log grade will be dashed when no sawlog is present.

47.1 - Surface Defect. Surface defect observations provide a measure of the number and size of limbs, knots, and other defects that affect quality of lumber, veneer, and other products.

47.11- Softwoods for Eastern United States. Surface defect for eastern softwoods is based on knot count; that is, the number of overgrown knots more than one-half inch in diameter, plus the sum of diameters of sound knots or limbs, plus twice the sum of the diameter of unsound knots. Average diameter of knots should be estimated to the nearest whole inch. All limbs and knots less than one-half inch in diameter will be ignored. See table below and exhibit 13.

Tree Classification, Softwoods
Knot Count for Eastern United States

<u>Diameter Classes</u>	<u>Live Limbs and Sound Knots</u>	<u>Knot Counts</u>	<u>Dead Limbs or Unsound Knots</u>
0.6-1.5"	1		2
1.6-2.5"	2		4
2.6-3.5"	3		6
3.6-4.5"	4		8
4.6-5.5"	5		10

Overgrown Knots Each Knot Count 1, Diameter class .6" and up.

All limb and knot diameters for both softwoods and hardwoods will be taken at right angles to the axis of the limb at the outer edge of the limb collar. This procedure is used in determining bole length and saw log length stoppers as well as surface defect for softwoods. See exhibit 14.

Record knot count code for the first:

8-foot section of trees 5.0 to 7.0 inches D.B.H.

12-foot section of trees 7.0 to 9.0 inches D.B.H.

16-foot section of trees 9.0 inches D.B.H. and larger.

The reduction in length of bole examined as specified both for softwoods and hardwoods serves to relax knot count and clear panel specifications with decrease in tree size to allow for natural pruning and overgrowth of knots and defects as trees become larger.

Record knot count index codes as follows:

<u>Knot Count</u>	<u>Code</u>
0	0
1-2	1
3-4	2
5-6	3
7-8	4
9-10	5
11-12	6
13-14	7
15-16	8
17+	9

47.13 - Hardwoods for Entire United States. Surface defect in hardwoods is based on length of clear panels in the tree face toward point center.

A clear panel is a section of the tree surface one-fourth the circumference of the tree and at least two feet long, free of limbs, knots, bumps, and other indications of defect which preclude clear cuttings in boards and veneer (exhibit 15).

Record the cumulative clear panel length to the last whole foot in the first:

8-foot section of trees 5.0 to 7.0 inches D.B.H.

12-foot section of trees 7.0 to 11.0 inches D.B.H.

16-foot section of trees 11.0 inches D.B.H. and larger, using the following codes:

<u>Code</u>	<u>Cumulative clear panel length (feet)</u>
0	0
1	2 or 3
2	4 or 5
3	6 or 7
4	8 or 9
5	10 or 11
6	12 or 13
7	14 or 15
8	16

In judging clear-panel length include as defects:

1. Bark distortions consisting of breaks across and along the normal bark pattern which indicate overgrown knots or defects in the underlying wood.

2. All adventitious twig growth on trees less than 15.0 inches in D.B.H.

3. All overgrown and adventitious twigs over 3/8 inch in diameter on trees 15.0 inches D.B.H. and larger.

4. All bird pecks, grub holes, or other insect holes, recent or overgrown on trees less than 15 inches in D.B.H.

5. All overgrown bird pecks, grub holes, or other insect holes on trees 15.0 inches D.B.H. or larger.

Ignore as defects:

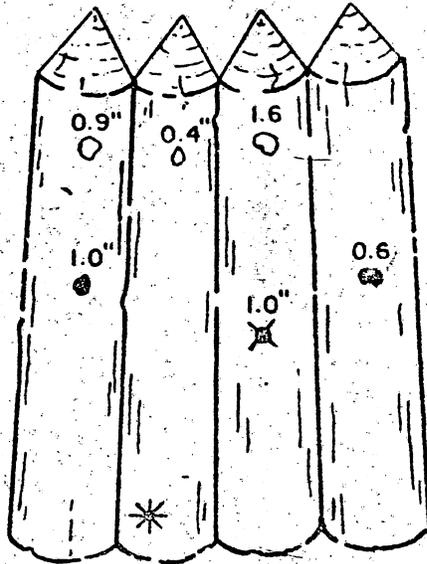
1. Slight bark distortions, consisting of a simple horizontal break across the normal bark pattern.

2. Shallow fire and other scars, seams, and frost cracks where minimum depth appears to be less than 1/5 of the tree diameter at that point. These shallow defects are expected to be cut out in slabbing for lumber and rounding for veneer.

Defect definitions are adapted from "Hardwood Log Grades for Standard Lumber and How to Apply Them," U.S. Department of Agriculture, Forest Service, Forest Products Laboratory Publication D173A, May 1956.

Exhibit 13

**TREE CLASSIFICATION, SOFTWOODS,
KNOT COUNT FOR EASTERN UNITED STATES**



LEGEND

- Live Limb
- Sound Knot
- ✕ Unsound Knot
- * Overgrown Knot

Source of knot count

Live limbs:

Number	Diameter
1	0.9"
1	0.4"
1	1.6"
	Live limb total

Sound knots:

1	0.6"
	1.0"
	Sound knot total

Unsound knots:

1	1.0"
---	------

Overgrown knots:

Total knot count

Knot count

1
0

2
3

1

1
2

2

1

8

Exhibit 14

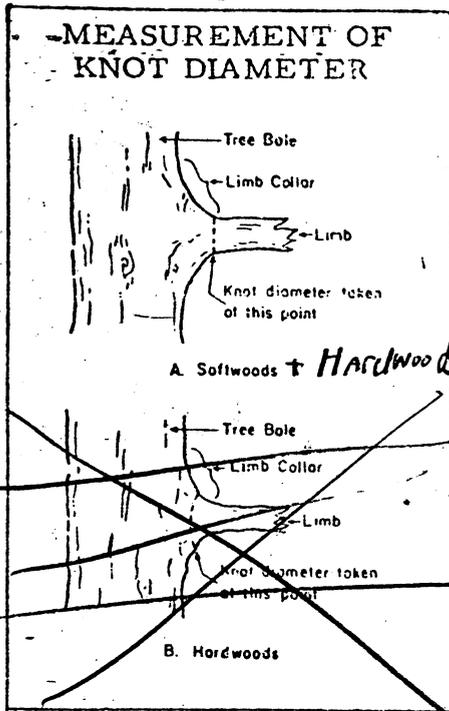
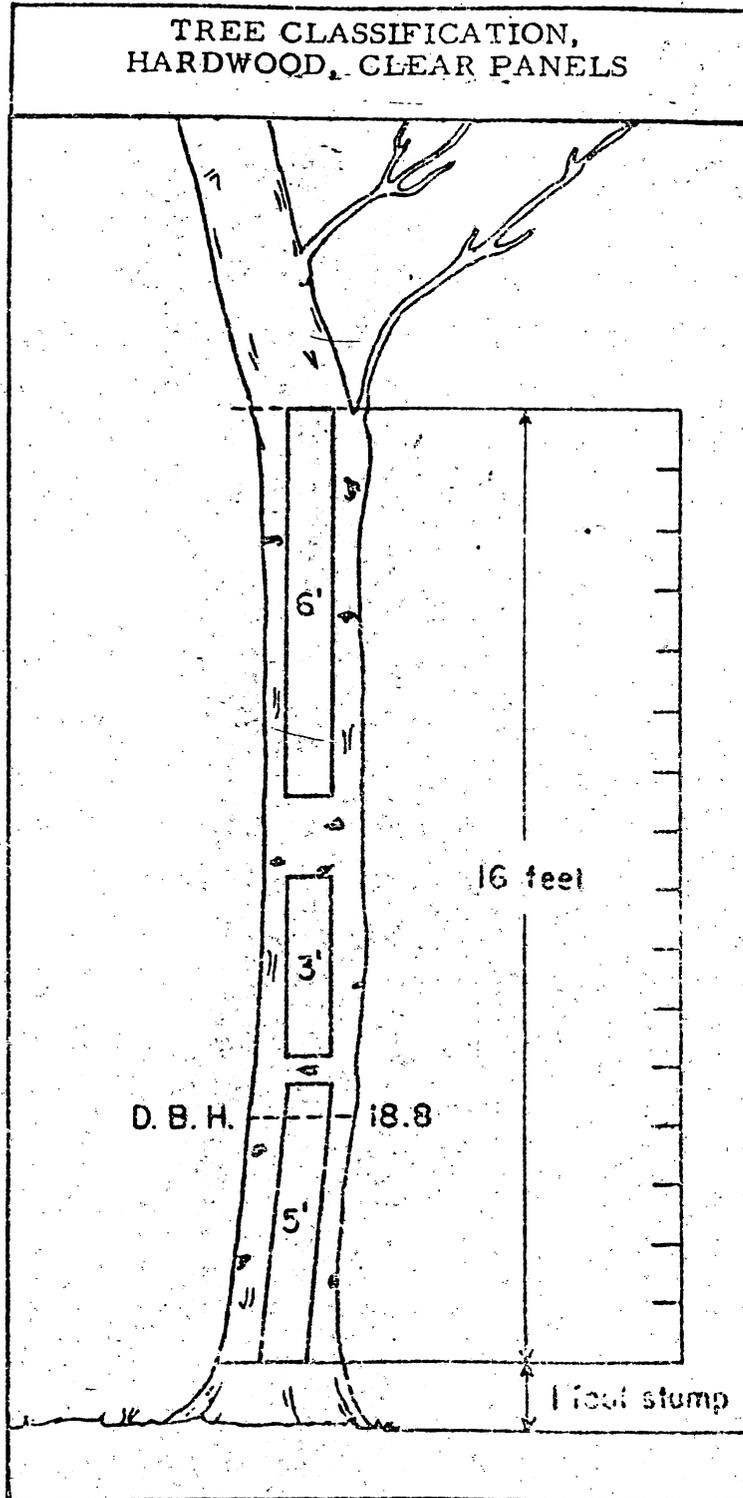


