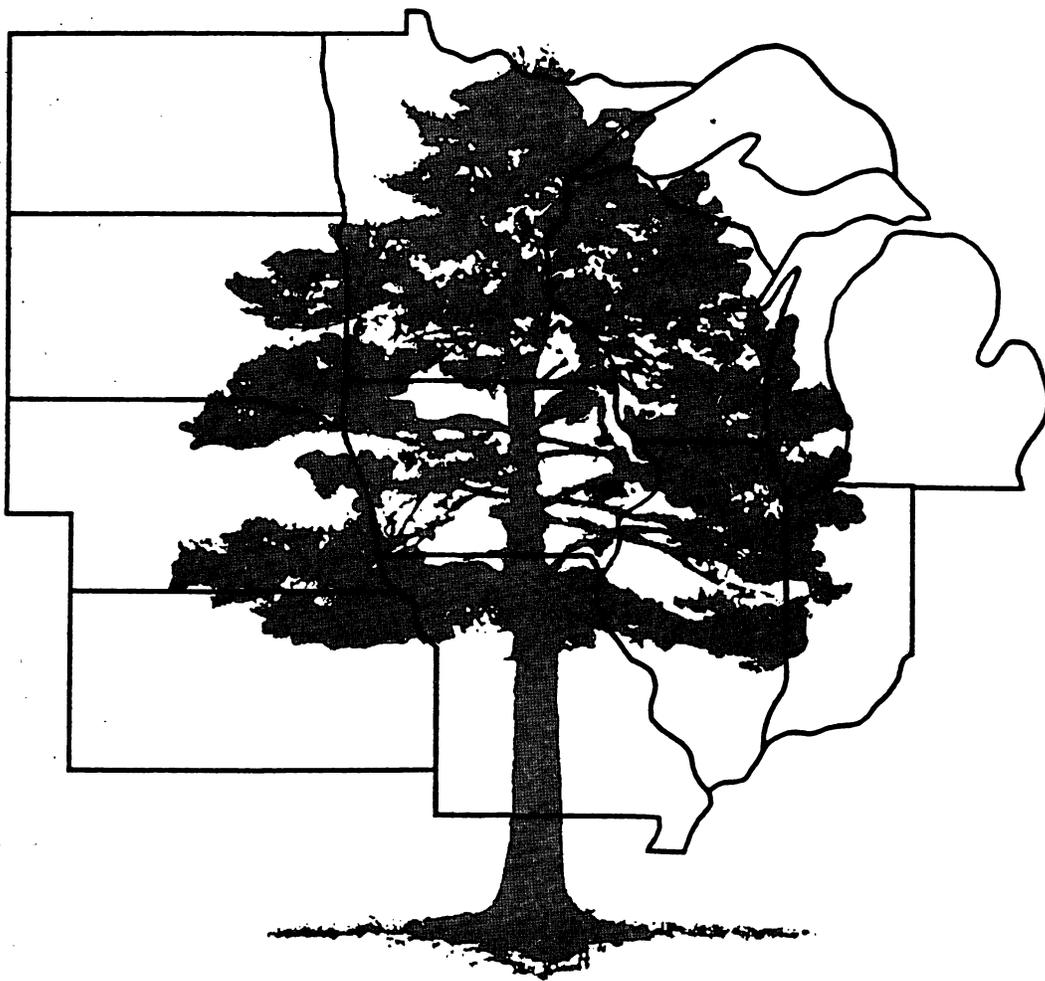


**NORTH CENTRAL REGION
FOREST INVENTORY AND ANALYSIS
FIELD INSTRUCTIONS**



**NORTH CENTRAL FOREST EXPERIMENT STATION
FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE**

NORTH CENTRAL FOREST EXPERIMENT STATION

FOREST INVENTORY AND ANALYSIS

FIELD MANUAL

IOWA, 1989
MINNESOTA, 1989

U.S. Department of Agriculture - Forest Service
North Central Forest Experiment Station

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INTRODUCTION

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

Permanent Forest Inventory plots measured during the previous inventory will be remeasured to obtain information on changes which took place between surveys. Some of these changes will be reflected in land use, growth, and removals. It is therefore important that every plot and every tree tallied previously be accounted for at the time of remeasurement.

Most instructions which apply to a new measurement plot will also hold true for a remeasurement plot. When additional information or explanation is needed, it will appear with instructions for that item but for a remeasurement plot.

Copies of the present and previous survey manuals are available at the Forest Survey Field Office. It may be helpful to consult these manuals if there are questions on procedure or definition changes between the time of the past and present surveys.

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) and chaining pin
- Clinometer (Suunto)
- Photo Holder
- Clip Board (With Tatum Guides and Photo Scales)
- Telescopic Height Pole (30 ft.) - 1 per crew or vehicle
- Wheeler Pentaprism - 1 per crew or vehicle
- Cruiser's Vest
- Tree Marking Scribe
- Tree Paint
- One Yellow Stake
- Ten Metal Pins
- Flagging
- Safety Pin
- Mini-Caliper
- Data Recorder or field plot sheet
- Hip chain

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.

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 pole-timber, 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.

An appropriate 4 digit code (Sequential Plot Number) will be recorded by a photo interpreter to identify consecutive plot numbers in each unit. All plots, both forest and questionable forest, permanent and temporary, office and field, will receive a number. Sequential Plot Numbers will be used to identify sample plots on aerial photographs and county road maps. A plot header sheet must be completed for all plots, forest and non-forest, that are sent to the field.

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.

Information obtained on each sample location will be recorded on a data recorder and a plot header sheet. All measurement categories have an "X" for each digit that must be recorded for that entry. The criteria used to determine these measurements can be found in the appropriate sections of this manual. In addition, commonly used codes can be found on each crew member's clip board under the heading "Tatum Guides".

For Remeasurement Plots

Each remeasurement crew will be equipped with the original plot sheet and aerial photograph, plus a remeasurement plot sheet and new photographs. The first step towards remeasurement is to check the plot sheets and photographs to see that the plot number from the old sheet coincides with the "old plot number" entry on the remeasurement plot sheet.

A check should also be made to see that the plot center is correctly pinpricked on both photos. If the pinpricks are in different locations on the old and new photographs, field inspection will be necessary to ascertain which, if either, of the pinprick locations is correct. If the pinprick on the new photo is grossly incorrect, prick the photo in the correct place, and record the error in the "Notes" section on the plot sheet. Once all photo and plot sheets appear to be in order, the crew can begin location of the plot in the field.

The tallier and cruiser must work together to locate the original trees and then work together adding in new trees in the proper sequence. Each original tree should be checked to see that DBH was measured correctly.

Ownership, Item 1.

Field personnel will visit county court offices to obtain owner's name, ownership class, owner's address, ownership size (commercial forest land only), and length of tenure from tax and ownership records for all plot center locations on private land. USFS land ownership information may be taken from the land status atlas located at the District or Supervisor's offices. Ownership information on public lands (other than USFS) can usually be obtained from local field offices.

Personal contact with the landowner (while gaining permission to trespass) is often the best way to get ownership information on very small tracts of land.

For a remeasurement plot, owner class and tenure will be recorded for any ground land use reclassification that involves removal of timber... i.e., conversion to cropland, pasture, etc.

Ownership Class. - Record the ownership class using the following 2-digit codes:

<u>Code</u>	<u>Owner</u>
11	National Forest
12	Bureau of Land Management
13	Indian
14	Miscellaneous Federal
15	State
16	County & Municipal
2*	Forest Industry (Must process own products)
4*	Farmer
6*	Miscellaneous Private Corporate
7*	Miscellaneous Private Individual

*In ownership class codes 2- through 7- use the second digit to indicate ownership size (commercial forest land only) in the United States by the following codes:

<u>Code</u>	<u>Areas of Commercial Forest Land</u> (round to nearest acre)
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+

(Include ACTUAL number of acres owned for all tracts 5000+ acres in notes section)

Owner Tenure. - Record the two digit code for the length of time that the present owner has owned the property where the plot center is located.

<u>Code</u>	<u>Years Owned</u> (Round to nearest year)
01	1
02	2
03	3
04	4
05	5
.	.
.	.
.	.
.	.
99	99+

Owner tenure is needed only for plots established on commercial forest land. All publicly owned CFL lands will receive an automatic code of 99.

NOTE: Ownership accuracy will be noted on the plot sheet header but not entered in the data recorder for each of these ownership items:

(1) owner name and address (2) owner area class (3) owner tenure, using the following codes:

<u>Code</u>	<u>Definition</u>
1	Unknown - best estimate
2	Poor - courthouse records unclear or someone thought owner was.....
3	Good - verified in courthouse or by owner

Sample Kind, Item 2.

A one digit code recorded by the photo interpreter.

MINNESOTA SAMPLE KINDS

<u>Code</u>	<u>Description</u>
1	<u>Full New Measurement</u> - Take all measurements including merchantable heights. This is a new plot, with no old trees to locate.
2	<u>Full Remeasurement Plot</u> relocate and remeasure all old trees and record new merchantable heights.
6	<u>Partial Remeasurement Plot</u> - relocate and remeasure all old trees, exclude new merchantable heights.
7	<u>Partial New Remeasurement</u> - take all measurements excluding merchantable heights. No old trees to relocate.

SAMPLE KIND REASSIGNMENT -- AUTHORIZED IN FIELD

7	A remeasurement plot where old trees can not be located (a lost plot) and where cutting or other disturbance has not been a factor. Reassign plot to a sample kind 7.
9	Denied access remeasurement plot determined to be undisturbed. Verify and return for processing.

On sample kind 6 and 7, items 34-40, sawlog length through cull cubic feet will not be recorded except log grade should be recorded for sample kind 6's.

IOWA SAMPLE KINDS

<u>Code</u>	<u>Description</u>
1	Full New Plot (volume measurements taken.) Use only if old plot can not be located.
2	Full Remeasurement Plot (volume measurements taken.)
9	Partial Remeasurement Plot (old full measurement plot - only selected items remeasured)

On sample kind 9 plots items 34-40, sawlog length through cull cubic feet will not be recorded.

Sample Kinds - Office use only

5	Reserved Area Plot
---	--------------------

Plot Location, item 3.

Establishment of Base Line. The first step in locating the forest sample location is to draw a straight base 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 two distinct trees. 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 base line.

Next draw the base 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 1/2 degree and record it on the back of the photograph. Disregard magnetic declination.

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 prominent trees, field corners, house corners, etc.

Pinprick the starting point on the aerial photograph on which the sample location is pinpricked. Label and circle 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 DBH and a 3 inch high "SP" near ground level. Discretion should be used in painting trees in well travelled areas, or on private lands.

Describe the starting point on the back of the plot sheet under starting point description.

For remeasurement plots the following procedure should be used:

Using both the old and new photographs, locate the starting point, or S.P. If the S.P. pinprick is missing from the old photo, refer to the starting point description on the old plot sheet and determine the S.P. location according to the azimuth and distance to plot center, P.C. Another aid to S.P. location is checking the sketch of the area on the back of the original plot sheet. Pay close attention to any openings on the photo, such as clearings, roads, woods trails, lakes and streams where the S.P. might logically be located.

Once the S.P. tree is located, it should be inspected to see that it is still suitable according to current guidelines. If the S.P. is still suitable, the cruiser should rescribe, repaint, and remeasure DBH, while the tallier inspects the course to sample location on the plot sheet to see if it seems reasonable. The tallier should then transfer the original course to sample location, S.P. description, and the remeasured DBH to Item 3 on the new plot sheet. On the new photo, pin prick the S.P. and record course to sample location.

In the event that the original S.P. cannot be relocated, or if the S.P. is not suitable, a new starting point should be established. Record the course to sample location, S.P. description, and S.P. DBH on the new plot sheet.

An easy way to establish a new S.P. tree, when needed, is to inspect the vicinity of the original S.P. for a suitable replacement. Measure the distance and azimuth from this new S.P. to the original S.P. Record these figures in the notes, along with the course to sample location from the original S.P. In this way, a new S.P. tree has been established and the original S.P. tree has been established and the original S.P. tree then becomes a turning point in the course to sample location.

In cases where visual plot locations were used, a new S.P. must be established. If the P.C. appears equally well in both the old and new photos, and upon fieldchecking no change has taken place, look in the areas surrounding the photo pinprick to locate P.C. on the ground. Once the plot center is located on the ground, select an S.P. that is suitable and do the necessary azimuth and distance calculations for the proper course to sample location. This can be done before or after the plot work has been completed, depending on circumstances.

If any change has taken place between the original and current photographs, S.P. and P.C. may be difficult to locate. Study both the old and new photos and try to select the area that looks most likely to be the plot location. Look in the "Notes" section of the original plot sheet for any clues that might be helpful. Look for similar areas in which the plot might have been located by mistake.

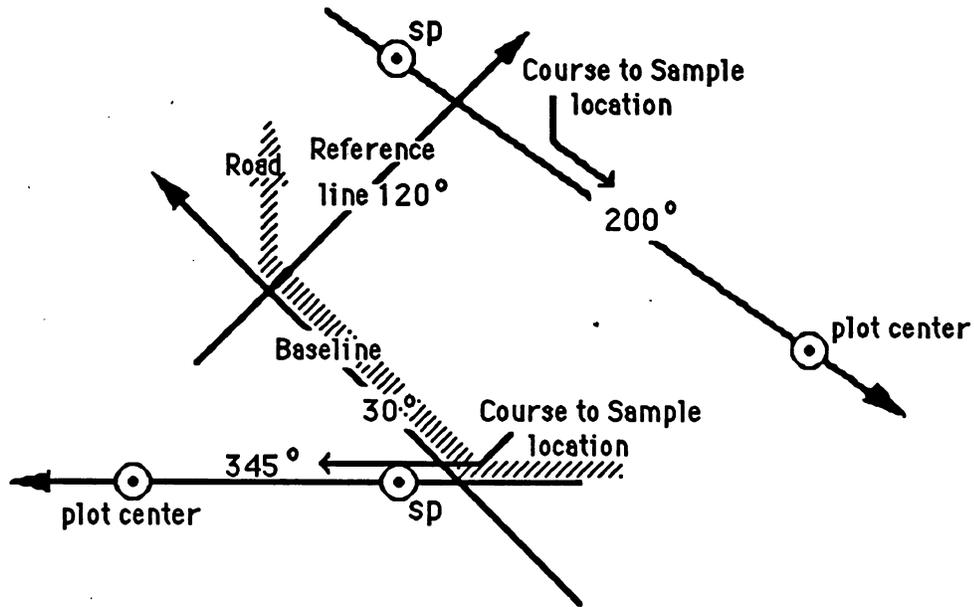
Azimuth and Distance Computation. Draw a straight line on the back of the photograph through the center of the starting point pinprick and the center of the sample location pinprick. Extend this line to intersect the base line. Lines should extend well beyond the intersection to allow reading the backsight off the 360 degree protractor to check the accuracy of the angle being measured.

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

Measure the angle between these lines, starting from the base 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 base line. Once the azimuth of the base 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 east-west azimuths are reversed 180 degrees when working on the back of the photographs. Repeat this procedure if an additional line (reference line) was needed to intersect the course to sample location. To minimize error check the backsights of both base and course to sample location lines. This is a check to see if straight lines have been drawn.

Figure 1.--Azimuth calculations



Measure on the photograph the distance from the starting point to the plot center to the nearest 1/3 of a chain by using a transparent photo scale. Each crew member is supplied with various photo scales which correspond to the scale of the aerial photograph. Record both distance and direction on the back of the photograph and on the back of the plot sheet under Course to Sample Location.

Chaining. Using compass and tape, run a course on the computed azimuth. 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 tallier after the cruiser has run out the line. Making adjustments for differences in the height of crew partners the tallier can sight on the cruiser and directly read the percent scale on the clinometer, using the percent slope and the following table (Table 1). The correct adjustment to whatever length line was run should be added at the same percent slope.

Once the computed course has been run, place a permanent stake at the end of the computed course. Check to make sure that photograph location agrees with ground location.

Table 1.--Slope Correction

Distance is measured on slope.

<u>Percent</u>	<u>66'</u>	<u>70'</u>	<u>99'</u>
10	.3	.3	.5
15	.7	.8	1.1
20	1.3	1.4	2.0
25	2.0	2.2	3.0
30	2.9	3.1	4.4
35	3.9	4.2	5.9
40	5.1	5.4	7.6
45	6.4	6.8	9.6
50	7.8	8.3	11.7
55	9.3	9.9	14.0
60	11.0	11.6	16.5
65	12.7	13.5	19.1
70	14.6	15.5	21.9
75	16.5	17.5	24.7
80	18.5	19.7	27.8
85	20.6	21.9	30.9
90	22.8	24.2	34.2
95	25.0	26.6	37.6
100	27.3	29.0	41.0

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 the course to sample location and remove the first pin. The initial pin is referred to as a turning point. The second pin becomes the location of point one of the 10-point cluster.

Plot Location - Remeasurement: Once the S.P. has been re-established, the crew should chain the computed azimuth and distance along the approach line. Once chaining is completed, the cruiser should mark the location.

Both members of the crew should then begin to search the area for evidence of the old plot. Items to look for are paint on the tree bases (vertical line) and at DBH (horizontal line). Other evidence includes 10" wire pins and bits of flagging at each point, blazed trees, and witness trees (painted with an "X").

In the event that, after chaining the prescribed distance, no evidence of the old plot can be found, several alternatives for locating P.C. are available. These are:

1. If using a newly established S.P., estimate the distance and azimuth from the new S.P. location to the original S.P. location. Find the location of the original S.P., and follow the original course to sample location.

2. Using the original S.P., look for landmarks to discern if the plot is in the area. Look especially for mistaken openings, trails, etc.
3. Search an area of 5 chains around the end of the approach line(s).
4. Return to the S.P., check the photo work, and try rechainning.
5. Check the photo work to see if the original crew chained in the opposite direction.
6. Pick a new S.P., establish a new approach line, and chain in from there.

For remeasurement plots: if after a thorough search you are unable to locate the plot, bring it to the attention of the person in charge. After two crews have tried finding the plot (as long as there has been no disturbance), establish a new sample kind plot at the correct location. Change the sample kind on the plot sheet to a new full measurement if the old plot was a full remeasurement and to a new partial measurement if the old plot was a partial remeasurement and make a note of the sample kind change in the notes. Where there have been major disturbances and the old plots cannot be found (i.e., the area has been clearcut and bulldozed), a remeasurement should be established as close as possible to the old P.C. All new trees will receive a tree history reflecting ongrowth or ingrowth (31, 32, 61 or 62). Original tree data will be transferred to the data recorder and the current data collected to reflect whether the original trees were cut or dead. Tally items needed for these are listed under Missing Trees and Trees cut since Last Survey.