Exhibit 15

TREE CLASSIFICATION,
HARDWOOD, CLEAR PANELS



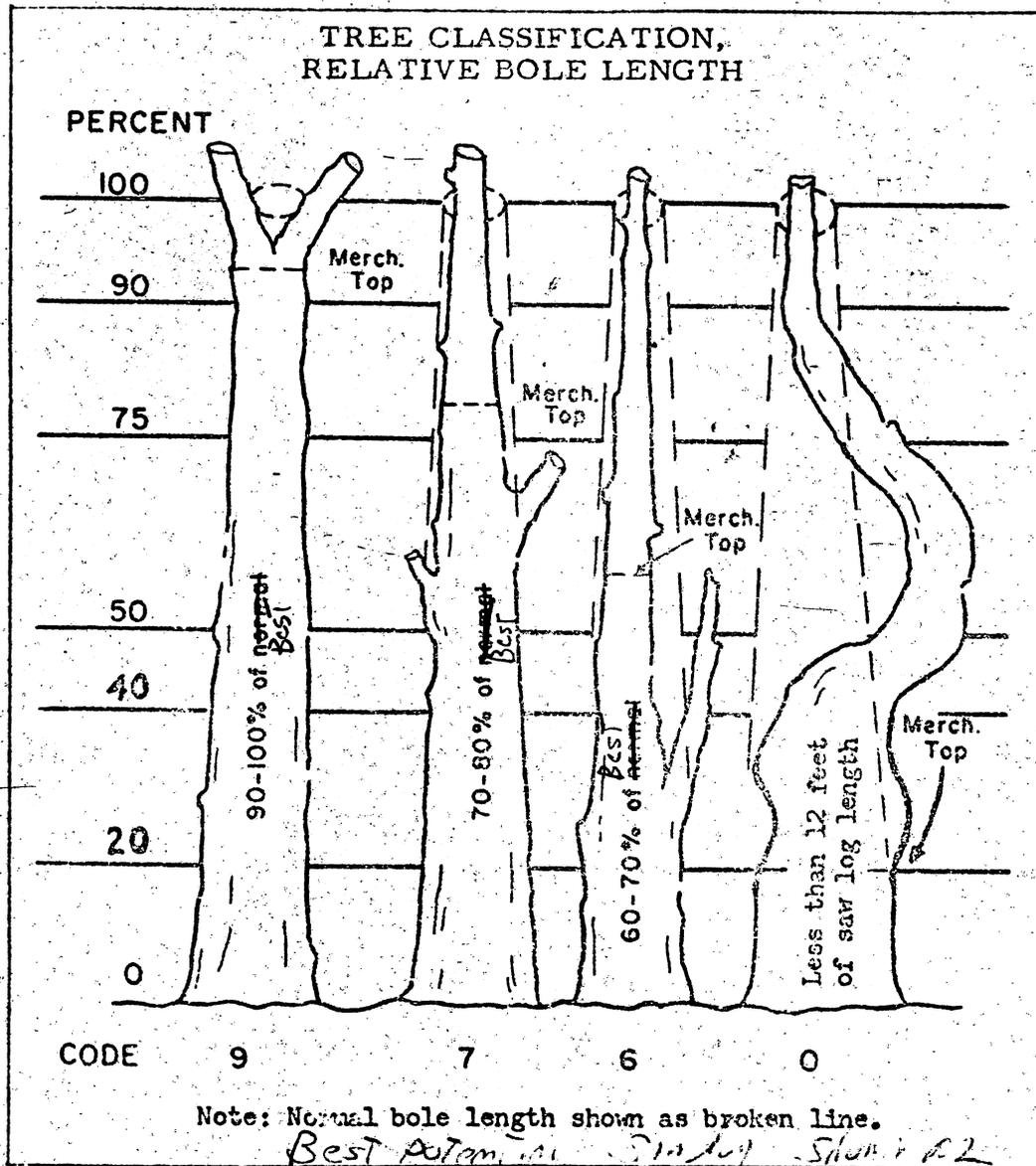
47.2 - Internal Defect. Internal defect includes the volume of decayed or missing wood in sections less than 50 percent rotten and the total volume in sections over 50 percent rotten. Figured on a board foot measure (see section 46.7) this is the unusable part of the board foot volume due to rot or missing wood in the saw log portion of sawtimber trees or the potential saw log portion of poletimber trees.

In growing-stock trees of sawtimber size internal defect will be accurately estimated and expressed as a percentage of the total saw log volume. In growing-stock poletimber-sized trees internal defect will be accurately projected and expressed as a percentage of the total volume of the projected saw-log portion at the time the tree will reach saw log size at D.B.H. When estimating internal defect for a poletimber tree, consider not only the size increase of the main stem, but defect extension from present until the tree will reach saw log size at D.B.H.

Two-inch Rule - When estimating volume increase for poletimber trees the two-inch rule can be applied as a guide. For example, a hardwood poletimber tree with a D.B.H. of 8.0 inches will need 3 inches of diameter growth to become sawtimber size. As a rough guide assume that diameter growth will be uniform along the bole. Using the pentaprism to locate the minimum saw log top D.O.B. minus two inches, 9 - 2 or 7 inches in this case, will identify the potential saw log portion. Using the height pole to measure the length the potential saw log volume can be found using the gross board foot tree volume table on Tatum Guide #5. For example, if the height to the 6.0 inch top D.O.B. were 20 feet the potential saw log volume would be found using the D.B.H. of 11.0 inches and log length 20 feet or 58 board feet. Use caution on 10- and 20-class trees if there are obvious defects which will not meet log grade specifications; for example, with forks, groups of large limbs, or rot, only the length below these stoppers will be projected as potential saw log volume unless there is an 8-foot or longer section above them that has a potential of meeting log grade specifications (12 feet if it is the only poletimber log).

Knowledge of how particular defects will increase or decrease relative to the total volume in different species is essential when projecting defect extension. Discussion concerning this area is vital when training new tallymen to maintain a consistency throughout the crew.

Exhibit 21



*Best potential study - Shur & R
y 100.00 - 1000*

47.31 - Sweep and Crook. Estimate the percent of gross board foot volume loss due to sweep and crook using the tables on Tatum Guide #5.

47.4 - Relative Bole Length. Compare the saw log length, now or prospective, to the best saw log length potentially possible for the trees of a given diameter, species and site in the absence of deformities, etc. Note: Trees now growing on a particular site may not necessarily exhibit the best saw log length potentially possible.

<u>Code</u>	<u>Percentage of best potential saw log length</u>
9	90 to 100
8	80 to 90
7	70 to 80
6	60 to 70
5	50 to 60
4	40 to 50
3	30 to 40
2	20 to 30
1	Under 20, but at least one 12-foot merchantable log
0	Less than 12 feet of potential saw log length

Relative bole is zero for all cull trees.

See next page for Exhibit 21.

In 30- and 40-class trees internal defect will not have to be accurately determined, but an estimation can be recorded. On 30-class trees internal defect codes must be within 0-5 and on 40-class trees, internal defect codes must be within ~~6-9~~ to meet the definitions of these tree classes. See section 47.81 Tree Class.

An accurate estimation of internal defect will be necessary on 31-class trees.

The following percentage classes will be used to record internal defect.

<u>Code</u>	<u>Percentage defect</u>
0	0
1	1 through 10
2	11 through 20
3	21 through 30
4	31 through 40
5	41 through 50
6	51 through 60
7	61 through 67
8	68 through 75

47.3 - Total Volume Loss. Total volume loss on 10- and 20-class trees is the sum of volume losses due to internal defect plus volume losses due to sweep, crook, deep splits, forks, and cracks. The percentage of gross board foot volume (see section 46.7) of the saw log portion of sawtimber trees unusable because of these losses or in the case of poletimber trees, prospectively unusable at the time trees reach saw log size, should be recorded by percentage classes as follows:

<u>Code</u>	<u>Percentage of total volume lost</u>
0	0
1	1 through 10
2	11 through 20
3	21 through 30
4	31 through 40
5	41 through 50
6	51 through 60
7	61 through 67
8	68+

The two-inch diameter rule can be applied for pole-sized trees as it was for internal defect (see section 47.2).

All cull trees will have a total volume loss of 8.

47.5 - Crown Ratio. Crown ratio is the percentage of total tree height that supports a full, live, green, healthy, foliage that is effectively contributing to tree growth. Crown ratio is expressed as a percent of total tree height and recorded as a 1-digit code for all live trees 1 inch D.B.H. or larger. For trees that have uneven length crowns, ocularly transfer branches to fill holes in the upper portion of the crown, until a full even crown is visualized. For example, a tree might have scattered green branches extending over 60 percent of its total height, but by ocularly transferring branches to produce a full crown, the crown ratio might be 40 percent.

Record crown ratio using the following one-digit codes:

<u>Code</u>	<u>Crown Ratio</u>
1	1 through 10 percent
2	11 through 20 percent
3	21 through 30 percent
4	31 through 40 percent
5	41 through 50 percent
6	51 through 60 percent
7	61 through 70 percent
8	71 through 80 percent
9	81 through 90 percent
0	91 through 100 percent

47.6 - Crown Class. Application of crown classification primarily reflects the amount of sunlight received, ~~tree vigor, freedom to grow, and response to release~~ rather than the conventional "crown position" classification found in forestry textbooks. Record a one-digit code to show crown class of all live trees of commercial species 5.0 inches D.B.H. and larger, as follows:

Code

- 1 Open grown. Trees with crowns which have received full light from above and from all sides throughout most of the life of the tree, particularly during its early developmental period.
- 2 Dominant. Trees with crowns extending above the general level of the crown cover and receiving full light from above and partly from the sides; larger than the average trees in the stand, and with crowns well developed, but possibly somewhat crowded on the sides.
- 3 Codominant. Trees with crowns forming part of the general level of the crown cover and receiving full light from above, but comparatively little from the sides--usually with medium-sized crowns more or less crowded on the sides. (In stagnated stands, includes trees with small-sized crowns crowded on the sides).

- 4 Intermediate. Trees shorter than those in the two preceding classes, but with crowns either below or extending into the crown cover formed by codominant and dominant trees, receiving little direct light from above, and none from the sides; usually with small crowns considerably crowded on the sides.
- 5 Overtopped. Trees with crowns entirely below the general level of the crown cover, receiving no direct light either from above or from the sides.

In multiple-age stands with understory trees of younger age classes, crown classification is often difficult. As a general rule, the crown class for each tree should be judged in the context of its immediate environment; that is, those trees affecting it or being affected by it in terms of crown competition. For example, the intermediate and overtopped crown classes are intended to include only trees seriously affected by direct competition from adjacent trees.

47.7 - Damage or Cause of Death

47.71 - Damage. For live trees record presence of damage or pathogen activity if serious enough to reduce the quality by one tree classification code (see section 47). For example, damage would be considered serious if a tree has 25 percent total volume loss (coded 3) due to butt rot and this rot is expected to increase until the tree falls into the next class (code 4) 31-40 percent.

The second digit of damage, code 20 (disease) will be used to identify specific diseases of living trees. Identifying the presence of any of these diseases will be sufficient reason to record them as a damage. Note: It will be necessary to indicate damage on live trees 1.0" to 5.0" D.B.H. that are recorded on the fixed plots of points 1 through 3 only if one of these specific diseases is present.

Tent caterpillar, spruce budworm, jack pine budworm and pine sawfly are the most notable defoliators in Michigan. Extensive damage by these or other insects should be noted in the comments section of the field form. Also record extensive disease occurrence in this section.

All cull trees must have a damage code other than 00. A damage code indicating rot (codes 20-27) must be used on 40-class trees.

Damage code 60 automatically puts a tree in a cull category. When a tree is damaged by more than one agent, code the most severe one.

Record presence of pathogens or damage using the following two-digit code:

<u>Code</u>	<u>Disease</u>	<u>Susceptible species</u>	<u>Code</u>	<u>Disease</u>	<u>Susceptible species</u>
10	Insect damage				
11	Poplar Borer	Aspen			
20	Disease damage				
21	Fomes igniarius	Aspen	21	Scleroderris	Red and jack pine
22	Hypoxylon canker	Aspen	22	Sirococcus	Red pine
23	Other cankers	Aspen	23	Scleroderris & Sirococcus	Red pine
24	Fomes igniarius & Hypoxylon canker	Aspen	24	White pine blister rust	White pine
25	Hypoxylon canker & Other canker	Aspen	25	Dwarf mistletoe	Black spruce
26	Fomes igniarius & Other canker	Aspen	26	Other cankers	All hardwoods except Aspen
27	Fomes igniarius & Hypoxylon canker & Other cankers	Aspen	27	Annual cankers	
			28	Other canker and Annual canker	
30	Fire damage				
40	Animal damage				
50	Weather damage				
60	Suppression				
70	Unknown and other damage--Used to indicate old age; leaning or forked trees; excessive sweep or crook; broken, spike, or flat top crowns; crown defects such as foliage color and length; any presence of barb wire or nails from signs or deer stands. (Note: Should not be used just because you don't like the looks of a tree.)				
71	Dead Tops		72	Form defect	
80	Logging and related damage				
82	Timber stand improvement				
85	Conversion to nonforest or noncommercial forest land use. (Note: Includes all growing trees that were attempted to be removed in the process of changing the land use.)				
00	No serious damage.				

Exhibit 22 STANDARDS FOR COMMERCIAL SPECIES BY TREE CLASS

Desirable tree (Code 10)

Log Grade--A 10-class tree must have a merchantable 12-foot saw log or two merchantable 8-foot logs now or at the moment the tree reaches saw log size at D.B.H. (See log grade for acceptable tree on next page.)

<u>Surface defect</u>	<u>East</u>		
	<u>D.B.H.</u> <u>(inches)</u>	<u>Log length</u> <u>(feet)</u>	<u>Maximum</u> <u>knot count</u>
Softwood	5.0-6.9	8	8
	7.0-8.9	12	8
	9.0-14.9	16	6
	15.0+	16	4
	<u>D.B.H.</u> <u>(inches)</u>	<u>Log length</u> <u>(feet)</u>	<u>Minimum cumula-</u> <u>tive clear panel</u> <u>length (feet) -</u>
Hardwood	5.0-6.9	8	4
	7.0-10.9	12	6
	11.0-14.9	16	8
	15.0+	16	10

<u>Internal defect</u>	<u>Maximum allowable percentage</u>
Poletimber	0
Small sawtimber	10
Large sawtimber (15" +)	20
<hr/>	
<u>Total volume loss</u>	
Poletimber	0
Small sawtimber	10
Large sawtimber (15" +)	20

Relative bole length	80 percent or more of normal
Crown ratio	31 percentage or over
Crown class	Open-grown, dominant and codominant
Damage class	No serious damage

(Sapling-sized trees which exhibit good form and vigorous growth can receive a tree class of 10.)

Exhibit 22 (Continued)

Acceptable tree (Code 20)

Log Grade--A 20-class tree must have a merchantable 12-foot saw log or two merchantable 8-foot logs now or at the moment the tree reaches saw log size at D.B.H. In evaluating the potential saw log portion of pole-sized trees only rot or large limbs may be used to disqualify the tree as a growing-stock tree. Site index of the plot is not a consideration in determining tree class.

Surface defect

Softwoods (All tree sizes and areas)--No limit to knot count or size of knot or limb.

Hardwoods (All tree sizes areas)--No minimum cumulative clear panel length

<u>Internal defect or total volume loss</u>	<u>Maximum allowable defect percentage</u>
---	--

All East except Southern Station Hardwoods	67
---	----

Relative bole length	Any except code 0
Crown ratio	No limit
Crown class	No limit

Damage class	Any except damage class codes 60 or 90
--------------	--

For seedlings and saplings unless a specific damage is observed, they should be considered growing stock trees. Excessive sweep and crook will not be considered a specific damage code on seedlings and small saplings.

For growing-stock trees (tree classes 10 and 20) bole length will be recorded to a 4.0-inch top D.O.B., or that point where the central stem is terminated by a stopper and there is not a four-foot merchantable section above it (see section 46.3). Cubic foot cull will be recorded for the rotten volume within merchantable sections and the total volume in unmerchantable sections. These are sections that are limb stoppers, have too much sweep, or are over 50 percent rotten (see section 46.4). Saw log length should be recorded to the top of the highest saw log section meeting minimum saw log requirements. Board foot cull will include the unusable board foot volume in merchantable saw log sections and the total volume of sections that do not meet saw log requirements (see Tatum Guide Hardwood and Softwood Log Grades). All remaining information will be accurately recorded.

For seedling and saplings unless a specific damage is observed they should be considered growing-stock trees. Excessive sweep and crook will not be considered a specific damage code on seedlings and small saplings.

~~BOTTOM~~ - 7/ page
47.72 - Cause of Death. Record cause of death for dead trees tallied, using the following two-digit codes:

<u>Code</u>	<u>Cause of death</u>
10	Insects
20	Disease
30	Fire
40	Animals
50	Weather
60	Suppression
70	Unknown
81	Logging
82	Timber stand improvement
84	Land clearing
85	Conversion to nonforest or noncommercial forest land use. (Note: Includes all growing trees removed from inventory by changes in land use whether trees are killed or not.)

Where there is only one cause of death evident, use 0 for the second digit. When there are multiple causes of mortality, use the first digit to indicate the most important subsequent cause of death and the second digit to indicate the initial cause. Thus, a tree killed by windthrow, but showing evidence of root rot, would be coded 52. A tree killed by disease only would be coded 20.

47.8 - Tree or cover Class

47.81 - Tree Class. Tree class of all trees will be based on tree classification codes (see section 47). Tree class is not permanently assigned. On future remeasurements it is possible for a tree to move from a cull category back to an acceptable tree. The following tree class codes will be used:

<u>Code</u>	<u>Tree class</u>
10	Desirable tree
20	Acceptable tree
30	Rough tree
31	Short sawtimber tree
40	Rotten tree

On partial plots where log grade, surface defect, internal, and total volume loss are not recorded the requirements for these items must be met when assigning tree classes, particularly on 10-class trees.