If a remeasurement plot is found to be put in the wrong location (i.e. not in the same location as the photo pinprick), re-establish the plot in the wrong location. If the error is significant (use the black circle as a guide), re-pinprick the new photo where the plot is actually located. In the notes section indicate that the plot was put in a different location and record the distance and azimuth (use photo scale) from the original pinprick on the new photo to the location where the plot is actually located. Turn in plots like these to the person in charge. It should be assumed that the plot is located in the correct location unless evidence of the plot is found in the wrong place (i.e., pins, paint or flagging).

Point Location: When some evidence of the old plot has been found, look for several trees which have been marked at the base and at DBH with white paint. When several of these trees are found in close proximity, examine the original plot sheet and try to match these trees to trees on one of the original points. This matching is accomplished by comparing present tree species, azimuths, distances, and DBH's to the original figures for trees on the original plot sheet.

Once it is determined to which point the trees belong, triangulation may be used to find the point center, most of which were marked with a piece of galvanized or aluminum wire, bent into a loop with a piece of blue flagging tied through it. Triangulation is accomplished by measuring back azimuths and distances from several known trees from the old plot sheet. The intersection of these back azimuths and distances will provide a small area in which to search for the wire marking each respective point center. Not all points were marked in the above manner. If the wire cannot be located, it may be because it was never put in to mark the point. (This is most common

on points that were cover classed, or on which only seedlings occurred). It is then up to the crew to use triangulation to accurately mark the point from which the point measurements were taken.

Once an individual point center has been relocated, it should be remarked in the prescribed manner. The crew should then calculate the proper distance and azimuth to point #1, or plot center, and begin to search for plot center. When P.C. is found, it should be remarked in the prescribed manner. If the distance between P.C. and the end of the approach line exceeds 3% of the chaining distance, a turning point needs to be established. The distance and azimuth from the end of the approach line to P.C. should be recorded on the back of the new photo and on the new plot sheet under course to same location. Remove the blue flagging at the turning point location.

It is highly important that each individual point be located as accurately as possible. Finding each point is a challenge, because most of the flagging disintegrates, the wires rust and appear just like twigs or roots, or the point center was never permanently marked. Therefore, the best method is to run out 70 feet from the last point at the proper azimuth, mark the spot, and search by running your hands through the area. If several trees identifiable from the paint are available, use the triangulation method to relocate the point. If this is not possible, due to lack of trees or other extenuating circumstances, locate several adjacent points, and use these to triangulate to the missing point. The general location of the missing point can then be found, thus reducing the area to be searched. Each point after P.C. should be marked in the prescribed manner.

Ground Land Use, item 4.

Once plot center has been established, carefully examine, select and record the present primary land use classification as determined from ground examination.

For remeasurement plots, it is important to determine what, if any, land use changes have occurred between the previous inventory and the remeasurement. Fill in ground land use as it is at the time of remeasurement.

FOREST LAND: Land not currently developed for nonforest use and having at least 16.7 percent stocking of all live forest trees of any size or formerly having 16.7 percent stocking. Roadside or streamside strips of trees 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 will be classed as forest if less than 120 feet wide. The minimum area for classification of forest land is 1 acre and 120 feet in width. (Also see definitions - especially nonstocked forest land.)

Use one of the following two digit codes:

Code

- 20 Commercial forest land: Forest land that is capable of producing in excess of 20 cubic feet per acre per year of roundwood products, excluding fuelwood, and is not withdrawn from timber utilization by statute, administrative designation, or exclusive use for Christmas tree production. (If land is used for grazing, see codes 21 and 59).

- 21 Pastured commercial forest land: Forest land for which the primary use is wood production, but is used for grazing. (If land is less than 25 percent stocked in growing stock trees, see code 59).
- 22 Plantations: An artificially reforested area sufficiently productive to qualify as commercial forest land, established by planting or by direct seeding. Planted species is not necessarily predominant. For a plantation plot the forest type, stand age, and stand size class should be of the trees planted. If the plantation has failed, give the plot a ground land use of 20. (If land is used for Christmas Tree production, see code 46.)
- 40 Unproductive forest land: Forest land incapable of producing 20 cubic feet per acre per year of roundwood products, excluding fuelwood, because of adverse site conditions. Based on site index under 15 for northern white-cedar, under 20 for black spruce and tamarack, under 25 for eastern redcedar and under 35 for all other species. All commercial species must be unproductive.
- 41 Reserved forest land-unproductive: Forest land withdrawn from timber utilization by a public agency or by law but that is incapable of producing 20 cubic feet per acre per year of roundwood products.
- 45 Reserved forest land-productive: Forest land withdrawn from timber utilization by a public agency or by law and sufficiently productive to produce 20 cubic feet per acre per year of roundwood products.
- 46 Christmas Tree Plantations: Forest land sufficiently productive to qualify as commercial forest land but withdrawn from timber utilization for exclusive use in Christmas tree production. There must be evidence of annual shearing, or other management practices that indicate the exclusive use.

Commercial Forest Locations (Code 20, 21, 22). 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 TALLY ITEMS).

In dealing with plot location, it should be remembered that plot center (as defined by the pinprick on the photo) determines the land use 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 tallier 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.

Noncommercial Forest Locations (Code 40). 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 land. These trees receive a tree history of 99. The

tallier must use judgment when determining whether the unproductive area is over one acre in size; if it is, the area is classified as unproductive. Refer to Site Index for more information.

Noncommercial forest land also includes productive and unproductive forest land withdrawn from commercial timber use, including land used for Christmas tree production (code 41, 45, 46).

For a plot with land use 40, 41, 45, or 46, record the following information on the plot sheet:

Old Plot No./Dot No	National Forest	Stand Origin
State	Ranger District	Stand History
Unit	Ownership Class	Photo Age
County	Owner Tenure	Date
Sample Kind	Ground Land Use	BA/Acre
Stand Area	GLU - reason for change	Forest Type-
Distance to Water	Aspect-Position-Slope	Stand-Size Class
Distance to Road	Physio-class	Stand Age
		Recreational Opportunities

BA/acre, forest type-stand size class and stand age may be estimated. Site index will be recorded or estimated for ground land use codes 40, 41, and 45.

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 non-forest.

NONFOREST LAND. Land currently developed for use other than growing trees; and/or land that has never had 16.7 percent stocking in forest trees 5.0" DBH or larger.

Nonforest with trees (Tree species present in plot area) has at least one or more 5.0 inch trees occurring on plot area.

Code

51 Cropland with trees

52 Improved pasture and rangeland with trees: Land currently improved for grazing by cultivation, seeding, irrigation, or clearing of trees or brush (less than 16.7 percent stocked with all trees). The 16.7 percent stocking is only a guide, and stocking can be greater when the primary land use is grazing and the pasture is maintained at regular intervals. Examples of pasture maintenance are: (1) bush hogged periodically, (2) maximum height of seedlings 3 to 4 feet and basal scars present on trees as evidence of being bush hogged, (3) area periodically treated with herbicides.

53 Wooded strip: An acre or more of continuous forest land that meets the definition of commercial forest land (code 20, 21, 22) except that it is less than 120 feet wide.

- 54 Idle farmland with trees: Farmland that has not been tended within the last two years and is less than 16.7 percent stocked with all trees. Timeline: from 2 years up to the time it reaches 16.7% stocked. **Caution:** Do not confuse this with non-stocked forest land which should have a GLU code 20 and Stand-Size class code 4..
- 55 Marsh with trees: Land that has less than 16.7 percent stocking with live trees; and which characteristically supports low, generally herbaceous or shrubby vegetation and which is intermittently covered with water.
- 56 Narrow windbreaks: A group of trees less than 120 wide feet used for the protection of buildings in use.
- 57* Wide windbreaks: A group of trees greater than 120 feet wide and one acre in size used for the protection of buildings in use. Area would qualify as commercial forest land except that the primary land use is protection of buildings.
- 58 Shelterbelt: A group of trees less than 120 feet wide and used for the protection of soil and cropfields.
- 59* Wooded pasture: Pasture land with more than 16.7 percent stocking in all trees, but less than 25 percent stocking in growing stock (20 class) trees and would qualify as pastured commercial forest land except that the primary land use is grazing. Area is 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 and woody understory. The above should indicate that the primary use of the land is something other than wood production or the protection of buildings. The 25 percent stocking rule will be used to help determine primary land use in fairly homogeneous areas. The 25% rule should be used as a guide in non-homogeneous areas only (i.e. clumps and openings).
- 71 Urban forest land - locationally reserved: Land that would otherwise meet the criteria for commercial forest land, but is in an urban-suburban area surrounded by commercial, industrial, or residential development. (Ex. wooded lot.)
- 72 Urban and other with trees: Areas with trees that are developed for residential, industrial, recreational, or other urban uses. For example city parks, cemeteries, or golf courses. (Ex. yard with trees.)

*A plot will be established for plots with land use 57 and 59, and a plot sheet completed.

For a plot with land use 51-56, 58, 71 and 72 record the following on the plot sheet:

Old Plot No./Dot No	National Forest	Stand Origin
State	Ranger District	Stand History
Unit	Ownership Class	Photo Age
County	Owner Tenure	Date
Sample Kind	Ground Land Use	BA/Acre
Stand Area	GLU - reason for change	Forest Type-
Distance to Water	Aspect-Position-Slope	Stand-Size Class
Distance to Road	Physio-class	Stand Age
		Recreational Opportunities

BA/acre, forest type-stand size class and stand age may be estimated.

Nonforest without Trees. (no tree species present in plot area)

Code

- 61 Cropland without trees. Presently cropped or fallow up to 2 years.
- 62 Improved pasture and rangeland without trees
- 64 Idle farmland without trees: Farmland that has not been tended within the last two years and has no trees.
- 65 Marsh without trees
- 66 Other farmland: Including farmsteads and farm buildings.
- 67 Urban and other areas without trees: Areas without trees that are developed for residential, industrial, recreational, or other use than those covered in other land use codes.
- 68 Rights-of-way: Transportation, utility, and communication rights-of-way. These include railroads, powerlines, pipelines, and maintained roads.
- 69 Nonforest without trees (reserved)
- 80 Noncensus Water: A body of water more than 120 feet wide, and one acre in size, but less than 10 chains wide and 40 acres in size (normal water level).
- 90 Census Water: A body of water greater than 10 chains wide and greater than 40 acres (normal water level).

For a plot with land use 61-69, 80 and 90 record the following on the plot sheet:

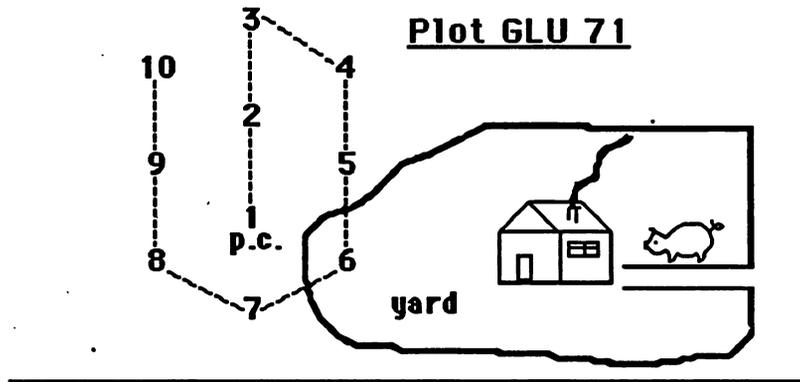
Old Plot No./Dot No.	Ground Land Use	Photo Age
State	GLU - reason for change	Date
Unit	National Forest	*Ownership class
County	Ranger District	*Owner tenure
Sample Kind	Recreational Opportunities	

*NOTE - on remeasurement plots that are reclassified from forest land to nonforest without trees, record ownership class and owner tenure.

The following information is for remeasurement plots with ground land use changes and guidelines for collecting tree data and assigning tree histories to these land use change plots.

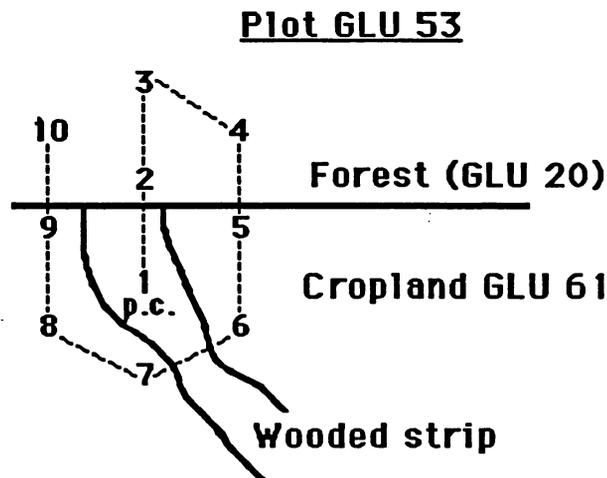
Remeasurement tree data must be taken on all plots except those that were classified as nonforest or noncommercial forest on the previous survey, and remain nonforest or noncommercial forest at the time of remeasurement. If a plot remains nonforest or noncommercial forest, it is treated as a regular non-forest or noncommercial forest plot according to ground land use. If there has been a land use change from noncommercial or nonforest back to commercial forest, a remeasurement plot will be

Example 2.



Assign points 1-5 and 7-10 a tree history of 10 or 20. Assign point 6 a tree history of cut and utilized or cut and not utilized.

Example 3.



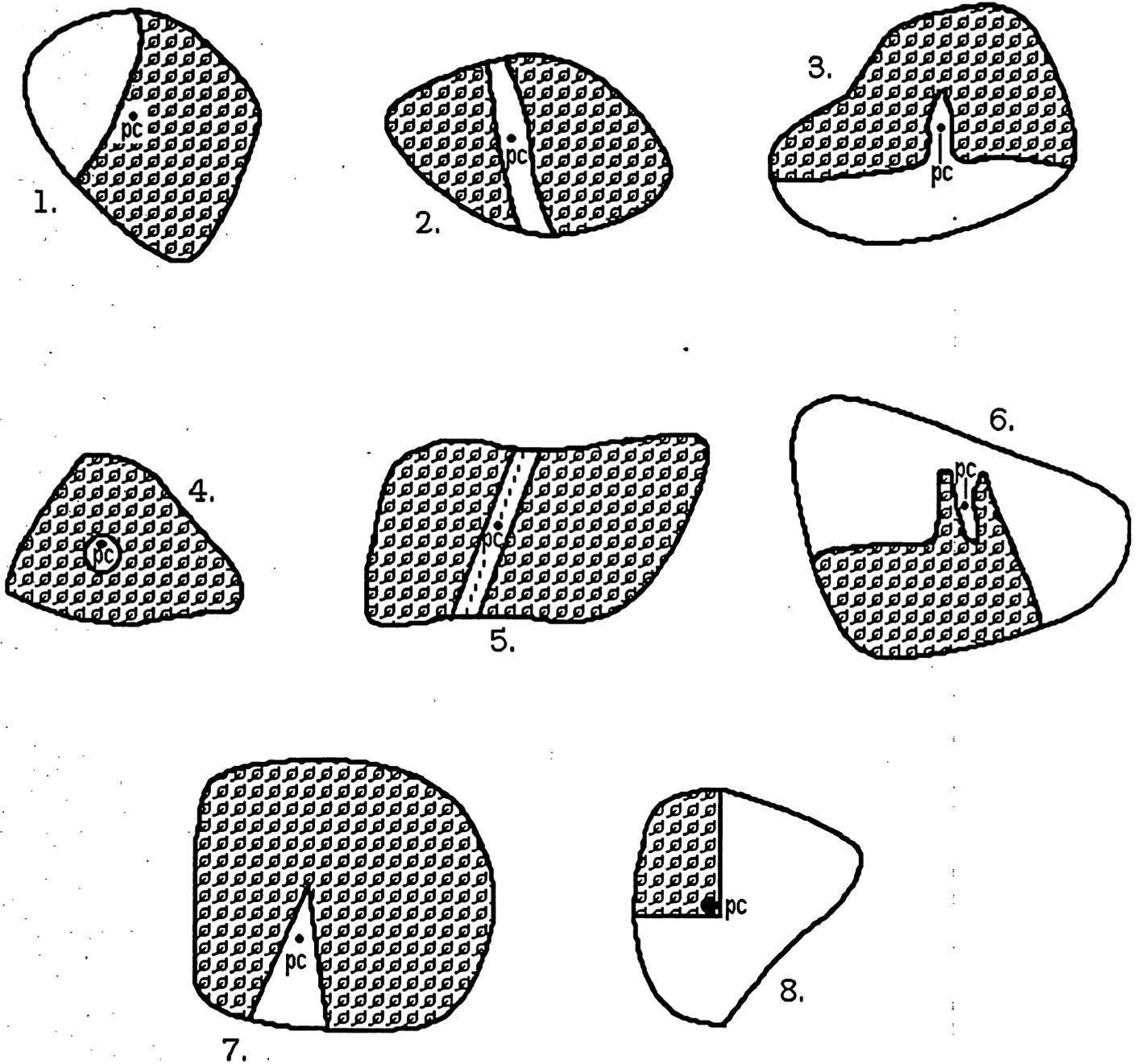
Assign trees on points 1, 2, 3, 4, and 10 a no status tree history (10 or 20). Assign trees on points 5, 6, 7, 8, and 9 a tree history of cut and utilized or cut and not utilized.

The information required for the header is the same for each type of remeasurement plot. Record current estimates of site index, B.A./Acre, Forest Type-Stand, Size Class and Stand Age on a nonforest with trees plot. A nonforest without trees plot requires no current B.A./Acre, Forest Type-Stand Size Class or Stand Age.

The following examples have been included to aid in assigning land use:

Shaded areas represent forest land.

Figure 2.



Explanation of land use classifications found in figure 2.:

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 powerline 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 the reverse manner, if the location of forest and nonforest land is reversed.

Ground Land Use, Reason for change, Item 4 (3 digits).

Record on header sheet original ground land use, current ground land use, and reason for change (if any). If both original and current ground land uses are the same, reason for change will be recorded as "0". If a change in ground land use has occurred, indicate the process that caused the change with one of the codes on the following page.

The following codes were those used at the previous inventory and are listed here only for explanation purposes.