Tree class is projected back to the time the tree died for all dead trees that are tallied.

Rough Tree (Code 30)

1. All trees of noncommercial species.
2. All trees of commercial species that are sawtimber-size and do not have a saw log portion eight feet long or pole-size trees that will not have at least one merchantable twelve-foot saw log or two eight-foot merchantable logs at the moment it reaches saw log size at D.B.H. In evaluating the potential saw log portion of pole-sized trees only rot or large limbs may be used to disqualify the trees as growing stock. Site index of the plot is not a consideration in determining tree class. (See damage class for acceptable trees for handling seedlings and saplings--exhibit 22.)
3. All trees of commercial species that are sawtimber-size and do not have any merchantable saw log volume where over one-half of the volume in the saw log portion does not meet minimum log grade specifications because of roughness, excessive sweep and crook, splits, and cracks. The saw log portion is the length between the one-foot stump and the 9.0-inch top D.O.B. for hardwoods and the 7.0-inch top D.O.B. for softwoods.

For a tree class 30 record bole length to a 4.0-inch top D.O.B. ignoring all stoppers. On cubic foot cull, cull out for rot only. Zero out saw log length, top D.O.B., board foot cull, and record a dash in log grade. Surface defect can receive any code, internal volume loss can be estimated and must be within "0-5," total volume loss is "9," relative bole is "0," crown ratio and crown class should be accurately recorded.

Short sawtimber-sized tree (Code 31)

1. Any live ^{5.0'+} ~~sawtimber-sized~~ tree of commercial species which ^{will have} ~~has~~ at least one eight-foot log, but less than a twelve-foot log that meets minimum log grade specifications.
2. Any live ^{5.0'+} ~~sawtimber-sized~~ tree of commercial species which ^{will have} ~~has~~ less than one-third of the total saw log volume in merchantable logs, but has at least one eight-foot saw log that meets minimum log grade specifications.

For a tree class 31 record bole length to a 4.0-inch top D.O.B. ignoring all stoppers. Cull out for rot only on cubic foot cull. Record saw log length and saw log D.O.B. to the height where the highest log present terminates. Cull out total board foot volume in all unmerchantable sections and the unusable board foot volume within merchantable saw logs. Record log grade for the log that is present. Surface defect can receive any code, internal defect will be a true indication of the volume loss due to internal defect, total volume loss will be a "9," relative bole a "0," crown ratio and crown class will be accurately determined. ~~Pole-sized trees cannot receive a tree class 31.~~

Rotten tree (Code 40)

1. All trees of commercial species that are sawtimber-sized and do not have any merchantable saw log volume where over one-half of the volume in the saw log portion does not meet minimum log grade specifications because of rot. The saw log portion is the length between the one-foot stump and the 9.0-inch top D.O.B. for hardwoods and the 7.0-inch top D.O.B. for softwoods. The same rules apply to 40-class pole-sized trees as 30-class pole-sized trees. (See #2 under Rough tree earlier in this section.)

For a tree class 40 record a bole length to a 4.0-inch top D.O.B. ignoring all stoppers. On cubic foot cull, cull out for rot only. Zero out saw log length, top D.O.B., board foot cull, and record a dash in log grade. Surface defect can receive any code, internal volume loss can be estimated and must be within "6-9," total volume loss is "9," relative bole is "0," crown ratio and crown class should be accurately recorded.

47.82 - Cover Class. If no live trees are recorded at a point, examine the fixed-radius plot for cover class and record, using the codes given below:

Code

- 51- Inhibiting vegetation. Cover sufficiently dense to prevent establishment of tree seedlings. Use the following codes: 51--grass, 52--shrubs, 53--vines, 54--other.
- 54
- 60 Nonstocked not overtopped. Area sufficiently clear to permit establishment and development of one or more tree seedlings by natural or artificial methods.
- 70 Nonstocked overtopped. Area clear enough to permit establishment of seedlings, but sufficiently overtopped by tree crowns to prevent survival of tree seedlings.
- 81- Nonstockable. Not capable of supporting trees of commercial species, because of the presence of rocks, water, etc. Use the following codes: 81--rocks, 82--water, 83--other.
- 83

48 - AREA DESCRIPTION

48.1 - Stand Origin. Record apparent stand origin on the area being sampled, using the following one-digit codes. Consider only trees in the predominant size class of the area.

Code

- 1 Natural stand with no evidence of artificial regeneration.
- 2 More than 40 percent of the sample location occupied by trees originating from artificial planting or seeding.
- 3 Less than 40 percent of the sample location estimated to be occupied by trees originating from artificial planting or seeding.

48.2 - Site Class. Site class will be left blank in the field, since this item will be determined as part of data processing. Site class codes to be used are as follows:

<u>Code</u>	<u>Potential yield, mean annual increment</u>
1	225 or more cubic feet per acre
2	165 to 225 cubic feet per acre
3	120 to 165 cubic feet per acre
4	85 to 120 cubic feet per acre
5	50 to 85 cubic feet per acre
6	20 to 50 cubic feet per acre
7	Less than 20 cubic feet per acre

48.3 - Site Index. Site index will be determined in the field.

48.31 - Site Tree Selection - Select two site trees of the preferred species for the forest type. If forest type can not be visually determined, it will be computed in the field before site trees can be selected. Refer to Section 48.7, "Forest Type," for procedures in computing forest type. Generally site trees should be vigorous in growth and still growing in height. All site trees should have been dominant or codominant throughout their lives and at least 3.0 inches at D.B.H.

Do not use trees that were suppressed during early years and then released. These can be identified by increment cores, which show growth rings close together in early years followed by a sudden and marked widening of growth rings. Site trees should be well distributed over the area. If there are no suitable site trees on the plot, select nearby trees from the same general aspect and elevation.

When site indexes measured are not within ten feet, additional trees must be measured until there are two within ten feet of each other. Always record the best site index, not the average, even if the others measured are more than ten feet below the best. When the lowest site index is not within ten feet of the others it should not be considered a good site tree and erased.

Do not select permanent tally trees if at all possible. See the following supplement for the species that should be selected for site index measurements by forest type.

Site index cannot be measured in the regular way for trees below about 15 feet. If larger nearby trees suitable for measuring site are not present, the following guides may be used. For softwood stands estimate site index on the 5-year intercept method using the following table:

Acid pine

- 5 Mesic sites. Soil-water relationships favorable to tree growth, with growth and species occurrence limited only by climate. These are the deep, well-drained soils, usually well suited to agriculture, in all regions. Those sites offer the most favorable management opportunities.
- 6 Hydromesic sites. Poor drainage or frequent flooding limits species occurrence. These include the better drained bottomland hardwood sites, the heavy, poorly drained, truncated soils of the Oxark-piedmont forest, and the hardpan soils of the northeastern coniferous forest.
- 7 Hydric sites. Growth and species occurrence seriously limited by excess water. These are the pocosins, swamps, and bays of the southeastern pine forest; the wet, frequently flooded river bottoms; and the spruce bogs of the northeastern coniferous forest.

48.5 - Stand Age. Determine age of the main stand from two or more borings of representative trees; that is, dominant or codominant trees on or near the sample location. In stands having more than one age class, classify by the age of the predominant stand size class. On nonstocked plots, estimate stand age as best as you can and enter it on the plot sheet.

Record appropriate age class by the following two-digit codes:

<u>Code</u>	<u>Age class</u> <u>years</u>	<u>Code</u>	<u>Age class</u> <u>years</u>
01	1 to 10	10	90 to 100
02	10 to 20	12	100 to 120
03	20 to 30	14	120 to 140
04	30 to 40	16	140 to 160
05	40 to 50	18	160 to 180
06	50 to 60	20	180 to 200
07	60 to 70	30	200 to 300
08	70 to 80	40	300 and over
09	80 to 90		

48.6 - Seed Source. The intention of seed source is to indicate the prospects for natural regeneration over the entire plot. The following codes will be used:

<u>Code</u>	
1	Adequate softwoods but inadequate hardwoods
2	Inadequate softwoods but adequate hardwoods
3	Adequate softwoods and hardwoods
4	Inadequate all species

Guidelines for applying these codes are listed below, but the tallyman has leeway to use his best professional judgment for each specific situation encountered.

Seed source is adequate for a plot when one of the following conditions exist on 5 or more points:

- 1) When there is a codominant or better tree of commercial species 9.0" D.B.H. and larger within the distance of a point not exceeding the total height of the tree;
- 2) When seedlings are present within the fixed-radius plot;
- 3) When hardwoods are expected to have suitable sprouts within the fixed-radius plot.

48.7 - Forest Type. Forest type must be determined before correct site trees can be selected. Based on plurality of stocking of all live trees forest type is determined by following the flow chart on the state supplement sheet. If there is insufficient stocking, use your best judgment.

49.1 - Sample Location Identification and Optional Items Items on the back of the forest inventory sample record (exhibit 1) provide information on the location of the field sample, the layout of the 10-point cluster, and descriptions of any disturbances within the area. This information will be used primarily in reestablishing the plot on future remeasurements. It should be recorded in legible and understandable terms. Any physical features that will assist in accurately relocating the plot should be drawn onto the 10-point cluster layout. This would include changes in timber type, old logging roads, forest and nonforest boundaries, streams, drainages, particular disturbances, etc. Clarification of any particular procedures or situations encountered on the plot will be explained in the notes so that remeasurement crews can take them into consideration. When a stand history code other than "00" is recorded, an explanation of the nature and degree of this disturbance will be recorded in the notes.