ORIGINAL GROUND LAND USE CODES FOR IOWA AND MINNESOTA

GLU code Iowa (1973)

- 20 Commercial forest land
- 40 Unproductive forest land
- 50 Productive reserved forest land
- 51 Christmas tree production land
- 61 Cropland
- 62 Improved pasture
- 64 Idle farmland
- 65 Marsh
- 66 Other farmland, including farmstead
- 67 Urban and other
- 68 Windbreaks
- 69 Wooded pasture
- 80 Noncensus water
- 90 Census water

GLU code Minnesota (1977)

- 20 Commercial forest land
- 21 Pastured commercial forest land
- 40 Unproductive forest land
- 45 Productive reserved forest land
- 46 Christmas tree production land
- 51 Cropland with trees
- 52 Improved pasture with trees
- 53 Wooded strip
- 54 Idle farmland with trees
- 58 Windbreak
- 59 Wooded pasture
- 61 Cropland without trees
- 62 Improved pasture without trees
- 64 Idle farmland without trees
- 65 Marsh
- 66 Other farmland
- 67 Urban and other
- 80 Noncensus water
- 90 Census water

GROUND LAND USE REASON FOR CHANGE:

Code Reason that caused the land use change

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

Aspect, Position, Slope, Slope Shape, and Slope Distance, Item 6

Slope Info: Items should tie together; complement each other. Record the macro features only.

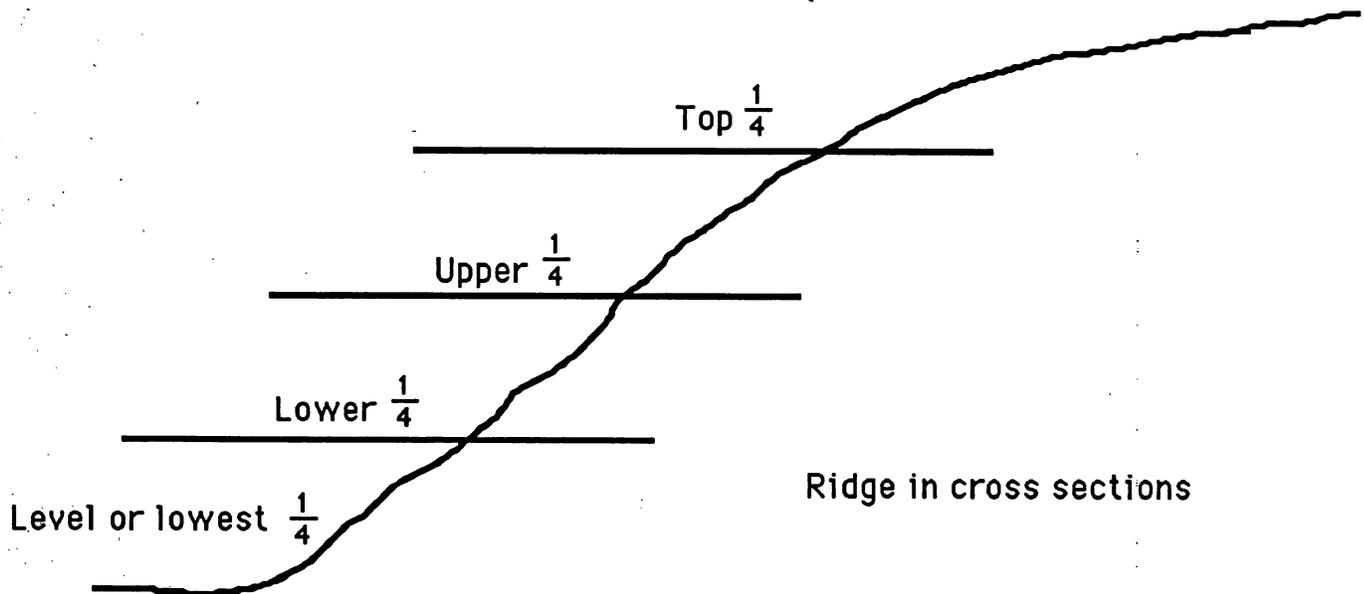
Items should be taken in the following order of collection: 1) Position; 2) Aspect; 3) Slope; 4) Slope length; 5) Slope shape.

Record the appropriate codes in the header information.

Position (1 digit)-represents the location of the majority of the points in reference to topography of the immediate area. (See figure 3)

<u>Code</u>	<u>Position</u>
1	Top 1/4
2	Upper 1/4
3	Lower 1/4
4	Level or lowest 1/4

Figure 3.



Aspect (3 digits)-represents the direction of drainage for the majority of the sample points, and is recorded as the azimuth of this direction. For instance, if the direction of drainage is 36 , the code is 036. Direction due North will be recorded as 001.

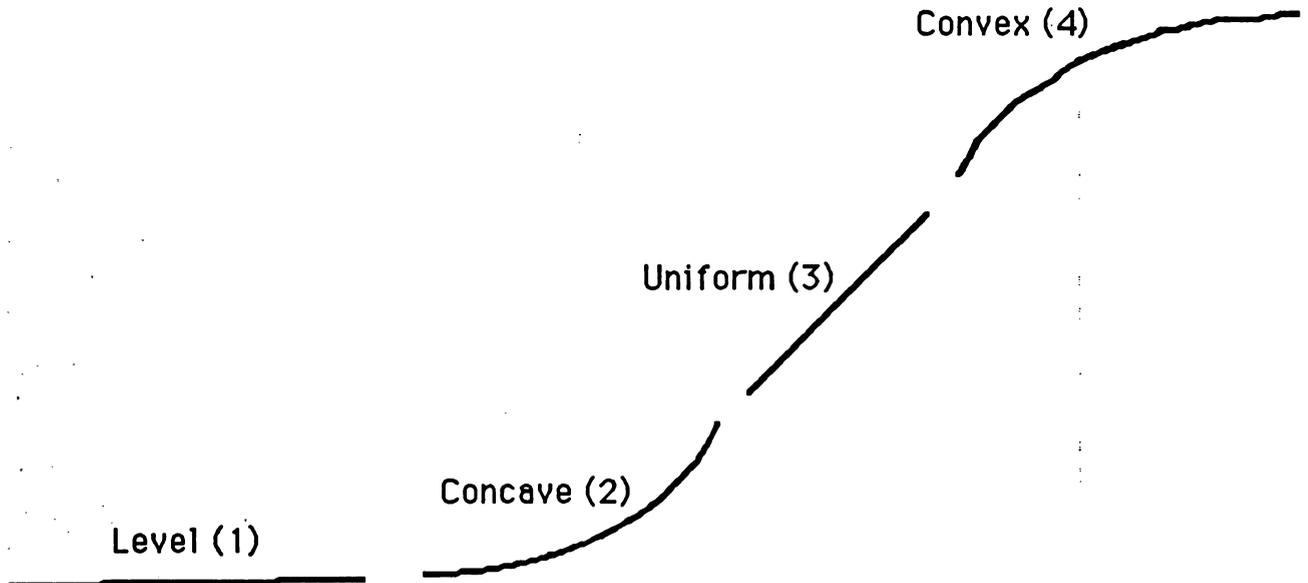
Slope (2 digits)-represents the average percentage of the deviation from horizontal over the entire 10 sample points. Recorded code will be a measure of this percentage. For instance, 35% slope is recorded as 35. All slope percentages 100+% will receive a code 99.

Slope length (4 digits) - At plot center or on the slope where the majority of the points fall, look up and down the slope and estimate total slope length to the nearest 1/2 chain (from 0000 to 999.5 chains). Slope length is measured to record the distance from the point where water starts to flow down slope (upper slope - ridge top) to the point where runoff enters a well defined channel, or at the bottom of the slope where deposition begins. For flatland and bottomland, record slope length as 0000.

Slope shape (1 digit)-represents the location of Point 1 of the majority of the points in reference to slope shape. A convex shape is usually found on the upper part of a slope and indicates an area with potential erodibility and rapid runoff. A concave shape is found on the lower part of the slope profile and has good water holding capacity for a slope.

<u>Code</u>	<u>Slope Shape</u>
1	Level
2	Concave
3	Uniform
4	Convex

Figure 4. --Slope shape



Physiographic Class, Item 7.

Physiographic class is a measure of soil and water conditions that affect tree growth on the majority of the points. Record the appropriate code.

Code Physiographic Class

- 3 Xeric sites. Very dry soils where excessive drainage seriously limits both growth and species occurrence. Example: sandy jack pine plains.
- 4 Xeromesic sites. Moderately dry soils where excessive drainage limits growth and species occurrence to some extent. Examples: dry oak ridges and the red pine-jack pine associations on sandy and gravelly soils.
- 5 Mesic sites. Deep well drained soils. Soil and water relationship most favorable to management opportunities. Growth and species occurrence limited only by climate.
- 6 Hydromesic sites. Moderately wet soils where insufficient drainage or frequent flooding limit growth and species occurrence to some extent. Example: better drained bottomland hardwood sites.
- 7 Hydric sites. Very wet sites where excess water seriously limits both growth and species occurrence. Examples: wet, frequently flooded river bottoms and spruce bogs.

Stand Origin, Item 8.

Record the stand origin of the sample area using the following 1 digit codes. Consider only trees in the predominant stand-size class of the area.

Code Stand Origin

- 1 Natural stand with no evidence of artificial regeneration.
- 2 40 percent or more of the trees originating from artificial regeneration.
- 3 Less than 40 percent of the trees originating from artificial regeneration.

Stand History, Item 9.

Stand history reflects the kind of disturbance on 5 or more of the sample points within the last 20 years.

For remeasurement plots, this code should reflect any changes since the last inventory. Stand history cannot exceed the remeasurement period.

Explain the kind and extent of any disturbance in the "Notes" on the back of the plot sheet. Use the following 2-digit code to record stand history:

First digit (what happened)

Code Occurrence

- 0 No Disturbance: No evidence to indicate any of the following:
- 1 Grazing: Significant disturbance has been caused by livestock grazing. Evidence of livestock grazing would include: the absence of an understory, exposed tree roots and mineral soil, dead standing timber, severe erosion and cow patties (fecal evidence of bovine habitation).
- 2 Timber Stand Improvement: There is evidence that some trees have been deadened or removed (or vines cut) through some type of pre-commercial thinning, pruning, or selective firewood harvest.
- 3 Commercial Clear Cut: All merchantable stems, or stems down to some minimum diameter have been removed. Some large diameter cull-trees may have been left, but in general all merchantable material has been removed.
- 4 Partial Harvest Cut: Less than 50% of merchantable stems have been removed. Usually only large diameter, old, or otherwise high value stems are removed in this type of cut.
- 5 Natural: Significant disturbance has been caused by fire, wind, insect or disease agents.
- 6 Man-Caused: Significant disturbance has resulted directly or indirectly as a result of human activities (e.g., alteration of natural drainage, chemical spraying, salt damage from oil wells, or acid water run off, etc.
- 7 Planting of Forest Land:
- 8 Planting of Non-Forestland: Areas that were once old field sites, reclaimed strip mines, pasture, or crop land that were planted to commercial tree species (usually about 300 trees per acre).
- 9 Natural Regeneration of Non-Forestland: Areas that are reverting to forest vegetation. This would include old field sites.

Second digit (how long ago)

Code Time

- 0 No disturbance
- 1 1-4 years
- 2 5-10 years
- 3 11-15 years
- 4 16-20 years

Seed Source. Item 10.

Select and record a 1-digit code that represents the prospects for natural regeneration of commercial species. Seed source is adequate for a plot when one or more of the following conditions exist on 5 or more points:

- A. There is a tree of commercial species that is capable of producing seed within the distance of a point not exceeding the total height of that tree.
- B. Natural seedlings are present within the 16.6 foot fixed-radius plot.
- C. Hardwoods are expected to have sprouts within the 16.6 foot fixed-radius plot.

Code Seed Source

- 1 Adequate softwood
- 2 Adequate hardwood
- 3 Adequate softwood and hardwood
- 4 Inadequate, all species

Conifer Understory. Item 11 (4 digits).

First digit-identifies the condition of the coniferous understory within the plot area.

Code Condition

- 1 No conifers or inadequate conifer stocking for future stands.
- 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.

Second, Third, and Fourth Digits-identify the predominant softwood species present in the understory using regular species codes. For example, 4012 would indicate an understory of Balsam Fir that should succeed when the present stand is harvested. Code 1000 indicates no conifer understory.

In order for a stand to be adequately stocked, conifers must be present on at least five sample points.

Photo Age. Item 12.

Photo age represents the number of growing seasons between the photo date and the date the fieldwork is completed. July 1st will be considered the last day of a growing season. Minimum photo age is one growing season. Record a 1-digit code.

Code Photo Age

1	1	growing season or less
2	2	growing seasons
3	3	growing seasons
4	4	growing seasons
5	5	growing seasons
6	6	growing seasons
7	7	growing seasons
8	8	growing seasons
9	9	or more growing seasons

Example: If you are taking a plot on 1-23-89, and your photos are dated 6-01-84, the photo age would be 5 years. The '84, '85, '86, '87, and '88 growing seasons are included, but not '89.

Date of Survey, Item 13.

Record a 4-digit code to show the month and year in which the plot is measured, using the following codes:

First two digits

Second two digits

Code Month

Code Year

01	January
02	February
03	March
04	April
05	May
06	June
07	July
08	August
09	September
10	October
11	November
12	December

86	1986
87	1987
88	1988
89	1989
90	1990
91	1991
92	1992
93	1993
94	1994
95	1995
96	1996
97	1997

Example: A plot completed in June, 1987 would be coded 0687.

Recreational Opportunities, item 14

A 3 digit code will be used to describe the physical setting of recreational opportunities on forest and nonforest plots.

Setting (one digit) - Field crews should determine the setting of the immediate plot area in relation to the surrounding natural environment.

Code Setting

- 1 Primitive. An area 3 or more miles from all maintained roads or railroads and which has an unmodified natural environment. There can be evidence of foot trails, or recreational use. Structures in use are rare. Contact with humans is rare and chances of seeing wildlife are good. Example: Boundary Waters Canoe Area, Minnesota.
- 2 Semi-Primitive Nonmotorized. An area 1/2 to 3 miles from all maintained roads or railroads, but which can be close to primitive roads or trails used only occasionally. Modifications to the environment are evident, such as old stumps from logging, but are not apparent to the casual observer. Structures in use are rare. Human contact is low and chances of seeing wildlife are good. Example: Recently undisturbed State lands.
- 3 Semi-Primitive Motorized. An area 1/2 to 3 miles from all maintained roads or railroads, but 1/2 mile or less from primitive roads or trails used by motorized vehicles. Modifications to the environment, human contact and chances of seeing wildlife are the same as code 2. Example: State lands with snowmobile trails.
- 4 Roaded Natural. An area less than 1/2 mile from maintained roads or railroads. Modifications to the environment may be obvious, and buildings are occasionally seen. Chances of seeing wildlife are diminished by evidence of increased human contact. Example: Private hunting lands.
- 5 Rural. An area close to maintained roads, but not limited by distance, and in a setting which has been substantially altered by man. Structures and houses are obvious and/or visible, and human contact is frequent. Wildlife can be present, but sightings are rare. Example: Farm woodlot.
- 6 Urban. An area close to maintained roads, but not limited by distance and surrounded by an urban-suburban setting. Substantial modifications to the environment may be apparent and buildings or structures can usually be seen. Human contact is quite frequent and wildlife sightings are rare. Example: Home Development areas.

Size of area (one digit) Photo interpreters will record and field crews should check the size of area used for determining the setting class of recreational opportunities, by recording one of the following codes:

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

Posting (one digit) For each property containing a forest sample plot record a 1-digit code to indicate whether the property is posted or restricted from public use. Record the most significant evidence.

<u>Code</u>	<u>Evidence</u>
0	None
1	Locked gate
2	Keep out
3	No trespassing
4	No hunting
5	No fishing
6	No dumping
7	Other posted signs
8	Owner contact
9	Other evidence

All denied access plots should have a posting code other than 0. Personal contact with the Landowner and his refusal to grant permission to go on his land is the only way a plot can be called a denied access plot.

Plot Design. Item 16.

The pattern of sample points is designed to obtain a uniform distribution of points over approximately 1 acre. Measured distances between sequential points is 70 horizontal feet.

Figure 5.

<u>From Point</u>	<u>to Point</u>	<u>Azimuth</u>
1	2	0°
2	3	0
3	4	120
4	5	180
5	6	180
6	7	240
7	8	300
8	9	0
9	10	0

After point one has been established the other nine points should be located and marked with metal pins and flagging. The entire 10 points should be restricted to the same land use as shown in the preceding tabulation. (Three exceptions to this are: between GLU 20-21, GLU 20-22, and GLU21-22. See figure 7a on page 32 for clarification.)

Point Class Record, Point Type/Size (Assigned tree number 40). A point class record for each point 1 through 10 will be recorded. If the forest type and/or stand size class for the point is noticeably different than the general type/size for the plot, as evidenced by a noticeable type and/or size change while traversing the plot, record this in item 27, Damage/Death of the #40 tree. The point forest type must meet minimum area classification requirements of 1-acre and 120 feet in width to qualify as a separate type. Looking at the plot location on the air photo can also help to determine if type and size are different on some of the points.

Record forest type in the first 2 digits and stand size in the 3rd. The point class record line (tree #40) should also be used to record cover class if no live trees are recorded on the point. Record cover classes in Item 28 (Tree/Cover class column) of the #40 tree. Basal area tree count will also be recorded under item 20 (Basal Area column) of the #40 tree. If a different forest type does occur on the plot, sketch the location on the plot layout on the plot header sheet.

Shifted Points. If point one or any other of the 9 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. Such changes should be recorded in the "Notes" section.

Substitute Points. If any of the points 2 through 10 falls on land with a different land use than the major land use recorded for the plot, a regular point will not be established, provided the different land use is 120 feet wide and an acre in size. Instead, a substitute point must be established so that all ten points are in the same land use. (Three exceptions to this are: between GLU 20-21, GLU 20-22, and GLU 21-22. See figure 7a on page 32 for clarification.)

After establishing all possible regular points, use the following procedures to search for a suitable location where a point has not already been established and that has the same land use as the land use recorded for the plot.

Procedure 1: Consider locations 70 feet horizontal distance from the highest numbered established regular point. First consider the location 0 azimuth from the point. If this location is unsuitable, consider in turn locations at azimuth 60 , 120 , 180 , 240 , and 300 . When a suitable location has been found, establish the lowest numbered substitute point.

Procedure 2: If procedure 1 fails to yield a suitable point, repeat procedure 1 at each of the next highest numbered regular points in turn.

Procedure 3: If procedures 1 and 2 have been exhausted and a suitable point still has not been found, repeat procedure 1 at each substitute (rotated) point in turn beginning with the lowest numbered point.

Note: The general rule for substituting a point is: 1) Rotate the lowest point to be rotated off the highest established point, until exhausted; 2) Then, rotate the lowest point yet to be rotated off the lowest already established rotated point (lowest off highest - then lowest off lowest). See figure 7, page 31 for an example.

If more than one point is to be substituted, repeat procedures 1 and 2 to establish the second lowest numbered substitute point next, and continue in order until all points to be substituted are established.