49.21 - Stand-size class. Normally this item will be computed in the office. If ten or less trees are recorded, enter the estimated size class. Use stocking percents of growing-stock trees only to calculate stand-size class. Separate and total the stocking percents of all growing-stock trees into one of three categories: seedling-sapling, poletimber, and sawtimber. Combine the poletimber and sawtimber and compare it to the seedling-sapling total. If the seedling-sapling total is higher record code "30," if poletimber-sawtimber is higher whichever one is greater will receive the stand size class. When ties occur poletimber-sawtimber will win over seedling-sapling and sawtimber will win over poletimber. A plot that has less than 16.7 percent in growing-stock trees will be recorded as nonstocked. Record stand size class using the following two-digit codes:

48.7 - Forest Type

LAKE STATES TYPE SPECIES
Michigan, Minnesota, Wisconsin

	<u>Type</u>	<u>Code</u>		<u>Species</u>
01	JACK PINE	1	105	JACK PINE
02	RED PINE	2	125	RED PINE
03	WHITE PINE	3	129	WHITE PINE
OB	<i>Scotch pine, other exotics</i>			
13	BALSAM FIR	4	012	BALSAM FIR
16	WHITE SPRUCE	5	094	WHITE SPRUCE
12	BLACK SPRUCE	6	095	BLACK SPRUCE
14	NORTHERN WHITE-CEDAR	7	241	NORTHERN WHITE-CEDAR
15	TAMARACK	8	071	TAMARACK
50	OAK-HICKORY	9	068	EASTERN REDCEDAR
		9	402	BITTERNUT HICKORY
		9	403	PIGNUT HICKORY
		9	405	SHELLBARK HICKORY
		9	407	SHAGBARK HICKORY
		9	409	MOCKERNUT HICKORY
		9	802	WHITE OAK
		9	804	SWAMP WHITE OAK
		9	806	SCARLET OAK
		9	809	NORTHERN PIN OAK
		9	823	BURR OAK
		9	826	CHINKAPIN OAK
		9	830	PIN OAK
		9	832	CHESTNUT OAK
		9	833	NORTHERN RED OAK
		9	834	SHUMARD OAK
		9	837	BLACK OAK
		9	601	BUTTERNUT
		9	602	BLACK WALNUT

<u>Type</u>	<u>Code</u>	<u>Species</u>
70 ELM-ASH-COTTONWOOD	10	313 BOXELDER
	10	317 SILVER MAPLE
	10	373 RIVER BIRCH
	10	543 BLACK ASH
	10	462 HACKBERRY
	10	731 SYCAMORE
	10	742 COTTONWOOD
	10	922 BLACK WILLOW
80 MAPLE-BEECH-BIRCH (SUGAR MAPLE-BASSWOOD)	11	261 HEMLOCK
	11	314 BLACK MAPLE
	11	318 SUGAR MAPLE
	11	371 YELLOW BIRCH
	11	531 BEECH
	11	762 BLACK CHERRY
	11	951 BASSWOOD
	11	541 WHITE ASH
91 ASPEN	12	741 BALSAM POPLAR
	12	743 BIGTOOTH ASPEN
	12	746 QUAKING ASPEN
92 PAPER BIRCH	12	375 PAPER BIRCH
RED MAPLE-ELM	23	316 RED MAPLE
	23	972 AMERICAN ELM
	23	975 SLIPPERY ELM
	23	977 ROCK ELM
	23	544 GREEN ASH

Note: Not all species are expected in every state.

In determining forest type the stocking in the Red maple-elm group is added to 80 Maple-beech-birch, if physio class is 5 or less, and to 70 Elm-ash-cottonwood if physio class is 6 or greater.

48.7a - P.I. Forest Type, Stand-Size Class, and Stocking Classes. As a guide to the fieldmen, P.I. Forest type, size and stocking will be recorded on the field plot sheet under P.I. class by photo interpreters in St. Paul.

The appropriate codes from list below will be recorded in St. Paul.
First two digits--Forest type, Third digit--Stand-size stocking.

P.I. Forest type Codes	Stand-size, stocking codes
01 - Jack pine	1 - Very good (superior) stocked, sawtimber
02 - Red and white pine	2 - Good stocked, sawtimber
10 - Balsam fir-white spruce	3 - Medium-poor stocked, sawtimber
12 - Black spruce	4 - Very good (superior) stocked, poletimber
14 - White cedar	5 - Good stocked, poletimber
15 - Tamarack	6 - Medium-poor stocked, poletimber
83 - Redcedar	7 - Good stocked, restocking
50 - Oak	9 - Medium-poor stocked restocking
70 - Elm-ash-cottonwood	
80 - Sugar maple-basswood	
90 - Aspen-birch	

Code

10	Sawtimber stands
20	Poletimber stands
30	Sapling and seedling stands
40	Nonstocked stands

49.22 - Basal Area Per Acre. Using a three-digit code record the basal area per acre for the plot. BA/A is determined by:

1. Counting the number of live trees 1" D.B.H. and larger at each point that occurs within the radius of the 37.5 factor plot. This count will be recorded in the right-hand margin of the field form, directly across from the first entry for each point. Two digits can be used when necessary.
2. Then multiplying the total number of trees counted by 3.75. Total BA/A may be determined directly from the "Basal Area Table" in the Appendix.

49.24 - Point Occupancy. If one or more live trees are recorded, show the order of occupancy by ranking those trees making the most use of the site. Crown class, crown ratio, and D.B.H. can be used as guidelines in determining point occupancy. Trees fully crowned and of large diameter that are obviously dominating the point yet are shorter than the surrounding trees can receive a higher point occupancy code than a taller tree that has a small weakened crown. Record occupancy using the following one-digit codes:

Code

1	Most controlling tree
2	Second most controlling tree
3	Third " " "
4	Fourth " " "
5	Fifth " " "
6	Sixth " " "
7	Seventh most controlling tree and all remaining trees on the point. No code greater than 7 is recorded.

If no trees are recorded leave this item blank.

49.25 - Stocking Percent. When forest type cannot be visually determined stocking percent will be computed in the field. Using the stocking percent assigned each live tree to arrive at the the correct forest type will be necessary before the correct site trees can be selected.

<u>Code</u>	<u>Common name</u>	<u>Species</u>	<u>Genus</u>
731	American sycamore	occidentalis	<u>Platanus</u>
741	balsam poplar	balsamifera	<u>Populus</u>
742	eastern cottonwood	deltoides	
743	bigtooth aspen	grandidentata	
745	plains cottonwood	sargentii	
746	quaking aspen	tremuloides	
760	cherry; peach; plum	sp.	<u>Prunus</u>
761	pin cherry*	pensylvanica	
762	black cherry	serotina	
763	common choke cherry*	virginiana	
800	oak	sp.	<u>Quercus</u>
802	white oak	alba	
804	swamp white oak	bicolor	
808	Durand oak	durandii	
809	northern-pin oak	ellipsoidalis	
817	shingle oak	imbricaria	
822	overcup oak	lyrata	
823	bur oak	macrocarpa	
824	blackjack oak	marilandica	
826	chinkapin oak	muehlenbergii	
833	northern red oak	rubra	
837	black oak	velutina	
901	black locust	pseudoacacia	<u>Robinia</u>
922	black willow	nigra	<u>Salix</u>
931	sassafras	albidum	<u>Sassafras</u>
951	American basswood	americana	<u>Tilia</u>
952	white basswood	heterophylla	
971	winged elm	alata	<u>Ulmus</u>
972	American elm	americana	
974	Siberian elm	pumila	
975	Slippery elm	rubra	
977	rock elm	thomassii	
999	Noncommercial, not coded in other more specific codes.		<u>Noncommercial species</u>

There are two categories of stocking percents. The category to be used is determined separately on each point by the point description given in the table below. Following the order of point occupancy assigned to trees on a particular point, stocking percents are given according to the trees's D.B.H. class. A maximum of 16.0 percent stocking will be assigned to each point. Ususally, the last tree to contribute to the 16.0 percent total will not be awarded its full value possible for that D.B.H. class, but will receive just that amount needed to reach 16.0 percent. For example, on a point with four 5.0" or larger trees, the tree given a point occupancy of 4 will receive only 1.9 percent stocking, which would bring the total to the 16.0 percent stocking necessary for that point.

<u>Point</u>	<u>Tree Size</u>	<u>Percent</u>
One or more 5.0" D.B.H. trees	5.0" +	4.7
	4.0 - 4.9	4.0
	3.0 - 3.9	2.4
	2.0 - 2.9	1.2
	1.0 - 1.9	.4
No trees 5.0" D.B.H. or larger	4.0 - 4.9	4.0
	3.0 - 3.9	3.5
	2.0 - 2.9	3.0
	1.0 - 1.9	2.5
	Seedling	2.0

49.29 - Aspect, Position and Slope (two digits).

<u>Aspect (first digit)</u>		<u>Position and slope (second digit)</u>	
<u>Code</u>	<u>Direction</u>	<u>Code</u>	
1	N 338 - 22	1	Ridge and upper 1/4--steep
2	NE 23 - 67	2	Ridge and upper 1/4--gentle
3	E 68 - 112	3	Upper mid-1/4--steep
4	SE 113 - 149	4	Upper mid-1/4--gentle
5	S 150 - 202	5	Lower mid-1/4--steep
6	SW 203 - 247	6	Lower mid-1/4--gentle
7	W 240 - 292	7	Level and lower-1/4--steep
8	NW 293 - 337	8	Level and lower-1/4--gentle

Aspect represents direction of drainage over entire plot.

Steep--35 percent plus average slope over entire 10 points.
Gentle--less than 35 percents.

There are three categories of stocking percent. The category to be used is determined separately on each point by the point description given in the table below. Following the order of point occupancy assigned to trees on a particular point, stocking percents are given according to the tree's D.B.H. class. A maximum of 16.0 percent stocking will be assigned to each point. Usually, the last tree to contribute to the 16.0 percent total will not be awarded its full value possible for that D.B.H. class, but will receive just that amount needed to reach 16.0 percent. For example, on a point with four 5.0" or larger trees, the tree given a point occupancy of 4 will receive only 1.9 percent stocking, which would bring the total to the 16.0 percent stocking necessary for that point.

<u>Point</u>	<u>Tree Size</u>	<u>Percent</u>
One or more 5.0" D.B.H. trees	5.0"+	4.7
	4.0-4.9	4.0
	3.0-3.9	2.4
	2.0-2.9	1.2
	1.0-1.9	.4
No trees 5.0" D.B.H. or larger	4.0-4.9	4.0
	3.0-3.9	3.5
	2.0-2.9	3.0
	1.0-1.9	2.5
No trees 1.0" D.B.H. or larger	seedling	4.0

49.29 - Aspect, Position and Slope (two digits).

<u>Aspect (first digit)</u>		<u>Position and slope (second digit)</u>	
<u>Code</u>	<u>Direction</u>	<u>Code</u>	
1	N 338° - 22°	1	Ridge and upper 1/4--steep
2	NE 23° - 67°	2	Ridge and upper 1/4--gentle
3	E 68° -112°	3	Upper mid-1/4--steep
4	SE 113° -149°	4	Upper mid-1/4--gentle
5	S 150° -202°	5	Lower mid-1/4--steep
6	SW 203° -247°	6	Lower mid-1/4--gentle
7	W 248° -292°	7	Level and lower-1/4--steep
8	NW 293° -337°	8	Level and lower-1/4--gentle

Aspect represents direction of drainage over entire plot

Steep--35 percent plus average slope over entire 10 points.

Gentle--less than 35 percent.

49.31 - Stand History (two digits).

Stand history reflects the kind and extent of vegetative change or treatment that has occurred in the recent past that has been instrumental in creating the present stand condition. A partial harvest cut indicates major logging activities in the area. This code should not be used to indicate situations where a few trees have been removed.

The period in which disturbance occurred is not tied in with change since date of photography.

An explanation of the kind and extent of any disturbance should be written in the notes on the back of the inventory sample record. Use the following codes to record stand history:

First digit

- 1 No disturbance
- 2 TSI
- 3 Clearcut harvest
- 4 Partial cut harvest (indicates major logging activities, not to be used when a small number of trees removed)
- 5 Significant damage--natural (fire, insects, disease, wind)
- 6 Significant damage--man-caused (drainage, flooding, spraying)
- 7 Artificial regeneration of forest land
- 9 Natural regeneration of nonforest land

*8 m/yr. recovery
m/yr. for*

Second digit - Period in which disturbance caused

- 0 No change
- 1 1-4 years before measurement
- 2 5-10 years before measurement
- 3 11-15 years before measurement
- 4 15+ years before measurement

49.32 - Stand Area. The size of the forest type-size-density condition that the plot falls in will be determined by the photo interpreter in St. Paul and recorded using the following codes:

<u>Code</u>	<u>Size*(acres)</u>
1	1-4
2	5-9
3	10-19
4	20-39
5	40-79
6	80-159
7	160-319
8	320-639
9	640+

of

49.33 - Combination

49.33a - Distance to water

49.33b - Distance to roads

49.33c - Conifer understory

Information for items 49.33a and 49.33b will be taken from aerial photo observations and recorded by the photo analyst in St. Paul.

49.33a - Distance to water (one digit).

The straight line distance to the nearest lake 5 acres or larger or stream at least 1 chain wide will be recorded using the following codes:

Code

1	0 - 1/8 mile	0 - 10 ch
2	1/8 - 1/4 mile	10 - 20 ch
3	1/4 - 1 mile	20 - 80 ch
4	1 - 2 1/2 miles	80 - 200 ch
5	2 1/2 - 5 miles	200 - 400 ch
6	5 - 10 miles	400 - 800 ch
7	10 - 20 miles	800 - 1,600 ch
8	20+ miles	1,600+ ch

49.33b - Distance to roads (one digit).

The distance to the nearest maintained road will be recorded using the same codes as in distance to water.

49.33c - Conifer understory (one digit).

This item identifies stands with coniferous understories.

1. No conifers or inadequate conifer stocking for next stand
(As a rough guide--if 5 or more of the points have no conifer understory trees recorded, call the plot inadequate conifer understory.)
2. Planted conifers should succeed when present stand is harvested.
3. Planted conifers need treatment other than regeneration cut.
4. Natural conifers should succeed when present stand is harvested.
5. Natural conifers need treatment other than regeneration cut.

49.34 - Photo age (one digit).

Record the number of growing seasons that elapsed between the date of the photo and the time of field check. A break-off date of July 1st will be used to determine the number of elapsed growing seasons. Minimum photo age that can be assigned is one.

Code

1	1 year
2	2 years
3	3 years
.	
.	
.	
9	9 or more years

49.35 - Nonforest plots---Black Walnut Inventory. An inventory of the volume of black walnut in trees 5.0 inches d.b.h. and larger will be made on nonforest plots in Kansas. This inventory will include all walnut trees (live, dead, and stumps) occurring on fence rows or as scattered trees on nonforest land. Walnut trees occurring on urban plots or on lawns, that will probably not be cut, will be excluded from the inventory.

The 10-point cluster plot layout will be used for this tally, and will be similar to the forest plot inventory. If any of the points 2-10 fall on forest land, they will be shifted to nonforest land. The same system of selecting substitute points on forest plots will be used to shift points into nonforest areas. Whenever substitute points are selected, their location will be shown on the back of the field tally sheet under Item 80. It will be unnecessary to mark the points with pins but a sketch of the plot location will be made on the back of each tally sheet.

In addition to the regular items completed for nonforest plots (1 through 9, and 72), the following items will be completed for all walnut trees:

Items

15	Point #, Tree #, Tree History, Species, D.B.H.
21-25	Bole Length, Cull Cubic Feet, Saw Log Length, Saw Log Top D.O.B., Cull Board, Log Grade.
30-34	Damage, Cause of Death, Tree Class
37	Bole Length Top D.O.B.

APPENDIX

TREE SPECIES.

Codes from 010 to 299 are for softwoods, and from 300 to 998 are for hardwoods. Within those groups numbers are listed in sequence alphabetically by scientific names of genera, species, and varieties. Each genus has been assigned a code ending in zero to record either an unidentified species or a genus as a group. Vacant codes may be assigned for important exotics as needed. Codes are primarily for use in recording trees tallied on field plots taken on Forest Survey and timber management inventories and for subsequent automatic data processing. Codes marked # are for use, as needed to supplement species codes, only in quarterly reports of timber cut and sold (specified in FSM 2493.43). Tree species within a designated area which do not develop into trees suitable for industrial products may be classed as noncommercial species in Regional or Station supplements to this section. The code 999 will be used to indicate noncommercial species. Noncommercial species are indicated by an asterisk in the following list.

Softwoods

<u>Code</u>	<u>Common name</u>	<u>Species</u>	<u>Genus</u>
			<u>Abies</u>
011	Pacific silver fir	amabilis	
012	balsam fir	balsamea var balsamea	
013	bracted balsam fir	balsamea var. phanerolepsis	
015	white fir	concolor	
			<u>Juniperus</u>
068	eastern redcedar	virginiana	
			<u>Larix</u>
071	tamarack	laricina	
			<u>Picea</u>
091	Norway spruce	abies	
093	Engelman spruce	engelmannii	
094	white spruce	glauca	
095	black spruce	mariana	
096	blue spruce	pungens	
097	red spruce	rubens	
			<u>Pinus</u>
105	jack pine	banksiana	
108	lodgepole pine	contorta	
110	shortleaf pine	echinata	
122	ponderosa pine	ponderosa	

<u>Code</u>	<u>Common name</u>	<u>Species</u>	<u>Genus</u>
125	red pine	resinosa	
126	pitch pine	rigida	
129	eastern white pine	strobus	
130	Scotch pine	sylvestris	
132	Virginia pine	virginiana	
133	Austrian pine		
			<u>Pseudotsuga</u>
201	bigcone Douglas-fir	macrocarpa	
202	Douglas-fir	menziesii	
			<u>Taxodium</u>
221	Baldcypress	distichum var. distichum	
			<u>Thuja</u>
241	northern white-cedar	occidentalia	
			<u>Tsuga</u>
261	eastern hemlock	canadensis	
		<u>Hardwoods</u>	
			<u>Acer</u>
313	boxelder	negundo	
314	black maple	nigrum	
315	striped maple*	pensylvanicum	
316	red maple	rubrum var. rubrum	
317	silver maple	saccharinum	
318	sugar maple	saccharum	
319	mountain maple*	spicatum	
			<u>Aesculus</u>
331	Ohio buckeye	glabra	
332	Yellow buckeye	octandra	
			<u>Ailanthus</u>
341	ailanthus*	altissima	
			<u>Betula</u>
371	yellow birch	allenghaniensis	
372	sweet birch	lenta	
373	river birch	nirgr	
374	water birch*	occidentalia	
375	paper birch	papyrifera var. papyrifera	
379	gray birch	populifolia	
			<u>Carpinus</u>
391	American hornbeam*	caroliniana	
			<u>Carya</u>
402	bitternut hickory	cordiformis	
403	pignut hickory	glabra	
404	pecan	illinoensis	
407	shagbark hickory	ovata	
408	black hickory	texana	