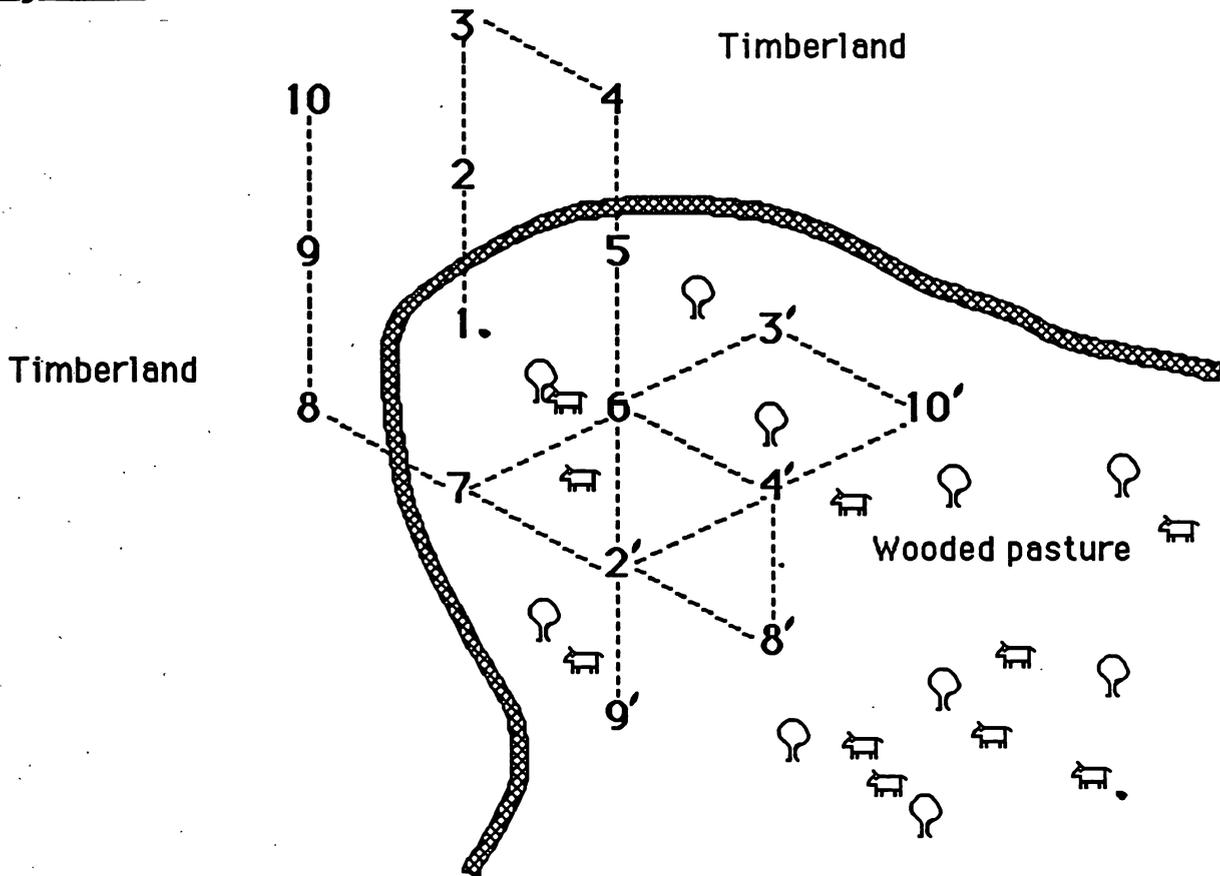
When a substitute point is used, show its location in the "Notes" section on the back of the plot sheet, and on the sketch.

For remeasurement plot points on the previous survey that were placed on commercial forest land that are presently nonforest or noncommercial forest land, all trees 1.0" DBH or larger that were on the last survey must be accounted for. Assign these trees a tree history code of 10, 20, 17, 18, 19, 27, 28, 29, 48, or 59 according to the same guidelines as on page 7, item 23, and transfer the original information to the data recorder, item numbers 16, 21, 22, 23, and 25 originals. Trees tallied as dead last survey should be accounted for if they are still standing or have been cut. Assign these trees a tree history code of 40, 50, 48, or 59, and transfer original information to the data recorder, item numbers 16, 21, 22, 23, and 25 originals. Then, the crew must rotate the point. This new substitute point is then measured according to remeasurement standards, and all trees tallied on the substitute point will receive a tree history reflecting ongrowth or ingrowth (code 31, 25, 32, 34, 61, 62, 64 or 65). Continue the tree numbers on the substitute point where they left off on the original point.

For points that were rotated out or nonforest or noncommercial forest which has since turned to commercial forest land, remeasure the substitute point.

Following are examples of substitute points:

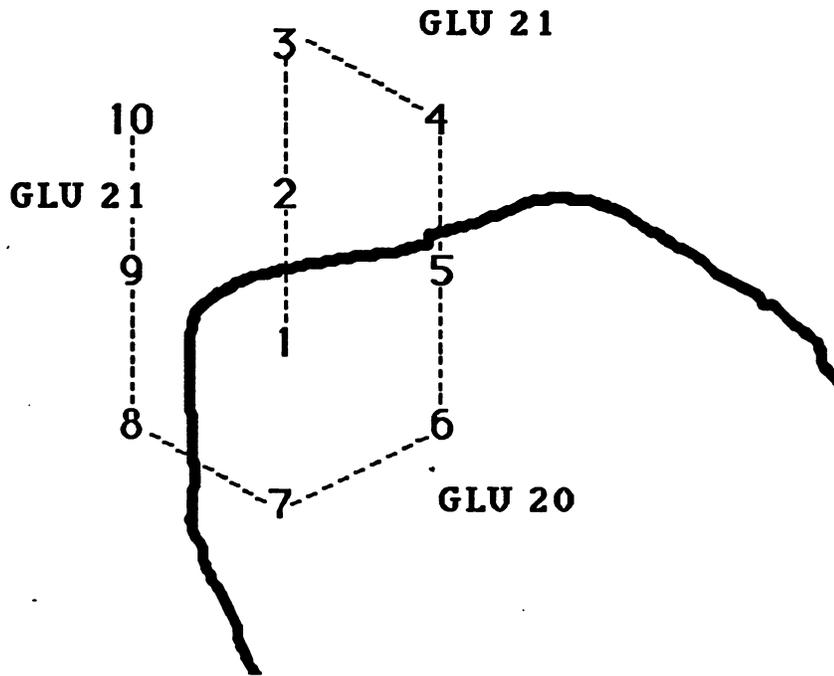
Figure 7.



In the second example, points 2, 3, 4, 8, 9, and 10 fell in a different land use than the land use recorded for the plot. Point 7 was the highest numbered established regular point. The lowest substitute point, substitute point 2, was established from point 7. No other location 70 feet horizontal distance from point 7 was suitable, so the search for suitable locations moved to point 6, the next highest numbered established regular point. Substitute points 3 and 4 were established in order from point 6 since they were the next lowest numbered points to be substituted. No other suitable locations were found 70 feet from established regular points, so the search moves to the lowest numbered substitute point, point 2. Substitute points 8 and 9 were established in order at the two suitable points found 70 feet from substitute point 2. The remaining substitute point, point 10, was established at the first suitable location 70 feet from the next lowest numbered established substitute point, point 3.

Figure 7a.

In this example, no substitute points are needed, since both Ground Land Uses are considered commercial forest land. Show any changes in ground land use on the cluster diagram located on your plot sheet.



Witness Point. Reference point one (or any other point within 70 feet) with three or more witness trees if possible. Witness trees should have the following characteristics:

1. Located within 100 feet of the witness point.
2. Not likely to die or be cut before the next survey.
3. Species easily located in the stand.
4. At least 5.0" DBH (at least 2.0" DBH if no 5.0"+ DBH available)

Points 3, 4, or 10 can be used as witness points when none of the other points have acceptable witness trees.

Record the point number of the witness point in the "Notes" section and the following witness tree data on the back of the tally sheet under witness trees:

- 1) species
- 2) DBH
- 3) Azimuth
- 4) slope distance (to nearest 1/10th foot from witness point center to the center of the tree at the base).

Mark each witness tree above DBH and at the base with a scribed and painted "X" on the side of the tree facing the witness point.

All established plots will be witnessed.

Rocks or other permanent features may be witnessed when acceptable witness trees are absent (write the description, distances, etc. in the "Notes" section on the back of the tally sheet).

For remeasurement plots, the witness trees established on the last survey must be located and inspected. Remeasure and rescribe at DBH and the base if they are still suitable witness trees. If the witness trees are missing or in poor shape (not expected to live until the next survey), select new witness trees.

Point Reference. On many plots, certain points within the ten point cluster design have no information that would enable remeasurement crews to determine their location on future surveys. Examples of this are: cover classed points, points where only seedlings are tallied.

All established points with no data that could be used to re-establish a point location (i.e. no azimuths or distances to any tree) must be referenced. Reference trees will be marked above DBH and at the base with a scribe mark and painted on the side of the tree facing the point. Cruisers will notify tallier how the tree is being painted. A general rule is to paint the tree with a number corresponding to the point being referenced.

Criteria for choosing a reference is the same as in the preceding discussion on "Witness Point". However, if those conditions cannot be met, a dominant seedling (or any group of seedlings) can be used.

Record the Point Number and Azimuth, distance and d.b.h. to the reference in the reference tree section on the plot header sheet.

TALLY ITEMS

Biomass Study (Shrubs), Item 17.

The following information is recorded for points 1, 2, and 3 in the NE quadrant, 0 to 90 , of the 6.8 foot fixed radius plot:

1. Point Number 1, 2, or 3
2. Tree number starting at 51 and increasing for each point. Each species diameter class will have a tree number.
3. Species. (See list).
4. Tree history 80-tall, woody perennials or 81-other perennials. Tree history codes of 80 and 81 are used only for the biomass study.
5. Diameter (use the following codes in the DBH column)

Tree History 80

<u>Code</u>	<u>Diameter measured along stem 6" from ground</u>
001*	0.0- .19"
002	.2- .29"
003	.3- .39"
004	.4- 49"
005	.5- .99"
010	1.0- 1.49"
015	1.5- 1.99"
020	2.0- 2.49"
025, 030,etc.	1/2" diameter classes continue

Tree History 81

<u>Code</u>	<u>% ground cover</u>
001	solitary plant, less than 1%
002	1-10%
003	11-20%
004	21-40%
005	41-70%
006	More than 70%

*also used on any woody stemmed shrub or tree less than 6" tall.

Azimuth column - enter the number of stems present in each size class for tree history 80. This column is left blank for tree history 81.

Note: Only seedlings may be recorded twice, once on the Biomass Study (with a number of 51+) and also on the 6.8 foot fixed radius plot if there are no trees 5.0" DBH on the point. Any tree 1.0" DBH or larger on the point will not be recorded in the Biomass Study.

Iowa Biomass List (Shrubs), Item 17.

(Includes all commercial and noncommercial tree species and appropriate codes (see Item 22.) Record biomass data on sample kind 1's and 2's)

<u>Code</u>	<u>Tree History</u>	<u>Common Name</u>	<u>Scientific Name</u>
490*	80	Dogwood	<i>Cornus spp.</i>
712	81	Virginia creeper	<i>Parthenocissus spp.</i>
855	80	Serviceberry, Juneberry	<i>Amelanchier spp.</i>
856*	80	Hazelnut	<i>Corylus spp.</i>
857	80	Prickly ash	<i>Xanthoxylum americanum</i>
859	80	Buckthorn, Indian cherry	<i>Rhamnus spp.</i>
862*	80	Viburnum, Nannyberry	<i>Viburnum spp.</i>
863	80	Elderberry	<i>Sambucus spp.</i>
864*	80	Sumac	<i>Rhus spp.</i>
865	81	Gooseberry, Black currant	<i>Ribes spp.</i>
867*	81	Blackberry, Dewberry, Raspberry	<i>Rubus spp.</i>
876*	81	Honeysuckle	<i>Lonicera spp.</i>
881*	81	Multiflora rose	<i>Rosa multiflora</i>
902	81	Poison ivy	<i>Rhus radicans</i>
920	80	Willow	<i>Salix spp.</i>
932*	81	Greenbrier	<i>Smilax spp.</i>
982*	81	Grape	<i>Vitis spp.</i>
997	80	Other species	(Tall, woody perennials)
998	81	Other species	(Other perennials)

* indicates species of particular value to wildlife biologists

Minnesota Biomass List (Shrubs), Item 17.

(Includes all commercial and noncommercial tree species and appropriate codes (see Item 22.) Record shrub data on remeasurement plots only.)

<u>Code</u>	<u>Tree History</u>	<u>Common Name</u>	<u>Scientific Name</u>
230	81	Yew	<i>Taxus canadensis</i>
356	80	Alder species	<i>Alnus spp.</i>
380	80	Bog birch	<i>Betula pumila</i>
492	80	Red osier dogwood	<i>Cornus stolonifera</i>
493	80	Alternate-leafed dogwood	<i>Cornus alternifolia</i>
494	81	Bunchberry	<i>Cornus canadensis</i>
500	80	Hawthorn	<i>Crataegus spp.</i>
712	81	Virginia creeper	<i>Parthenocissus spp.</i>
749	81	Labrador tea	<i>Ledum groenlandicum</i>
750	81	Leatherleaf	<i>Chamaedaphne calyculata</i>
751	81	Bog laurel	<i>Kalmia polifolia</i>
849	81	Sweetfern	<i>Comptonia peregrina</i>
853	80	Witch hazel	<i>Hamamelis virginiana</i>
854	80	Common ninebark	<i>Physocarpus opulifolius</i>
855	80	Juneberry	<i>Amelanchier spp.</i>
856	80	Beaked hazel	<i>Corylus cornuta</i>
857	80	Prickly ash	<i>Xanthoxylum americanum</i>
858	80	American hazel	<i>Corylus americana</i>
859	80	Buckthorn species	<i>Rhamnus spp.</i>
861	80	Leatherwood	<i>Dirca palustris</i>
862	80	Viburnum, Nannyberry	<i>Viburnum spp.</i>
863	80	Elderberry	<i>Sambucus spp.</i>
864	80	Sumac	<i>Rhus spp.</i>
865	81	Gooseberry-currant	<i>Ribes spp.</i>
867	81	Raspberry-Blackberry	<i>Rubus spp.</i>
868	81	Rose	<i>Rosa spp.</i>
870	80	American bladdernut	<i>Staphylea trifolia</i>
874	81	Blueberry, Bilberry	<i>Vaccinium spp.</i>

Minnesota Biomass List (Shrubs), continued

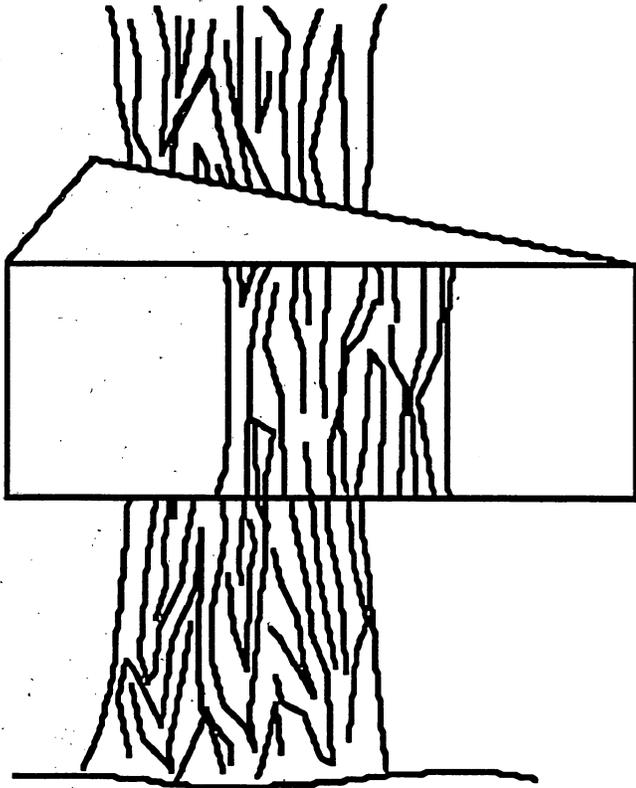
<u>Code</u>	<u>Tree History</u>	<u>Common Name</u>	<u>Scientific Name</u>
875	81	Bush honeysuckle	<i>Diervilla lonicera</i>
876	81	Honeysuckle	<i>Lonicera spp.</i>
880	80	Buffaloberry	<i>Shepherdia spp.</i>
902	81	Poison ivy	<i>Rhus radicans</i>
907	80	New Jersey tea	<i>Ceanothus americanus</i>
913	80	Russian or Autumn olive	<i>Eleagnus spp.</i>
932	81	Greenbrier	<i>Smilax spp.</i>
978	81	Bog rosemary	<i>Andromeda glaucophylla</i>
979	80	Willow species (clumped)	<i>Salix spp.</i>
980	80	Willow species (single stemmed)	<i>Salix spp.</i>
982	81	Grape	<i>Vitis spp.</i>
984	81	Strawberry	<i>Fragaria spp.</i>
997	80	Other species	(Tall, woody perennials)
998	81	Other species	(Other perennials)

Variable Radius Plot, Item 18.

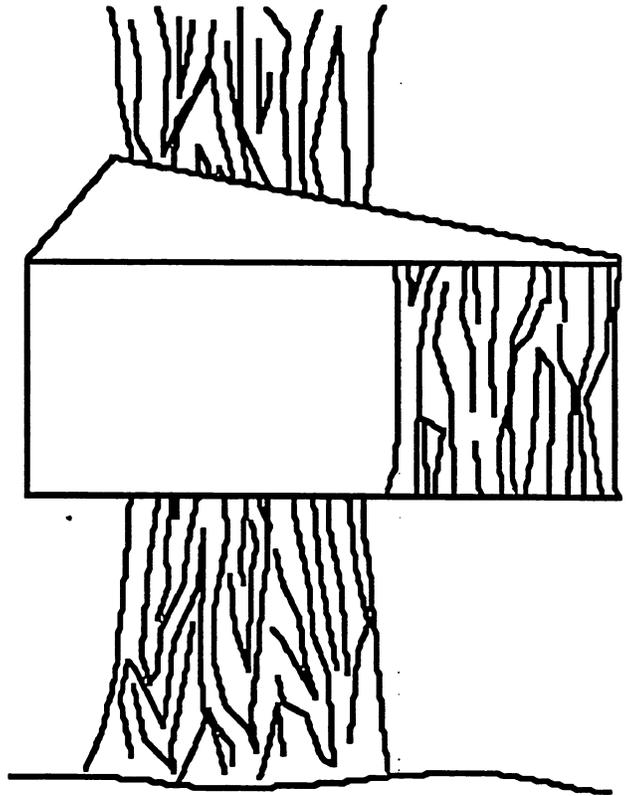
All trees 5.0" DBH and larger (except dead trees not qualifying as mortality or salvable-mortality) will be tallied if the tree is within the limiting distance of the 37.5 basal area factor prism. Figure 8 illustrates trees that are within the variable plot, outside the variable plot, and those that are questionable. Questionable trees will be checked for their limiting distance. The limiting distance is the horizontal distance from the pin to the center of the tree at DBH. For example, a tree with a DBH of 14.6", is 20.7 feet, using a basal area factor of 37.5. Table 2 shows the limiting distances for the 37.5 basal area factor prism.

Figure 8.

Within the variable plot



Outside the variable plot



Questionable tree

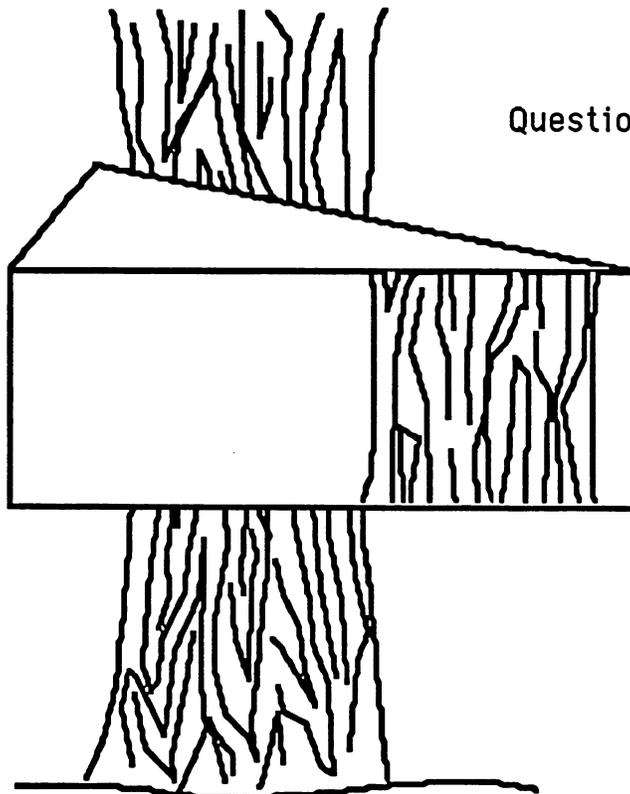


TABLE 2.--Limiting distances for B.A.F. 37.5 prism

(1.421 feet per inch DBH)

DBH (inches)	Tenths of inches										DBH (inches)
	0	1	2	3	4	5	6	7	8	9	
1	1.4	1.6	1.7	1.9	2.0	2.1	2.3	2.4	2.6	2.7	1
2	2.8	3.0	3.1	3.3	3.4	3.6	3.7	3.8	4.0	4.1	2
3	4.3	4.4	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.5	3
4	5.7	5.8	6.0	6.1	6.2	6.4	6.5	6.7	6.8	7.0	4
5	7.1	7.2	7.4	7.5	7.7	7.8	8.0	8.1	8.2	8.4	5
6	8.5	8.7	8.8	9.0	9.1	9.2	9.4	9.5	9.7	9.8	6
7	9.9	10.1	10.2	10.4	10.5	10.7	10.8	10.9	11.1	11.2	7
8	11.4	11.5	11.7	11.8	11.9	12.1	12.2	12.4	12.5	12.6	8
9	12.8	12.9	13.1	13.2	13.4	13.5	13.6	13.8	13.9	14.1	9
10	14.2	14.4	14.5	14.6	14.8	14.9	15.1	15.2	15.3	15.5	10
11	15.6	15.8	15.9	16.1	16.2	16.3	16.5	16.6	16.8	16.9	11
12	17.1	17.2	17.3	17.5	17.6	17.8	17.9	18.0	18.2	18.3	12
13	18.5	18.6	18.8	18.9	19.0	19.2	19.3	19.5	19.6	19.8	13
14	19.9	20.0	20.2	20.3	20.5	20.6	20.7	20.9	21.0	21.2	14
15	21.3	21.5	21.6	21.7	21.9	22.0	22.2	22.3	22.5	22.6	15
16	22.7	22.9	23.0	23.2	23.3	23.4	23.6	23.7	23.9	24.0	16
17	24.2	24.3	24.5	24.6	24.7	24.9	25.0	25.2	25.3	25.4	17
18	25.6	25.7	25.9	26.0	26.1	26.3	26.4	26.6	26.7	26.9	18
19	27.0	27.1	27.3	27.4	27.6	27.7	27.9	28.0	28.1	18.3	19
20	28.4	28.6	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	20
21	29.8	30.0	30.1	30.3	30.4	30.6	30.7	30.8	31.0	31.1	21
22	31.3	31.4	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.5	22
23	32.7	32.8	33.0	33.1	33.3	33.4	33.5	33.7	33.8	34.0	23
24	34.1	34.2	34.4	34.5	34.7	34.8	35.0	35.1	35.2	35.4	24
25	35.5	35.7	35.8	36.0	36.1	36.2	36.4	36.5	36.7	36.8	25
26	36.9	37.1	37.2	37.4	37.5	37.7	37.8	37.9	38.1	38.2	26
27	38.4	38.5	38.7	38.8	38.9	39.1	39.2	39.4	39.5	39.6	27
28	39.8	39.9	40.1	40.2	40.4	40.5	40.6	40.8	40.9	41.1	28
29	41.2	41.4	41.5	41.6	41.8	41.9	42.1	42.2	42.3	42.5	29
30	42.6	42.8	42.9	43.1	43.2	43.3	43.5	43.6	43.8	43.9	30
31	44.0	44.2	44.3	44.5	44.6	44.8	44.9	45.0	45.2	45.3	31
32	45.5	45.6	45.8	45.9	46.0	46.2	46.3	46.5	46.6	46.8	32
33	46.9	47.0	47.2	47.3	47.5	47.6	47.7	47.9	48.0	48.2	33
34	48.3	48.5	48.6	48.7	48.9	49.0	49.2	49.3	49.5	49.6	34
35	49.7	49.9	50.0	50.2	50.3	50.4	50.5	50.7	50.9	51.0	35
36	51.2	51.3	51.4	51.6	51.7	51.9	52.0	52.2	52.3	52.4	36
37	52.6	52.7	52.9	53.0	53.1	53.3	53.4	53.6	53.7	53.9	37
38	54.0	54.1	54.3	54.4	54.6	54.7	54.9	55.0	55.1	55.3	38
39	55.4	55.6	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	39
40	56.8	57.0	57.1	57.3	57.4	57.6	57.7	57.8	58.0	58.1	40
41	58.3	58.4	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.5	41
42	59.7	59.8	60.0	60.1	60.3	60.4	60.5	60.7	60.9	61.0	42
43	61.1	61.2	61.4	61.5	61.7	61.8	62.0	62.1	62.2	62.4	43
44	62.5	62.7	62.8	62.9	63.1	63.2	63.4	63.5	63.7	63.8	44
45	64.0	64.1	64.3	64.4	64.5	64.7	64.8	64.9	65.1	65.2	45
46	65.4	65.5	65.7	65.8	65.9	66.1	66.2	66.4	66.5	66.6	46
47	66.8	66.9	67.1	67.2	67.4	67.5	67.6	67.8	67.9	68.1	47
48	68.2	68.4	68.5	68.6	68.8	68.9	69.1	69.2	69.3	69.5	48

Fixed Radius Plot (1/300 Acre), Item 19.

Trees tallied on the fixed radius plot must be live and have the center of their stem at the base within a 6.8' horizontal distance of the point center.

Saplings - Points 1-10. Tally all live saplings (trees > 1.0" DBH, but < 5.0" DBH) within the fixed radius plot.

Seedlings - Points 1-10. If no live trees 5.0" DBH or larger are recorded at a point, and if not enough saplings are present to reach 16% stocking, record live seedling (trees < 1.0" DBH) data until 16% stocking is reached on that point.

Minimum height requirement to be considered a seedling is .5' for softwood and 1.0' for hardwood species. DBH for seedlings is recorded as 000.

When tallying seedlings; record the most dominant (tallest) seedling sized trees first. When equal dominance occurs follow the following order of preference:

- 1) 20 class commercial tree species
- 2) non-commercial tree species
- 3) poorly formed or diseased commercial tree species

Stumps - Points 1-10 Do not record any stumps on new measurement plots.

For remeasurement plots:

- 1) Only stumps of trees recorded last time will be measured.
- 2) For remeasurement plot stumps, record tree history (code 7, 8, or 9) and old (previous inventory) d.b.h.
- 3) It is not necessary to record stump height or stump diameter for remeasurement plot stumps.

Basal Area Count, Item 20.

Count the number of live trees 1.0" DBH and larger that occur within the limiting distances of the 37.5 basal area factor prism for each point. Record the count (two digits if required) for each point in the point class record line. (Recorded under tree #40)

Tree Number, Item 21.

Record a 2-digit code for all line entries including trees and stumps, point number with or without a cover class, and all biomass entries. Site trees for the plot will also be given tree numbers.

For each point:

- 01-39 - will be assigned consecutively for trees and stumps.
- 40 - will be assigned for: basal area count, cover class points, point class records.
- 51-99 - will be assigned consecutively for all biomass entries.

For the plot:

- 41-49 - will be assigned to the plot site trees.

For remeasurement plots:

Number previously measured trees using old tree number. Stumps, dead trees and seedlings, and trees <5.0" DBH on points 4-10 on the old tally sheet will be disregarded and their old tree numbers not used. New trees (ongrowth and ingrowth) will be numbered consecutively proceeding clockwise from 0 azimuth starting with the next available tree number.

Following are additional instructions (A-J) for remeasurements in reference to tallying trees and tree history codes.

A. New Live Trees (Tree History Codes 31, 32, 61 and 62): For ingrowth and ongrowth trees, tally all required items with the exception of original tree data (this includes DBH, tree class, crown ratio, and crown class). These items should be zeroed out. All seedlings will receive an ingrowth tree history (31 or 32).

B. Original Tally Trees Still Alive (Tree History Codes 10, 11, 12, 20, 21 and 22): All live trees tallied as live at the last survey must be accounted for, old tree number and old DBH transferred to the data recorder from the plot sheet, and all new items completed to survey standards. Use the proper tree history code to reflect both the original and current tree conditions. All entries except no status trees will be filled in according to guidelines set for sawtimber, pole timber and sapling sized trees.

C. Missing Trees (Tree History Codes 14, 15, 17, 18, 19, 25, 27, 28 and 29): Live trees tallied on the last survey, but now missing, must be accounted for and classified as dead or cut. See Section D. and E. for required tally items.

D. Trees Alive at the Last Survey, Now Dead (Tree History Codes 14, 15 and 25): All trees tallied as live on the last survey that have since died qualify as mortality trees. Standards for salvable-mortality trees remain the same as for a regular plot. Trees qualifying as mortality or salvable-mortality will require the following entries on the data recorder:

Pole-sized trees--enter Items 16, 21 - Old Tree Number (from cribsheet), 22, 23, 25 (original and current), 27, 28 (original and current), 29 (original), 30 (original), 33, (38, 39 and 40 on sample kind #2 only).

Sawtimber-sized trees--enter Items 16, 21 - Old Tree Number (from cribsheet), 22, 23, 25 (original and current), 27, 28 (original and current), 29 (original), 30 (original), 33, (34, 35, 36, 38, 39, and 40 on sample kind #2 only).

For trees under 5.0" DBH on points 1-3--enter Items 16, 21 - Original Tree No. (from cribsheet), 22, 23, 25 (original and current), 29 (original), 30 (original).

If the tree is so badly decomposed that accurate DBH, bole length, sawlog length, and top D.O.B. measurements cannot be made, use the original information or estimate these figures to the best of your ability.

By definition, trees that were cull at the previous survey that have since died cannot be salvable-mortality trees. Assign tree history 25 and fill in items for mortality trees outlined above.

E. Trees Cut Since Last Survey (Tree History Codes 17, 18, 19, 27 and 29): For trees that were tallied as live on the last survey and have been cut since that time, record the following items on the data recorder: 16, 21 - Old Tree Number, 22, 23, 25 (original). Stumps of live trees tallied on the last survey need to be tallied on remeasurement plots. There is no 16.6 foot fixed radius plot for stumps. For salvaged dead trees (17 and 27), record cause of death. If there is no way to determine cause of death, record unknown (code 700) but make an effort, especially in recently dead trees.

F. Stumps, Seedlings, and Trees < 5.0" DBH on points 4-10, Tallied at Time of Last Survey: Stumps, seedlings, and trees < 5.0" DBH from the previous inventory will be disregarded and their entry not transferred to the remeasurement plot sheet.

G. Trees Tallied or Omitted from the Last Survey By Error: We will assume that the work completed on the last survey was done as accurately as possible and was correct.

Record trees and tree history codes as they are even if you are suspicious or positive that an error was made on the last survey.

Three situations will arise:

1. (Tree History Codes 61, 62, 31, 32). If a tree was not tallied last survey, but should have been, and should be tallied now, record the tree as ingrowth or ongrowth.
2. (Tree History Codes 11, 12, 21, 22, 17, 27, 18, 28, 19, 29, 14, 15, 25). If a tree was tallied last survey, but should not have been, and should be tallied now, transfer old information and treat tree as if it was tallied correctly.
3. If a tree was tallied last survey, but should not have been, and should not be tallied now, drop the original tree from the sample (do not record tree history of 10 or 20). Scrape the old paint off the tree. Adjust original B.A./Acre if appropriate on the computer cribsheet.

H. Displaced Trees (Tree History Codes 10, 20, 31, 32, 61 and 62): A tree may have been physically moved either onto or off of the plot by such things as logging or wind. For trees displaced onto the plot and not tallied on the last survey, tally all current items and assign a tree history of ingrowth or ongrowth. Trees tallied on the last survey and displaced off of the plot will be considered no status trees. They will receive a tree history of 10 or 20. Record Item #'s 16, 21, 22, 23, (25 original, old tree number) on the data recorder. No current information needs to be recorded. Be sure to adequately explain the exact circumstances in the "Notes" section of the plot sheet. Trees tallied live on the last survey, now dead and displaced off of the plot, will be tallied as dead trees.

I. Dead Trees (Tree History Codes 44, 45, 55, 48, 49, 59): Trees > 5" and dead on the original survey will be accounted for if they are still standing or if they have been cut. Salvability standards remain the same. Items required are the same as for (D) trees alive last survey, now dead. Cause of death, Item 27, should be transferred from old plot sheet. Dead trees last survey, now on the ground or missing (rotted away) can be disregarded.

J. Ongrowth or Ingrowth Dead trees Codes 64, 65, 34, 35): Trees > 5", and too small at time of last survey, and have grown onto the plot and are dead, will be recorded. Use of code 34 or 35 is possible but not very likely; the only case being a tree in the 6.8 plot that attained 5.0", died, and was displaced off stick.

K. Special Instructions for Sample Kind 9 Plots (Partial Remeasurements in Iowa): On these plots, only some of the tree data needs to be measured on trees that were tallied last time. New trees (tree histories 31, 32, 61, and 62) will be tallied as on sample kind 2's, except skip items 34-40. Old tally trees are treated as described in sections B through I (above), except that current species, DBH, crown ratio, and crown class should not be measured. Tree history should be observed and distance and azimuth transferred from the old plot sheet and verified. If the trees are still alive or salvable dead, redo the paint mark.

Tree Species, Item 22

Record a 3-digit species code for all shrubs, and tree species live or dead. 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. 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.

The tree species for remeasured trees should be inspected and corrected if necessary. Assign tree species codes as needed for new trees. Those trees identified as noncommercial species on the prior survey (species code 999) which are now considered as shrubs can be dropped from the sample, and need not be accounted for. Code 999 cannot be used. Tree species coded 999 last time must be given their proper species code on the current survey. If the tree is missing, the tallier should use his best judgment in assigning a species.

Iowa tree species list, Item 22.

IOWA TREE SPECIES

<u>Code</u>	<u>Common Name</u>	<u>Scientific Name</u>
012	Balsam fir	<i>Abies balsamea</i>
068	Eastern redcedar	<i>Juniperus virginiana</i>
105	Jack pine	<i>Pinus banksiana</i>
125	Red pine	<i>Pinus resinosa</i>
129	Eastern white pine	<i>Pinus strobus</i>
130	Scotch pine	<i>Pinus sylvestris</i>
313	Boxelder	<i>Acer negundo</i>
314	Black maple	<i>Acer nigrum</i>
316	Red maple	<i>Acer rubrum</i>
317	Silver maple	<i>Acer saccharinum</i>
318	Sugar maple	<i>Acer saccharum</i>
331	Ohio buckeye	<i>Aesculus glabra</i>
373	River birch	<i>Betula nigra</i>
375	Paper birch	<i>Betula papyrifera</i>
391*	American hornbeam (musclewood)	<i>Carpinus caroliniana</i>
402	Bitternut hickory	<i>Carya cordiformis</i>
403	Pignut hickory	<i>Carya glabra</i>
404	Pecan	<i>Carya illinoensis</i>
405	Shellbark hickory	<i>Carya laciniosa</i>
407	Shagbark hickory	<i>Carya ovata</i>
409	Mockernut hickory	<i>Carya tomentosa</i>
452	Northern catalpa	<i>Catalpa speciosa</i>
462	Hackberry, Sugarberry	<i>Celtis spp.</i>
500*	Hawthorn	<i>Crataegus spp.</i>
521	Common Persimmon	<i>Diospyros virginiana</i>
541	White ash	<i>Fraxinus americana</i>
543	Black ash	<i>Fraxinus nigra</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
546	Blue ash	<i>Fraxinus quadrangulata</i>
552	Honeylocust	<i>Gleditsia triacanthos</i>
571	Kentucky coffeetree	<i>Gymnocladus dioica</i>

* Noncommercial tree species.

IOWA TREE SPECIES, continued

601	Butternut	<i>Juglans cinerea</i>
602	Black walnut	<i>Juglans nigra</i>
641*	Osage-orange	<i>Maclura pomifera</i>
660*	Apple, crabapple	<i>Malus spp.</i>
682	Red mulberry	<i>Morus rubra</i>
701*	Eastern hophornbeam (ironwood)	<i>Ostrya virginiana</i>
731	American sycamore	<i>Platanus occidentalis</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
743	Bigtooth aspen	<i>Populus grandidentata</i>
746	Quaking aspen	<i>Populus tremuloides</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
766*	Wild plum	<i>Prunus americana</i>
802	White oak	<i>Quercus alba</i>
804	Swamp white oak	<i>Quercus bicolor</i>
809	Northern pin oak, jack oak	<i>Quercus ellipsoidalis</i>
817	Shingle oak	<i>Quercus imbricaria</i>
822	Overcup oak	<i>Quercus lyrata</i>
823	Bur oak	<i>Quercus macrocarpa</i>
826	Chinkapin oak	<i>Quercus muehlenbergii</i>
830	Pin oak	<i>Quercus palustris</i>
833	Northern red oak	<i>Quercus rubra</i>
835	Post oak	<i>Quercus stellata</i>
837	Black oak	<i>Quercus velutina</i>
901	Black locust	<i>Robinia pseudoacacia</i>
922	Black willow	<i>Salix nigra</i>
931	Sassafras	<i>Sassafras albidum</i>
951	American basswood	<i>Tilia americana</i>
972	American elm	<i>Ulmus americana</i>
974	Siberian elm	<i>Ulmus pumila</i>
975	Slippery elm	<i>Ulmus rubra</i>
977	Rock elm	<i>Ulmus thomasii</i>

* Noncommercial tree species.