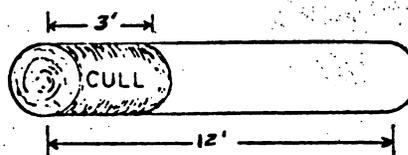
<u>Code</u>	<u>Common name</u>	<u>Species</u>	<u>Genus</u>
421	American chestnut	dentata	<u>Castanea</u>
452	northern catalpa	speciosa	<u>Catalpa</u>
461	sugarberry	laevigata	<u>Celtis</u>
462	hackberry	occidentalis	
471	eastern redbud*	canadensis	<u>Cercis</u>
481	yellowwood*	lutea	<u>Cladrastis</u>
491	flowering dogwood	florida	<u>Cornus</u>
500	hawthorn*	sp.	<u>Crataegus</u>
521	Common persimmon	virginiana	<u>Diospyros</u>
531	American beech	grandifolia	<u>Fagus</u>
541	white ash.	americana	<u>Fraxinus</u>
543	black ash	nigra	
544	green ash	pennsylvanica	
545	pumpkin ash	profunda	
546	blue ash	quadrangulata	
552	honeylocust	triacanthus	<u>Gleditsia</u>
571	Kentucky coffeetree	dioicus	<u>Gymnocladus</u>
601	butternut	cinerea	<u>Juglans</u>
602	black walnut	nigra	
611	sweetgum	styraciflua	<u>Liquidambar</u>
621	yellow-poplar	tulipifera	<u>Liriodendron</u>
641	Osage-orange	ponifera	<u>Maclura</u>
660	apple*	sp.	<u>Malus</u>
681	white mulberry	alba	<u>Morus</u>
682	red mulberry	rubra	
693	black tupelo	sylvatica var. sylvatica	<u>Nyssa</u>
694	swamp tupelo, blackgum	sylvatica var. biflora	
701	eastern hophornbeam*	virginiana	<u>Ostrya</u>

ESTIMATING CULL LOSS

This section divides logs into three uses.
The following are suggestions for estimating cull in logs.

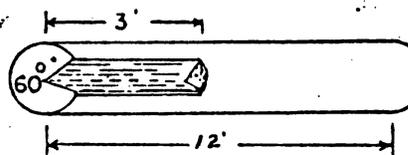
If section of log is affected, deduct length of log length affected.

Example: $\frac{3}{12} \times 100 = 25$ percent board foot cull.



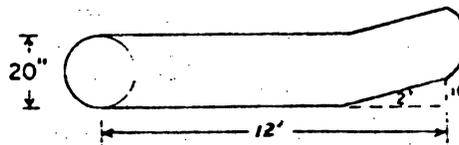
If sector is affected, multiply percent of circle times percent of length.

Example: $\frac{60}{360} \times \frac{3}{12} \times 100 = 4$ percent board foot cull.



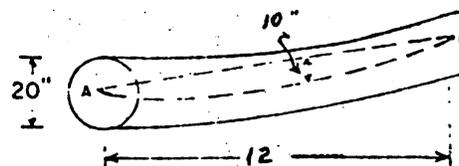
For a crook, multiply proportion of diameter displaced times proportion of log length affected by crook.

Example: $\frac{10}{20} \times \frac{2}{12} \times 100 = 8$ percent board foot cull.



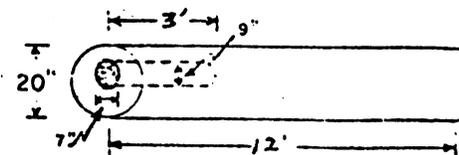
For sweep, determine sweep departure and subtract 2 inches. Divide this by minimum log diameter.

Example: $\frac{10-2}{20} \times 100 = 40$ percent board foot cull.



For interior defect, determine the defective material as percent of total volume of the log. Add 1 inch to width and thickness of defect, and divide by one less than average scaling diameter of the log.

Example: $\frac{8 \times 10}{20-1} \times \frac{3}{12} \times 100 = 11$ percent board foot cull.



DEFINITION OF TERMS - Terms used in this handbook are defined below.

1. Acceptable Trees. Growing-stock trees of commercial species that meet specified standards of size and quality, but not qualifying as desirable trees.
2. Afforested Areas. Lands formerly not in tree cover, but converted to forests by planting.
3. Allowable Cut. The volume of timber that would be cut on commercial forest land during a given period under specified management plans aimed at sustained production of timber products.
4. Area Condition Class. A classification of commercial forest land based upon stocking of desirable trees and other conditions affecting current and prospective timber growth.
5. Available Cut. The volume of timber that would be available for cutting on commercial forest land during a given period under specified assumptions concerning growth, cut, mortality, and forest management practices.
6. Bureau of Land Management Lands. Federal land administered by the Bureau of Land Management.
7. Clear Panel. A section of the tree surface one-fourth the circumference of the tree and at least 2 feet long free of limbs, knots, bumps and other indications of defect which preclude clear cuttings.
8. Commercial Forest Land. Forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. (Note: Areas qualifying as commercial forest land have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood under management. Currently inaccessible and inoperable areas are included, except when the areas involved are small and unlikely to become suitable for production of industrial wood in the foreseeable future.)
9. Commercial Species. Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality, such as hawthorn and sumac.)
10. Cull. Portions of a tree that are unusable for industrial wood products, because of rot, form, or other defect.
11. Crown Class. A classification of trees based on dominance in relation to adjacent trees in the stand as indicated by crown development and amount of light received from above and the sides. Crown classes recognized by the Forest Survey include:

a. Open Crown. Trees with crowns which have received full light from above and from all sides throughout all or most of the life of the trees, particularly during early development.

b. Dominant Trees. Trees with well-developed crowns extending above the general level of the crown cover and receiving full light from above and part light from the sides.

c. Codominant Trees. Trees with crowns forming the general level of the crown cover and receiving full light from above, but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides.

d. Intermediate Trees. Trees with crowns either below or extending into the crown cover formed by codominant and dominant trees, receiving little direct light from above, and none from the sides; usually with small crowns considerably crowded on the sides.

e. Overtopped Trees. Trees with crowns entirely below the general level of the crown cover, receiving no direct light either from above or from the sides.

12. Desirable Trees. Growing-stock trees of commercial species (a) having no serious defects in quality limiting present or prospective use for timber products, (b) of relatively high vigor, and (c) containing no pathogens that may result in death or serious deterioration before rotation age. (Note: These are the types of trees forest managers try to grow; that is, the trees favored in cultural operations, in over-rotation age stands, desirable trees are low-risk trees.)

13. Diameter Classes. A classification of trees based on diameter outside bark, measured at breast height (4-1/2 feet above the ground). (Note: D.B.H. is the common abbreviation for diameter at breast height. Two-inch diameter classes are commonly used in Forest Survey, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches D.B.H. inclusive.)

14. Face. A section of the tree surface one-fourth the circumference of the tree extending the full length of the log.

15. Farm. Either a place operated as a unit of 10 or more acres from which the sale of agricultural products totals \$50 or more annually or a place operated as a unit of less than 10 acres from which the sale of agricultural products for a year amounts to at least \$250. Places having less than the \$50 or \$250 minimum estimated sales in a given year are also counted as farms if they can normally be expected to produce products in sufficient quantity to meet the requirements of the definition.

16. Farm Operator. A person who operates a farm, either doing the work himself or directly supervising the work.

17. Farmer-Owned Lands. Lands owned by farm operators. (Note: These exclude land leased by farm operators from nonfarm owners, such as railroad companies and states.)

18. Farmer-Owned Leased. Lands owned by farm operators, but leased to forest industry.

19. Forest Industry Lands. Lands owned by companies or individuals operating wood-using plants.

20. Forest Land. Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparison of basal area and /or number of trees, by age or size and spacing with specified standards. The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet in width.) Also see definitions for land area, commercial forest land, noncommercial forest land, productive-reserved forest land, stocking, unproductive forest land, and water.

21. Forest Trees. Woody plants having a well-developed stem and usually more than 12 feet in height at maturity.

22. Forest Types. A classification of forest land based upon the species forming a plurality of live-tree stocking. (Note: Types shall be determined on the basis of species plurality of all live trees that contribute to stocking; that is, up to a maximum of 16 percent at each plot point.)

23. Gross Growth. Annual increase in net volume of trees in the absence of cutting and mortality.

24. Growing-Stock Trees. Live trees of commercial species qualifying as desirable or acceptable trees. (Note: Excludes rough, rotten, and dead trees.) See Explanation for 10- and 20-class trees under Exhibit #12.