MINNESOTA TREE SPECIES

<u>Code</u>	<u>Common Name</u>	<u>Scientific Name</u>
012	Balsam fir	<i>Abies balsamea</i>
068	Eastern redcedar	<i>Larix laricina</i>
071	Tamarack	<i>Juniperus virginiana</i>
094	White spruce	<i>Picea glauca</i>
095	Black spruce	<i>Picea mariana</i>
105	Jack pine	<i>Pinus banksiana</i>
125	Red pine	<i>Pinus resinosa</i>
129	White pine	<i>Pinus strobus</i>
130	Scotch pine	<i>Pinus sylvestris</i>
241	Northern white-cedar	<i>Thuja occidentalis</i>
313	Boxelder	<i>Acer negundo</i>
314	Black maple	<i>Acer nigrum</i>
315*	Striped maple	<i>Acer pennsylvanicum</i>
316	Red maple	<i>Acer rubrum</i>
317	Silver maple	<i>Acer saccharinum</i>
318	Sugar maple	<i>Acer saccharum</i>
319*	Mountain maple	<i>Acer spicatum</i>
341*	Ailanthus, tree-of-heaven	<i>Ailanthus altissima</i>
371	Yellow birch	<i>Betula alleghaniensis</i>
373	River birch	<i>Betula nigra</i>
375	Paper birch	<i>Betula papyrifera</i>
391*	American hornbeam (musclewood)	<i>Carpinus caroliniana</i>
402	Bitternut hickory	<i>Carya cordiformis</i>
407	Shagbark hickory	<i>Carya ovata</i>
462	Hackberry	<i>Celtis occidentalis</i>
500*	Hawthorn	<i>Crataegus spp.</i>
541	White ash	<i>Fraxinus americana</i>
543	Black ash	<i>Fraxinus nigra</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>

* Noncommercial tree species.

MINNESOTA TREE SPECIES, continued

571	Kentucky coffeetree	<i>Gymnocladus dioicus</i>
601	Butternut	<i>Juglans cinerea</i>
602	Black walnut	<i>Juglans nigra</i>
660*	Apple	<i>Malus spp.</i>
701*	Eastern hophornbeam (ironwood)	<i>Ostrya virginiana</i>
741	Balsam poplar	<i>Populus balsamifera</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
743	Bigtooth aspen	<i>Populus grandidentata</i>
746	Quaking aspen	<i>Populus tremuloides</i>
761*	Pincherry	<i>Prunus pennsylvanica</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
802	White oak	<i>Quercus alba</i>
804	Swamp white oak	<i>Quercus bicolor</i>
809	Northern pin oak	<i>Quercus ellipsoidalis</i>
823	Bur oak	<i>Quercus macrocarpa</i>
833	Northern red oak	<i>Quercus rubra</i>
837	Black oak	<i>Quercus velutina</i>
851*	Mountain ash	<i>Sorbus</i>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
922	Black willow	<i>Salix nigra</i>
951	American basswood	<i>Tilia americana</i>
972	American elm	<i>Ulmus americana</i>
975	Slippery elm	<i>Ulmus rubra</i>
977	Rock elm	<i>Ulmus thomasii</i>

* Noncommercial tree species.

Tree History, Item 23.

Record a 2-digit code for tree history.

Remeasurement Plots-First digit describes previous tree history, second digit describes current tree history. Ingrowth and ongrowth are explained below.

A. Ingrowth: Ingrowth trees are those that were not tallied or were seedlings at the time of the last survey, but are now 1.0" or larger, not on prism count, and occur on the fixed radius plot. In addition, all seedlings tallied during the current remeasurement will receive a tree history reflecting ingrowth.

All ingrowth trees must be tallied on points 1-10. Seedlings need only be tallied on points with no trees >5.0" DBH. Assign ingrowth tree history (31, 32, 34 or 35) according to present tree class.

B. Ongrowth: Ongrowth trees are defined as those trees that were too small to be included on the variable radius plot on the prior survey, but are now large enough to qualify for prism count. All ongrowth trees must be tallied on points 1-10. Trees >1.0" DBH tallied as live on the last survey cannot receive a tree history of ongrowth. Assign ongrowth tree history (61, 62, 64 or 65) according to present tree class.

Note: Remember that old trees on points 4-10 that were <5.0 DBH will not be remeasured as old trees, but will be considered ingrowth/ongrowth trees regardless of what they were called on the last survey. They will be given new tree numbers and the old tree numbers will not be used.

Non-Remeasurement Plots-First digit is always "0", second digit is current tree history.

<u>Code</u>	<u>Tree History</u>
0	No status
1	growing stock live
2	cull live
3	ingrowth
4	dead (salvable-mortality)
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 on remeasurement plots (i.e. ingrowth to cull is coded "32").

6 - is only valid as the first digit of tree history on remeasurement plots (i.e. ongrowth to growing stock is coded "61").

0 - is only valid as the first digit of tree history on nonremeasurement plots and the second digit on remeasurement plots that have points or plots 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 survey which is currently on non-commercial forest land). On remeasurement plots or points that have been cleared and are no longer CFL, record the appropriate code for cut and utilized or not utilized in the second digit of each tree.

Tree Distance. Item 24.

Record distances on all live trees tallied (except seedlings) on points 1 through 10. The distance recorded will be slope distance to the nearest foot from point center to the near face of each tree at its base. Record a 2-digit code.

Diameter Breast High (DBH). Item 25.

Record a 3-digit code for each tree tallied. DBH is recorded to the last 0.0". The 6.1" diameter class coded as 061, for example, should include trees 6.10" in diameter up to, but not including, trees 6.20" in diameter. Record code 000 for trees with a DBH less than 1.0"

In cases of irregularities at DBH such as swelling, bumps, depressions, or branches, measure the diameter immediately above the irregularity at the place where it ceases to affect the normal stem form. If a measurement cannot be taken above the irregularity, record the diameter at the least abnormal spot. Butt swelled trees should be measured at a point 1.5' above the end of the swell if the swell is more than 3' high.

If the stem forks at or above DBH measure diameter below the swell at the place where the fork ceases to affect the stem form. When the stem forks below DBH, consider the tree as two trees and measure the diameter 3 1/2' above the fork (use rule only once per tree).

On the side of the tree facing point center paint a 2" horizontal scribed mark just above the upper tape at the point where DBH is measured. Within the 1' stump facing point center, paint a 2" vertical scribed mark to facilitate remeasurement plotwork, in the event the tree is cut. Do not scribe small, thin-barked trees.

Cruisers should use their judgement to determine if trees that appear to have forked above DBH originated from a fork below DBH (use obvious separations and cracks as a guide).

Figures 9 and 10 (p.51 & 52) illustrate the proper methods for obtaining DBH.

DBH for remeasurement plots

A. Original: Transfer any original DBH as it appears on the original plot sheet. If paint or scribe mark is found, do not move the measurement location.

B. Current: Check to see that the original DBH was taken in the correct place. If DBH was correct, remeasure, rescribe, and repaint this original measurement. It is extremely important to measure the same place if the measurement was initially correct, so look carefully for evidence of paint at DBH.

If the previous measurement was taken on a deformity, or cannot be located, or another error was made, move the current DBH to the correct place on the bole, and record the new measurement.

If the tree is now dead at DBH, it will be considered a dead tree. If a new leader has taken over and is 1.0" DBH, it will be given a tree history of ingrowth or ongrowth. If the tree is not at least 1.0" DBH, it will be taken as a seedling if seedlings are needed to reach 16% stocking. If the tree is taken as a seedling, it will be recorded twice--once as a dead tree and once as a seedling.

Tree Azimuth, Item 26.

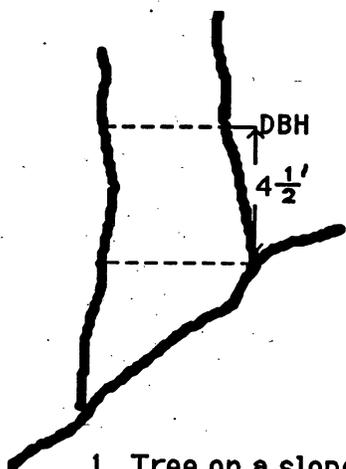
Record azimuth on all live trees tallied (except seedlings) on points 1 through 10. The azimuth recorded will be a 3-digit code representing the magnetic azimuth from the point center to the center of the tree at its base. Examples: 9 is recorded as 009, 89 is recorded as 089, 347 is recorded as 347.

Zero degree azimuth will not be used. Any tree at 0 will be tallied as 001 azimuth.

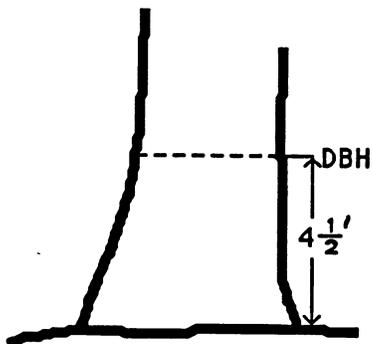
Two trees on the same point can not be recorded with the same azimuth. Record one before the other, for example, record one as 059 and the other as 060.

For remeasurement plots, record azimuths at the time of remeasurement.

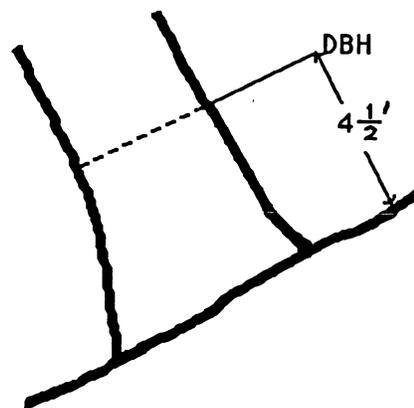
Figure 9.-- DIAMETER BREAST HIGH MEASUREMENT IN A VARIETY OF SITUATIONS



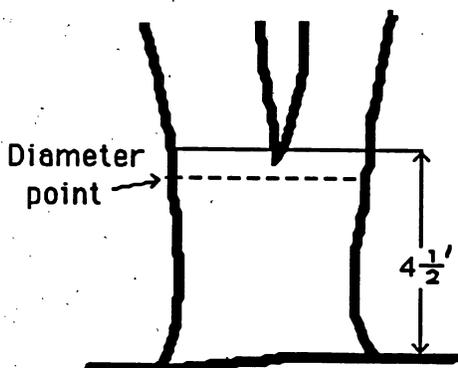
1. Tree on a slope



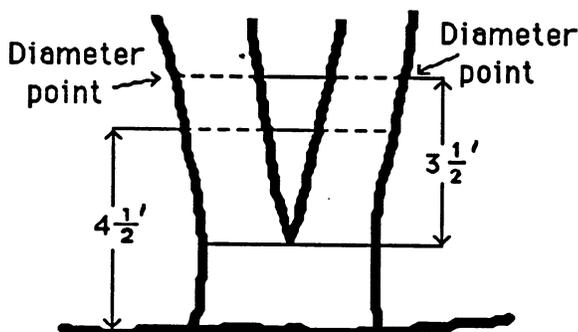
2. Tree on level ground



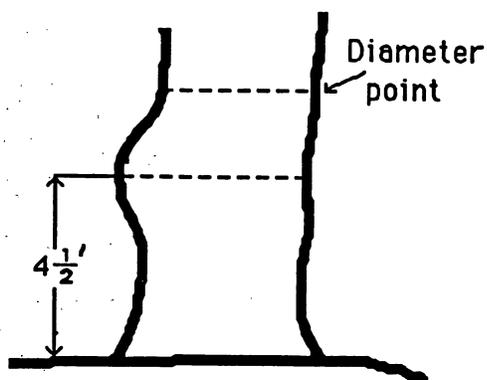
3. Leaning tree



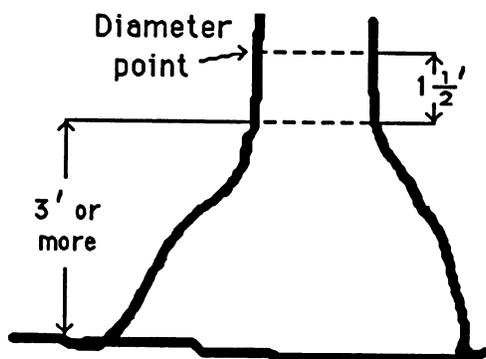
4. Tree forking at or above
 $4\frac{1}{2}$ feet



5. Tree forking below $4\frac{1}{2}$ feet



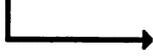
6. Tree deformed at $4\frac{1}{2}$ feet



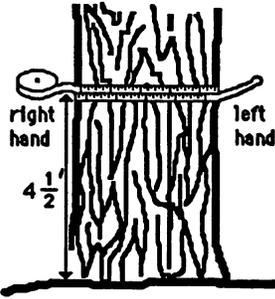
7. Bottlenecked tree

Figure 10.--Using the diameter tape

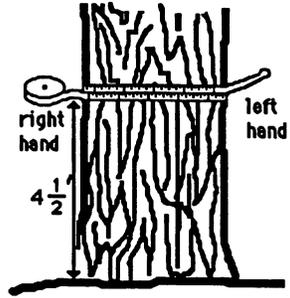
Right handed --
The right hand should cross over the left



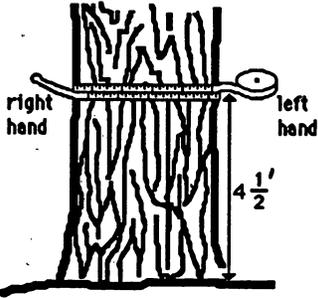
Correct



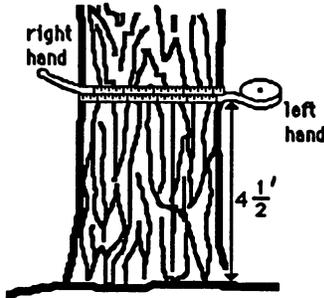
Incorrect



Correct



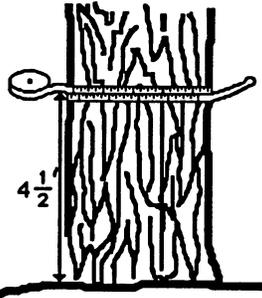
Incorrect



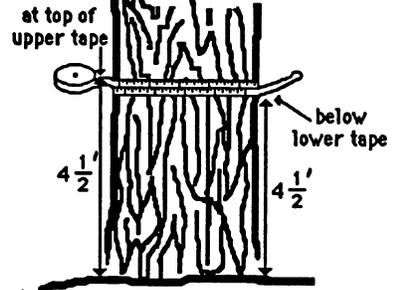
Left handed --
The left hand should cross over the right



Correct



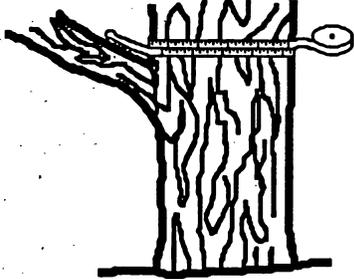
Incorrect



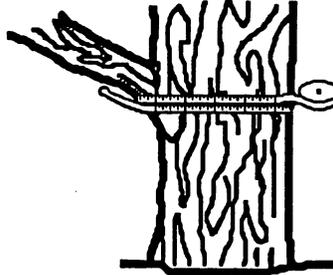
The DBH point is always at the top of the lower tape

The tape must be pulled straight.

Correct

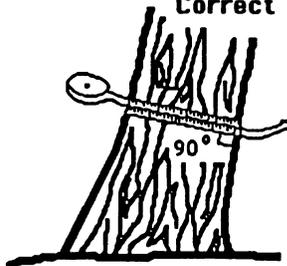


Incorrect

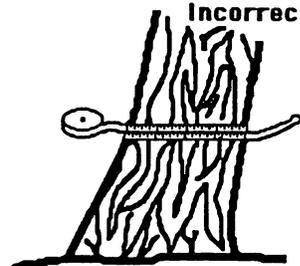


Don't position the tape at an abnormal place on the bole

Correct



Incorrect



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

Damage or Cause of Death. Item 27.

Damage. For live trees record presence of damage or pathogen activity if it is serious enough to reduce the quality or vigor of the tree. Identifying the presence of any of these diseases will be sufficient reason to record them as a damage. Extensive damage by insects should be noted in the "Notes" section of the plot sheet. Also record extensive disease occurrence in the notes section. Cull trees (except noncommercial species) must have a damage code other than 000. When a tree is damaged by more than one agent, code the most severe damage. Seedlings and saplings, unless a specific damage is observed, should be considered growing-stock trees. Excessive sweep and crook will not be considered a specific damage code on seedlings and small saplings (3.0 inches or smaller). A damage code will not be recorded to indicate the reason for not qualifying as a better quality log grade.

Record presence of pathogens or damage using the following 3-digit code:

Damage -IOWA

<u>Code</u>	<u>Disease or damage</u>	<u>Priority by tree species</u>
000	Healthy	
100	* Insect defoliators	8 All other species
113	Gypsy moth	
130	Shoot and branch insects	
140	Branch gall insects	
150	Bole borers	
170	Bark beetles	
190	Root/ root collar insects	
200	* Foliage diseases	9 All other species
210	Shoot blights	
220	Mistletoe	
240	Bole rusts	
250	* Bole cankers	5 All other species
251	Eutypella canker	
252	Hypoxylon canker	1 Aspen
255	* Fusarium canker	1 Walnut
257	* Butternut canker	1 Butternut
260	* Stem decay	1 All other species
261	Phellinus pini	
262	Phellinus tremulae	
271	* Ash yellows	1 Ash
281	Dutch elm disease	1 Elm
282	* Oak wilt	1 Oak
291	Fomitopsis annosus	
292	* Armillaria root rot	4 All other species
300	* Weather	2 All other species
304	Frost cracks	
307	Flooding	
400	* Animal damage	6 All other species
409	* Cattle/domestic animals	7 All other species
500	Fire	
600	Suppression	

Damage - IOWA, continued

<u>Code</u>	<u>Disease or damage</u>	<u>Priority by tree species</u>
710	Missing or dead top	
740	Ice gouging	
750	Oil and salt damage	
760	Vine damage	
770	Barbed wire, nails, metal	
771	* Air pollution	3 All other species
772	Soil compaction	
800	Logging and related mechanical	
810	Logging	
820	Timber stand improvement	
840	Land clearing	
850	Land use conversion	
860	Chemical (herbicide)	
901	Unknown defoliation	
902	Unknown discoloration	
903	Unknown decline/dieback	
904	Unknown breakage	
905	Unknown abnormal growth or form in crown	
906	Unknown canker	
907	Unknown cracks	
908	Unknown abnormal growth or form on the bole	
909	Unknown insect holes	

* Iowa's list of important pests and diseases.

Cause of Death. -IOWA

Note: All disease or damage codes can be used.

<u>Code</u>	<u>Cause</u>
100	Insects
200	Disease
300	Weather
400	Animal damage
500	Fire
600	Suppression
800	Logging
900	Unknown

Damage or death codes- MINNESOTA. (Item 27) (UNITS 3 & 4 ONLY)

<u>Code</u>	<u>Damage or Death</u>	<u>Host</u>
000	Healthy	All species
100	Insects defoliators	All species
101	Budworms	Jack pine, red pine, balsam fir, white spruce
110	Forest tent caterpillar	Hardwoods, aspen and basswood
113	Gypsy moth	Hardwoods
130	Shoot and branch insects	All species
131	White pine weevil	Conifers
140	Branch gall insects	All species
150	Bole borers	All species
170	Bark beetles	Conifers
190	Root/root collar insects	Conifers
200	Foliage diseases	All species
210	Shoot blights	Pines
212	Scleroderris	Conifers (Red and jack pine)
220	Mistletoes	Black and white spruce, tamarack
240	Bole rusts	Pines
241	White pine blister rust	White Pine
250	Bole cankers	All species
251	Eutypella canker	Maple
252	Hypoxylon canker	Aspen
254	Nectria canker	Hardwoods
257	Butternut canker	Butternut
260	Stem decay	All species
261	Phellinus pini	Conifers
262	Phellinus tremulae	Aspen
263	Inonotus obliquus	Birches
271	Ash yellows	Ash
281	Dutch elm disease	Elms
282	Oak wilt	Oaks
290	Root/butt rot	All species
291	Fomitopsis annosus	Conifers
292	Armillaria (shoestring) root rot	All species
300	Weather	All species
302	Wind	All
307	Flooding	All
309	Ice/snow	All
400	Animal damage	All
402	Moose/elk/deer	All
404	Beaver	All
409	Cattle/domestic animals	All
500	Fire	All
800	Logging & related mechanical/TSI	All
850	Land use conversion	All
860	Chemical	All

Damage or death codes- MINNESOTA, continued (UNITS 3 & 4 ONLY)

900	Unknown (dead tree only)	All
901	Unknown/uncoded defoliation	All
902	Unknown/uncoded discoloration	All
903	Unknown/uncoded decline/dieback	All
904	Unknown/uncoded breakage	All
905	Unknown/uncoded abnormal growthor form in crown	All
906	Unknown/uncoded canker	All
907	Unknown/uncoded cracks	All
908	Unknown/uncoded abnormal growthor form on the bole	All

NOTES: All codes can be used for damage or death except code 900, Unknown, which can only be used for cause of death.

When you use codes 901-909 in Itasca County, indicate whether the cause was insects, diseases, or unknown in the notes section by point and tree number.

MINNESOTA. (Item 27. continued)

When there are multiple causes of mortality, code for the predominant cause of death. Thus, a tree killed by windthrow, but showing evidence of root rot, would be coded 500, since windthrow actually caused the death of the tree.

Tree Class, or Cover Class Item 28 (2 digits)

Tree Classification. Entries of log grade, 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.

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 recording data.

Upon the first observation, the sawlog portion on a sawtimber tree, the potential sawlog portion on a poletimber tree, or any sapling or seedling, should be screened using criteria which would place it into one of two categories; growing stock or cull.

If an illegal tree class code is found, bring it to the attention of the person in charge of remeasurement.

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

Acceptable tree (Code 20)

Live trees of commercial species that are:

- 1) Sawtimber size and have at least one merchantable 12-foot sawlog or two merchantable 8-foot sawlogs, meet minimum log grade requirements, and contain 33 percent or more of their gross board foot volume in sound material.

- 2) Poletimber size trees that have the potential to meet the above specifications (see 1 above). The assumption shall be made that pole size trees will eventually attain sawlog size at DBH. In evaluating the potential sawlog portion of pole size trees, only rot, large limbs, forks, and excessive sweep and crook may be used to disqualify the tree as a growing stock tree. When estimating the potential sawlog height for poletimber trees, the two-inch rule can be applied as a guide. The two-inch rule assumes that a tree's diameter will increase uniformly along its bole. For example, a hardwood poletimber tree with a DBH of 8.0 inches needs three inches of diameter growth to become sawtimber size. If diameter growth is uniform then the DBH minus 2 inches, 8-2 or 6 inches, identifies the potential sawlog top. This system works for both hardwoods and softwoods.
- 3) Seedlings and saplings will be considered growing stock trees unless a specific damage is observed. Seedlings and small saplings (less than 3.0 inches) may not be culled on the basis of excessive sweep or crook. It will be assumed that seedlings and saplings will eventually attain sawlog size at DBH.

Tree vigor, predicted death, or plot site index are not considerations in determining tree class.

Rough Tree (Code 30)

- 1) All trees of noncommercial species.
- 2) All trees of commercial species that are:
 - a) Sawtimber size and do not have any merchantable sawlog, where over one-half of the volume in the sawlog portion does not meet minimum log grade specifications because of roughness, excessive sweep or crook, splits, cracks, limb stoppers, or forks. The sawlog portion is the length between the one-foot stump and the 9.0" top D.O.B. for hardwoods and the 7.0" top D.O.B. for softwoods.
 - b) Pole size trees which do not have the potential to meet the specifications for growing stock trees because of forks, limb stoppers, or excessive sweep or crook. The assumption shall be made that all live trees not presently sawlog size will eventually attain sawlog size at DBH. Predicted death, tree vigor, or plot site index are not considerations in determining tree class.

Short sawtimber-sized tree (code 31)

- 1) Any live sawtimber-sized tree of commercial species which has at least one eight-foot log, but less than a twelve-foot log, that meets minimum log grade specifications.
- 2) Any live sawtimber-sized tree of commercial species which has less than one-third of the volume of the sawlog portion in merchantable logs, but has at least one eight-foot or longer sawlog that meets minimum log grade specifications. Short sawlog must be 50% sound at any point. The sawlog portion is the length between the one-foot stump and the 9.0" top D.O.B. for hardwoods and the 7.0" top D.O.B. for softwoods.

NOTE: POLE SIZE TREES CANNOT RECEIVE A TREE CLASS 31.

Rotten tree (Code 40)

All live trees of commercial species that are:

- 1) Sawtimber size and do not have any merchantable sawlog, where over one-half of the volume in the saw log portion does not meet minimum log grade specifications primarily because of rot or missing sections. The saw log portion is the length between the one-foot stump and the 9.0" top D.O.B. for hardwoods and the 7.0" top D.O.B. for softwoods.
- 2) Pole size trees which do not have the potential to meet the log grade specifications for growing stock trees because of rot. The assumption shall be made that all live trees not presently sawlog will eventually attain sawlog size at DBH. Predicted death, tree vigor, or plot site index are not considerations in determining tree class.

SUMMARY:

If any of the sawlog section requirements for a growing stock tree (20) are not met, the tree is considered cull. If a short sawlog is present, the tree class is 31 and sawlog information recorded. If no sawlog is present tree class is 30 or 40. If a poletimber tree does not have the potential to meet sawlog standards, its tree class is 30 or 40.

Following are the required tally items for each tree class:

For growing stock trees (tree class 20) on full permanent plots bole length will be recorded to the highest possible 4.0" top D.O.B., or to that point where the central stem or branch breaks into limbs and above which there is no 4.0" D.O.B. On forked sawtimber trees, bole length will be recorded using the fork that contained the highest sawlog. Cubic foot cull will be recorded for the rotten or missing wood to the 4.0" top. Sawlog length should be recorded to the top of the highest sawlog section meeting minimum sawlog requirements. Board foot cull will include the unusable board foot volume in merchantable sawlog sections, and the total volume of sections that do not meet sawlog requirements below the sawlog top. All remaining required information will be accurately recorded.

For tree class 30, record bole length to a 4.0" top D.O.B. On cubic foot cull, cull out for actual rot or missing wood only. For sawtimber trees dash out sawlog length, sawlog top D.O.B., board foot cull and log grade. Crown ratio and crown class should be accurately recorded. Except for noncommercial species, the damage code must not be "00" and must reflect the primary reason that the tree was culled. Note evidence of tree cavities.

For short sawlog trees (tree class 31) record bole length to a 4.0" top D.O.B. On forked trees, bole length will be recorded using the fork that contains the highest sawlog. Cull out for rot or missing wood on cubic foot cull. Record sawlog length and sawlog top D.O.B. to the height where the highest merchantable log terminates. Cull out total board foot volume in all unmerchantable sections in the sawlog portion, and the unusable board foot volume within the merchantable sawlog. Record log grade for the log that is present. Crown ratio and crown class will be accurately determined. Damage code cannot be "000" and must reflect the primary reason that the tree was culled. Note evidence of tree cavities.

For tree class 40 record bole length to a 4.0" top D.O.B. On cubic foot cull, cull out for rot or missing wood. Dash out saw log length, saw log top D.O.B., board foot cull, and log grade. Crown ratio and crown class will be accurately recorded. Damage code must not be "000" and must reflect rot or disease (codes "100-900"). Cubic foot cull should seldom exceed 90% of total cubic volume.

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 on the next page and record in the point class record entry line and record a tree number of 40.

- | <u>Code</u> | <u>Cover Class</u> |
|-------------|--|
| 51-54 | Inhibiting vegetation. Cover sufficiently dense to prevent establishment of tree seedlings. Use the following codes:
51-grass, 52-shrubs, 53-vines, 54-other. |
| 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. |
| 81-83 | 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. |

For remeasurement plots

- 1) If a point was cover classed on the prior survey, two situations may be encountered. If the point is still cover classed on the current survey, determine and record what the current cover class should be. Reference cover classed points. If live trees or seedlings are now present on the point, record them as ongrowth or ingrowth. There is no need to record the original cover class in this instance.
- 2) If a point was not cover classed on the prior survey, and is currently cover classed, record a current cover class code on the point class record line, and then record previous trees as cut or dead. A tree number of 40 is recorded on the point class record.

DEAD TREES - Dead trees, 5.0" DBH or larger, will be tallied if they have died within the last 3 years. A tree history code of 04 or 05 will be assigned.

Code 04- Salvable-mortality- contains at least one four foot section that is at least 50% sound.

Code 05- Mortality- has no merchantable volume at least 50% sound.

The following tally items are required for dead trees: tree number, species, tree history, DBH, cause of death, tree class, tree cavities, sawlog length, sawlog top DOB, board foot cull, bole length, bole length top DOB, cubic foot cull. Unless specified, all tally items will be recorded using rules from the appropriate sections on live trees in the Forest Survey Field Manual.

How to Do a Dead Tree

DBH- Take into consideration any distortion (lost bark, cracks, splits, shrinkage, etc.) to best estimate the diameter the tree was at time of death. This is for both mortality and salvable-mortality trees.

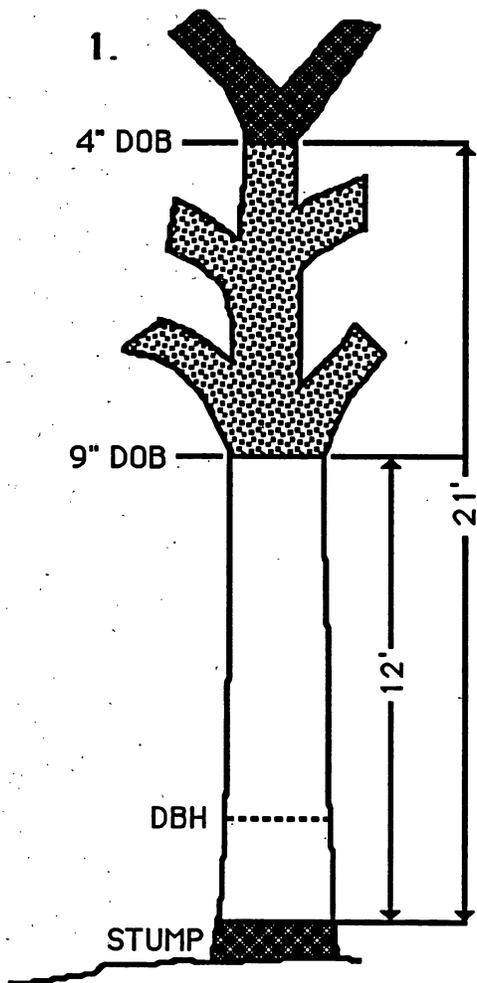
Mortality trees- All required information will be projected back to the time of death except tree cavities, which will be recorded as they exist now. Many mortality trees won't look very good, but will be given a tree class of 20 because that's what they were at time of death.

Salvable-Mortality trees- All required information will reflect the tree's present condition. Pretend the tree is alive today and record your information as such.

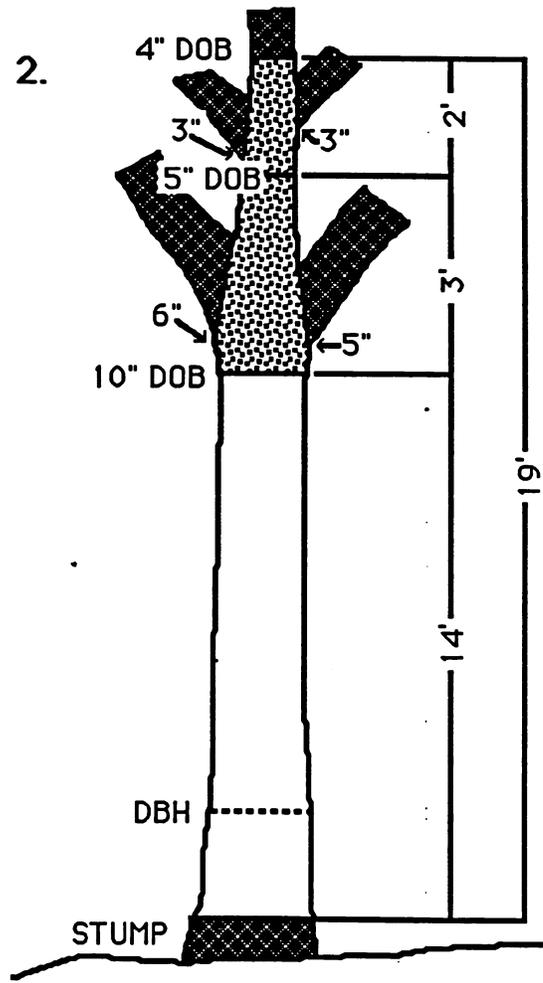
Summary- Dead trees are EASY! First, determine whether the tree is a mortality tree or salvable-mortality tree. Next, project the tree to the correct place in time (the present for salvable-mortality trees and time of death for mortality trees). Finally, record required information according to the Forest Survey Field Manual. Refer to remeasurement manual for dead trees on remeasurement plots. See example 10 to get confused.

Following is an explanation of tree class for selected examples. Hardwood trees are pictured in the examples, but softwoods can also be applied using a minimum 7.0" sawlog top D.O.B. (See Figure 11 - examples 1-10).

Figure 11.--How to handle tree measurements for all tree classes



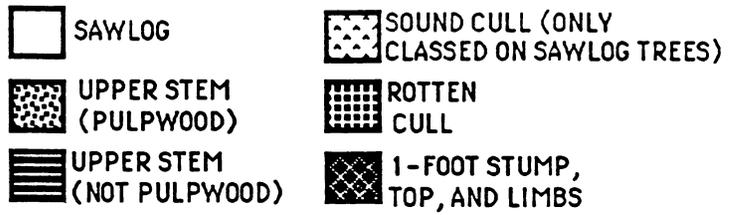
1. A GROWING-STOCK HARDWOOD SAWTIMBER TREE. Sawlog length terminates at 9" top DOB. The sawlog meets both minimum log grade specifications and the minimum 12-foot qualification for a growing-stock tree. The upper stem portion contains no cull and terminates at 4" DOB. Sawlog length is recorded as 12 feet; bole length as 21 feet.



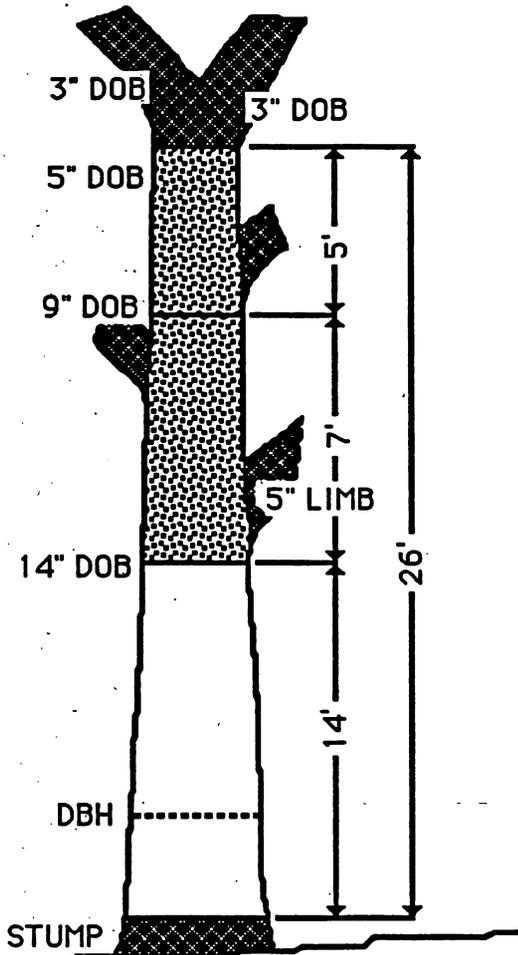
2. A HARDWOOD GRADED 1, 2, OR 3 OR A SOFTWOOD SAWTIMBER TREE. Sawlog portion is terminated by limbs creating a full diameter stopper. Each limb is over 2" in diameter, and their sum exceeds the diameter at the stopping point (10" DBH). The sawlog contains no cull and meets minimum grade specifications. Sawlog length is 14 feet. The upper stem portion contains no cull and terminates at 4" DOB, 5 feet above the sawlog portion. Bole length is 19 feet. Cull cubic is 0 for the tree.