25. Growing-Stock Volume. Net volume in cubic feet of growing stock trees 5.0 inches D.B.H. and over from a 1-foot stump to a minimum 4.0 inch top diameter outside bark of the central stem or to the point where the central stem no longer meets pulpwood specifications.

26. Growth. (See definitions for net growth, gross growth, and ingrowth.)

27. Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.

28. Idle Farmland. Includes former croplands, orchards, improved pastures and farm sites not tended within the past 2 years and presently less than 16.7 percent stocked with trees.

29. Improved Pasture. Land currently improved for grazing by cultivation, seeding, irrigation, or clearing of trees or brush.

30. Indian Lands. Tribal lands held in fee by the Federal Government, but administered for Indian tribal groups, and Indian trust allotments.

31. Industrial Wood. All roundwood products, except fuelwood.

32. Ingrowth. The number or net volume of trees that grow large enough during a specified year to qualify as saplings, pole timber or saw timber.

33. Land Area

a. Bureau of the Census. The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than 1/8 of a statute mile in width; and lakes, reservoirs, and ponds less than 40 acres in area.

b. Forest Survey. The same as the Bureau of the Census, except minimum width of streams, etc. is 120 feet and minimum size of lakes, etc. is 1 acre.

34. Limb. That part of the tree above the stump which does not meet the requirement for saw logs and upper-stem portions, including all live, sound branches to a minimum of 4 inches D.O.B.

35. Log Grades. A classification of logs based on external characteristics as indicators of quality or value.

36. Logging Residues. The unused portions of trees cut or killed by logging.

37. Merchantable. Refers to a pulpwood or saw log section that meets pulpwood or saw log grade specifications, respectively.

38. Miscellaneous Federal Lands. Federal lands other than National Forest, lands administered by the Bureau of Land Management, and Indian lands.

39. Miscellaneous Private Lands. Privately owned lands other than forest-industry and farmer-owned lands.

40. Mortality. Number or sound-wood volume of live trees dying from natural causes during a specified period.

41. National Forest Land. Federal lands which have been legally designated as National Forest or purchase units, and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III lands.

42. Net Annual Growth. The increase in volume of a specified size class for a specific year. (Note: Components of net annual growth include the increment in net volume of trees at the beginning of the specific year surviving to its end plus volume of trees reaching the size class during the year minus the volume of trees that died during the year minus the net volume of trees that became rough or rotten trees during the year.)

43. Net Volume. Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

44. Noncommercial Forest Land. (a) Unproductive forest land incapable of yielding crops of industrial wood, because of adverse site conditions and (b) productive-reserved forest land.

45. Noncommercial Species. Tree species of typically small size, poor form, or inferior quality which normally do not develop into trees suitable for industrial wood products.

46. Nonforest Land. Land that has never supported forests and lands formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1-to-40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide, and more than 1 acre in size, to qualify as nonforest land.)

47. Nonstockable. Areas of forest land not capable of supporting seedlings of commercial species, because of the presence of rock, water, etc.

48. Nonstocked Land. Commercial forest land less than 16.7 percent stocked with growing-stock trees.

49. Old-Growth Sawtimber Stands. Sawtimber stands in which 50 percent or more of the area is occupied by old-growth sawtimber trees.

50. Old-Growth Sawtimber Trees. Trees that are at least 100 years old.

51. Other Federal Lands. Federal lands other than National Forests, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and other Federal agencies.

52. Other Removals. The net volume of growing-stock trees removed from the inventory by cultural operations, such as timber-stand improvements, land clearing, and changes in land use.

53. Overgrown Knot. The scar left in the bark by a limb completely overgrown, but still outlined by the circular configuration in the bark.

54. Overstocked Areas. Areas where growth of trees is significantly reduced by excessive numbers of trees. (Note; Stands will be considered overstocked if stocking is 133 percent or more, when 100 percent represents the minimum level of stocking required to make full use of the site.)

55. Ownership. Property owned by one owner, regardless of the number of parcels in a specified area.

56. Plant Byproducts. Wood products, such as pulp chips, obtained incidental to production of other manufactured products.

57. Plant Residues. Wood materials from manufacturing plants not utilized for some product. (Note: Includes slabs, edgings, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and pulp screenings.)

58. Poletimber Stands. (See stand-size class.)

59. Poletimber Trees. Growing-stock trees of commercial species at least 5.0 inches in D.B.H., but smaller than sawtimber size.

60. Productive-Reserved Forest Land. Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas-tree production as indicated by annual shearing.

61. Prospectively. As used in this manual it refers to the moment a tree will reach sawtimber size at D.B.H.

62. Quality Classes. A classification of sawtimber volumes by log or tree grades..

63. Rangeland. Land on which the natural plant cover is composed principally of native grasses, forbs, or shrubs valuable for forage.

64. Rotation. The period of years between establishment of a stand of timber and the time when it is considered ready for cutting and regeneration.

65. Rotten Trees. Live trees of commercial species that do not contain at least one 12-foot saw log or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, and/or do not meet Regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

66. Rough Trees. (a) Live trees of commercial species that do not contain at least one 12-foot saw log or two noncontiguous saw logs, each 8 feet or longer, now or prospectively, and/or do not meet Regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees of noncommercial species.

67. Roundwood Products. Logs, bolts, or other round sections cut from trees for industrial or consumer uses. (Note: Includes saw logs; veneer logs and bolts; cooperage logs and bolts; pulpwood; fuelwood; piling; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

68. Salvable Dead Trees. Standing or down dead trees that are considered merchantable by Regional standards.

69. Saplings. Live trees 1.0 inch to 5.0 inches in diameter at breast height.

70. Sapling-Seedling Stands. (See stand-size class.)

71. Saw Log. A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter inside bark for softwoods of 6 inches (8 inches for hardwoods) or other combinations of size and defect specified by Regional standards.

72. Saw Log Portion. That part of the bole of sawtimber trees between the stump and the saw log top, being a 9.0 D.O.B. for hardwoods and a 7.0 D.O.B. for softwoods whenever they are present. (Does not refer to sections meeting minimum log grade specifications.)

73. Saw Log Top. The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw log top is 7.0 inches D.O.B. for softwoods and 9.0 inches D.O.B. for hardwoods.

74. Sawtimber Stands. (See stand-size class.)

75. Sawtimber Trees. Live trees of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs, each 8 feet or longer, and meeting Regional specifications for freedom from defect. Softwoods must be at least 9.0 inches in diameter breast height. Hardwoods must be at least 11.0 inches in diameter.

76. Sawtimber Volume. Net volume of the saw log portion of live sawtimber in board feet International 1/4-inch rule.

77. Seedlings. Live trees less than 1.0 inch in diameter at breast height that are expected to survive.

78. Site Classes. A classification of forest land in terms of inherent capacity to grow crops of industrial wood based on fully stocked natural stands.

79. Softwoods. Coniferous trees, usually evergreen having needles or scale-like leaves.

80. Sound Knot or Limb. Knots or limbs intergrown or encased with the surrounding wood and with no indication of decay. Bark may or may not be present on the limbs.

81. Stand-Size Class. A classification of forest land based on the size class of growing-stock trees on the area; that is, sawtimber, poletimber or seedlings and saplings. (Note: Only those trees that contribute to no more than 16 percent stocking at a plot point will be considered in determining stand-size class.)

a. Sawtimber Stands. Stands at least 16.7 percent stocked with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

b. Poletimber Stands. Stands at least 16.7 percent stocked with growing-stock trees of which half or more of this stocking is in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

c. Sapling-Seedling Stands. Stands at least 16.7 percent stocked with growing-stock trees of which more than half of the stocking is saplings and/or seedlings.

82. State, County, and Municipal Lands. Lands owned by states, counties, and local public agencies or municipalities, or lands leased to these governmental units for 50 years or more.

83. Stocking. The degree of occupancy of land by trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard. (Note: Also see stocking explanation in section 21.5 of Forest Survey Handbook.)

84. Timber Removals. The net volume of growing stock trees removed from the inventory by harvesting; cultural operations, such as timber-stand improvement; land clearing; or changes in land use.

85. Timber Products. Roundwood products and plant byproducts. (Note: Timber products output includes roundwood products cut from growing stock on commercial forest land; from other sources, such as cull trees, salvable dead trees, limbs, and saplings; from trees on noncommercial and nonforest lands, and from plant byproducts.)

86. Tree Size Class. A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

87. Unproductive Forest Land. Forest land incapable of producing 20 cubic feet per acre of industrial wood under natural conditions, because of adverse site conditions. (Note: Adverse conditions include sterile soils, dry climate, poor drainage, high elevation, steepness, and rockiness.)

88. Upper Stem Portion. That part of the bole of sawtimber trees above the saw log top to a minimum top diameter of 4.0 inches outside bark or to the point where the central stem breaks into limbs.

89. Urban and Other Areas. Areas within the legal boundaries of cities and towns; suburban areas developed for residential, industrial, or recreational purposes; schoolyards; cemeteries; roads; railroads; airports; beaches; powerlines and other rights-of-way; or other nonforest land not included in any other specified land use class.

90. Water

a. Bureau of the Census. Streams, sloughs, estuaries, and canals more than 1/8 of a statute mile in width; and lakes, reservoirs, and ponds more than 40 acres in area.

b. Forest Survey. The same as the Bureau of the Census, except minimum width of streams, etc. is 120 feet and minimum size of lakes, etc. is 1 acre.