Figure 11 continued

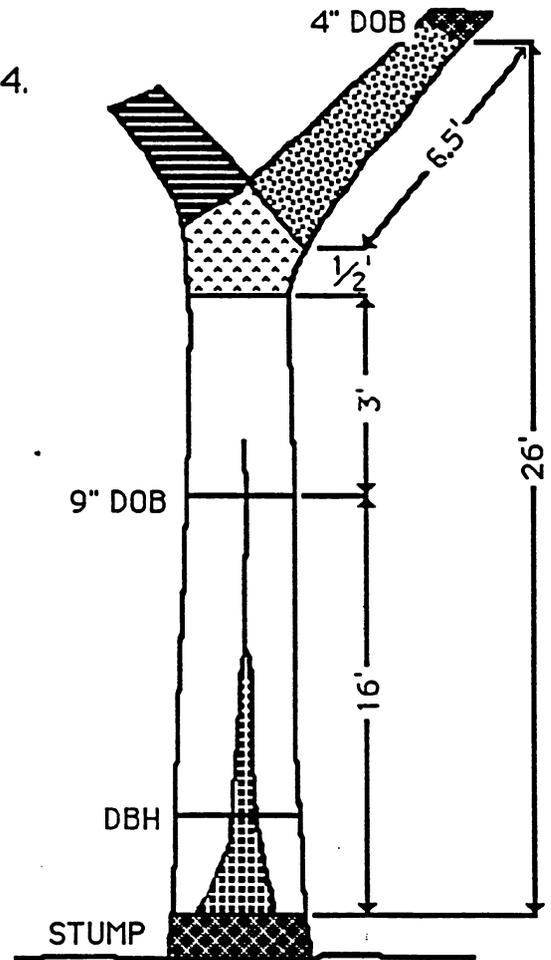


3.



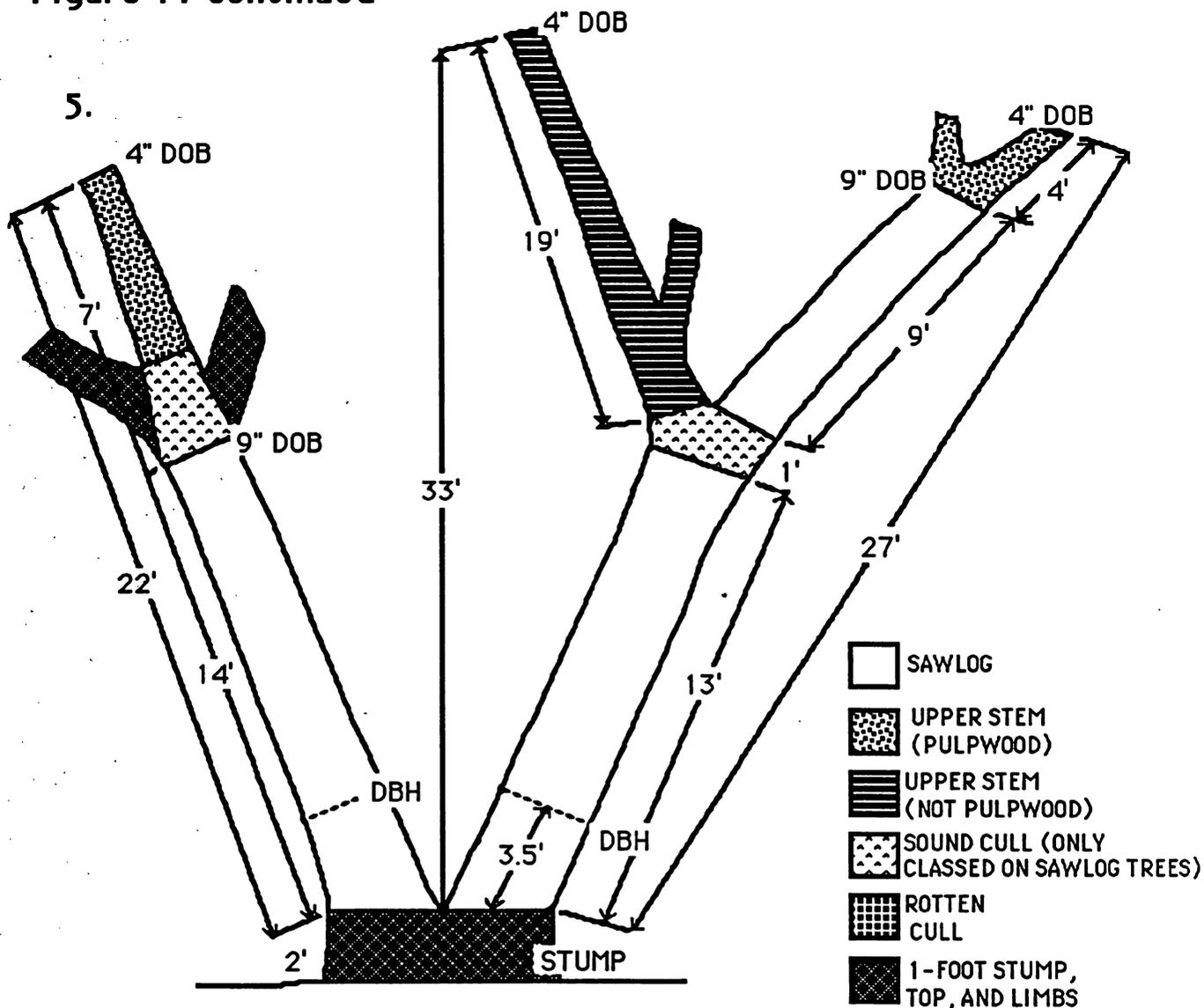
3. A GROWING-STOCK HARDWOOD, GRADE 4 SAWTIMBER TREE. There are no sawlogs in the 21-foot sawlog portion that have minimum clear panel length to meet hardwood factory log grade 3 specifications, but the bottom 14 feet contains no rot or sweep and will meet hardwood construction grade 4 specifications. The sawlog terminates at 14 feet, because the 5-inch diameter limb creates a one-third diameter stopper for hardwood construction grade 4, and only a 6-foot section is left above the 1-foot sawlog stopper. Log grade specifications require a minimum sawlog length of 8 feet. Bole length is terminated at 26 feet with a 5-inch top DOB because of a fork with two 3-inch diameter limbs. Cull board feet and cull cubic feet are zero.

4.



4. A HARDWOOD SAWTIMBER TREE. The sawlog length is 16 feet to the 9-inch DOB. The bottom 2 feet are over 50% 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 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 cubic foot volume loss due to rot in the first 16 feet.

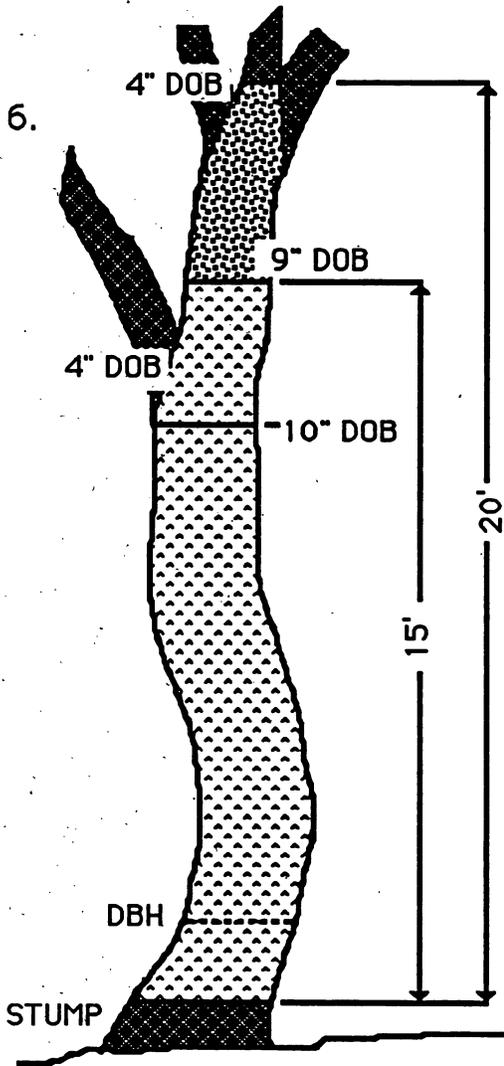
Figure 11 continued



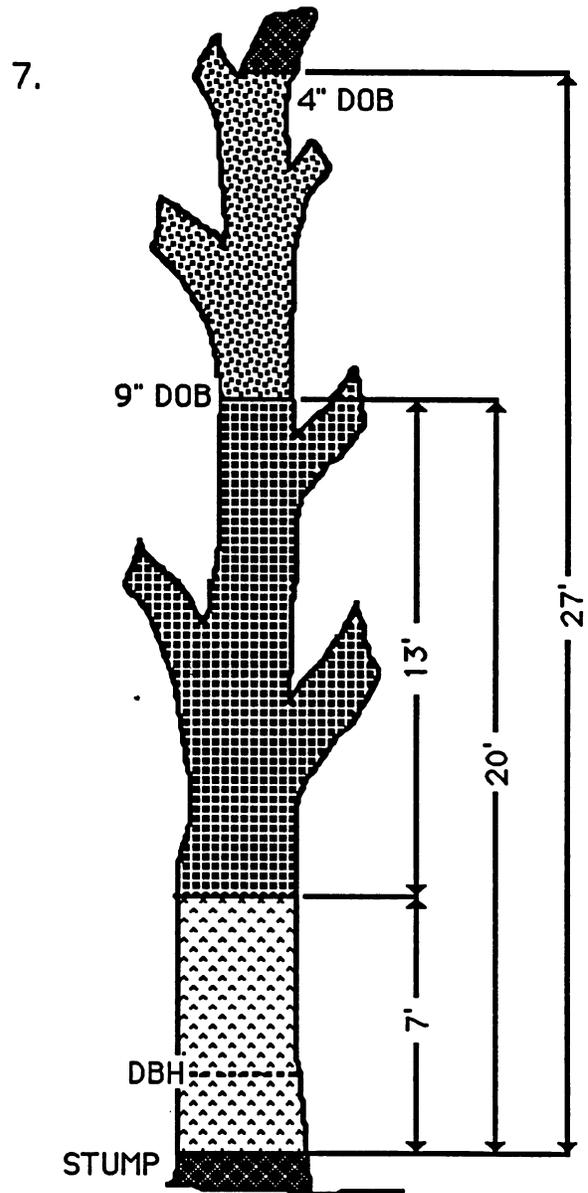
5. TWO HARDWOOD SAWTIMBER TREES. Since the lowest fork is below DBH, each fork is appraised and recorded as a separate tree. The lower 14 feet of the left-hand fork (or tree) meets log grade specifications. The bole length is 22 feet and the sawlog length is 14 feet. Cull board feet is zero and cubic foot cull is zero.

In the right-hand tree, a 13-foot merchantable sawlog, plus a 9-foot merchantable sawlog in the right-hand fork (with an intervening one-foot section of sound cull) is recorded as 23 feet of sawlog length. A 4-foot section of the right-hand fork meets pulpwood specifications, making the bole length 27 feet. Cull board feet would include the total volume of the one-foot fork. When a tree forks above DBH, measurements are recorded on one fork only. Merchantable bole length should be recorded continuing up the same fork that has the highest merchantable sawlog 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 sawlog length, so the bole length is recorded as 27 feet using the right-hand fork.

Figure 11. continued

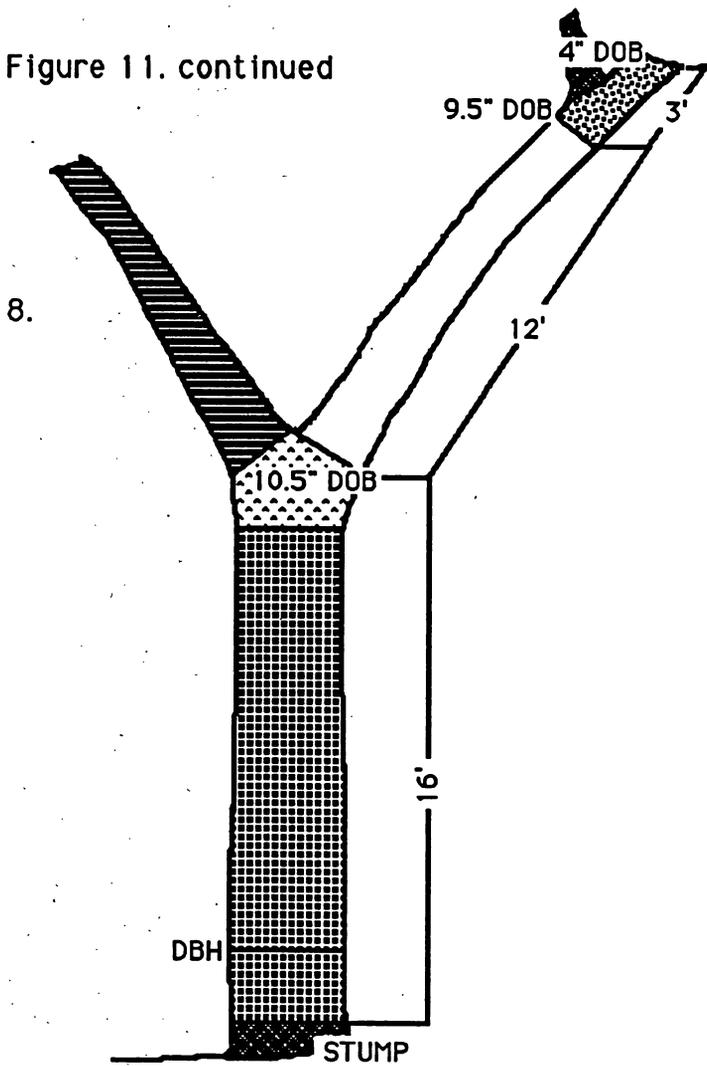


6. A ROUGH HARDWOOD SAWTIMBER TREE. Sawlog portion is 15 feet long. There is no sawlog present that will meet minimum hardwood log grades 1-4. Minimum clear panel length is not present for grade 3 and sweep plus a 1/3 diameter limb stopper prevents grade 4. Since more than half the board foot volume is lost as sound cull, it is a rough tree (tree class 30). Dash out sawlog information. Bole length is taken 25 feet to the 4-inch DOB. Cull cubic foot is zero.

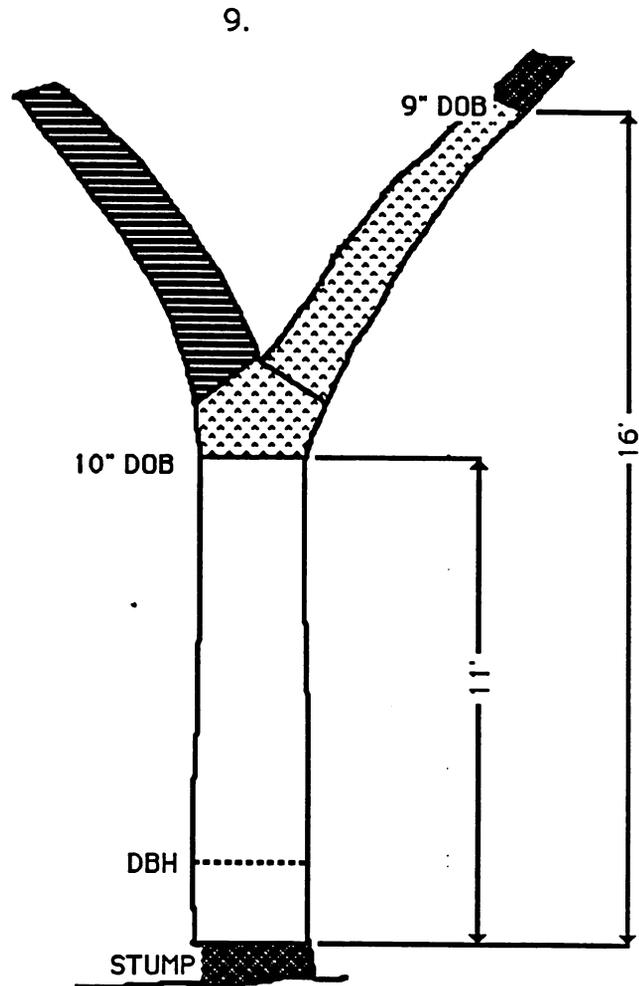


7. A ROTTEN HARDWOOD SAWTIMBER TREE. The sawlog portion is 20 feet long. The entire volume of a 13-foot section is cull, because it will not meet log grade specifications due to excessive rot. This creates a 7-foot sound cull section beneath, because there is not a minimum sawlog length of 8 feet. Since there is no sawlog that will meet minimum log grade specifications, the tree is cull. Because more than half the board foot volume loss is due to rot, the tree is a rotten cull tree (tree class 40). Dash out sawlog information and 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.

Figure 11. continued



8. A tree class 31. The sawlog portion is 28 feet and stops at a point just below where the tree forks for a second time at a 9.5" DOB. The first 16 feet do not meet minimum log grade specifications, but there is a 12 foot merchantable sawlog 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 sawlog is cull, this is a cull tree, but since the tree contains a merchantable sawlog, it is a tree class 31. Use Tatum Guides to compute the board foot volumes of the sections listed. For this example the sawlog information is recorded as sawlog length 028, sawlog top DOB 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 on other trees, culling out for rot and missing wood only.



9. A tree class 31. The sawlog portion is 16 feet to the 9.0" DOB. The tree does not contain a 12-foot merchantable sawlog, or two 8-foot merchantable sawlogs, because of a fork at 11 feet. This classifies the tree as a cull and since it contains a merchantable sawlog at least 8 feet or longer, it is a tree class 31. Sawlog length is recorded as 011, sawlog to DOB 100, and board foot cull 0000. Bole length and cubic foot cull are handled the same as on other trees, culling out for rot and missing wood only.

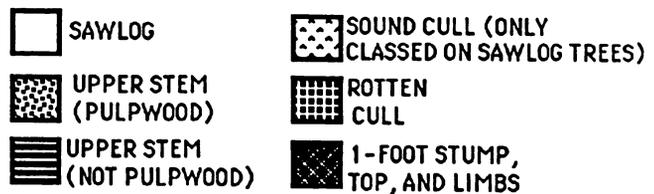
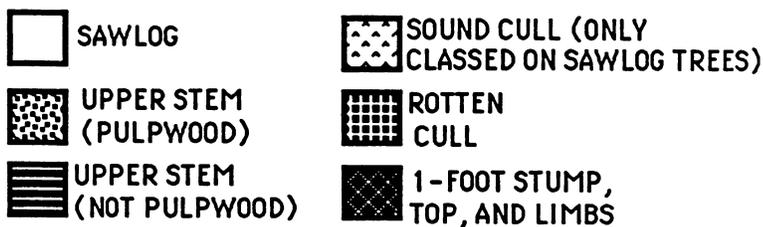
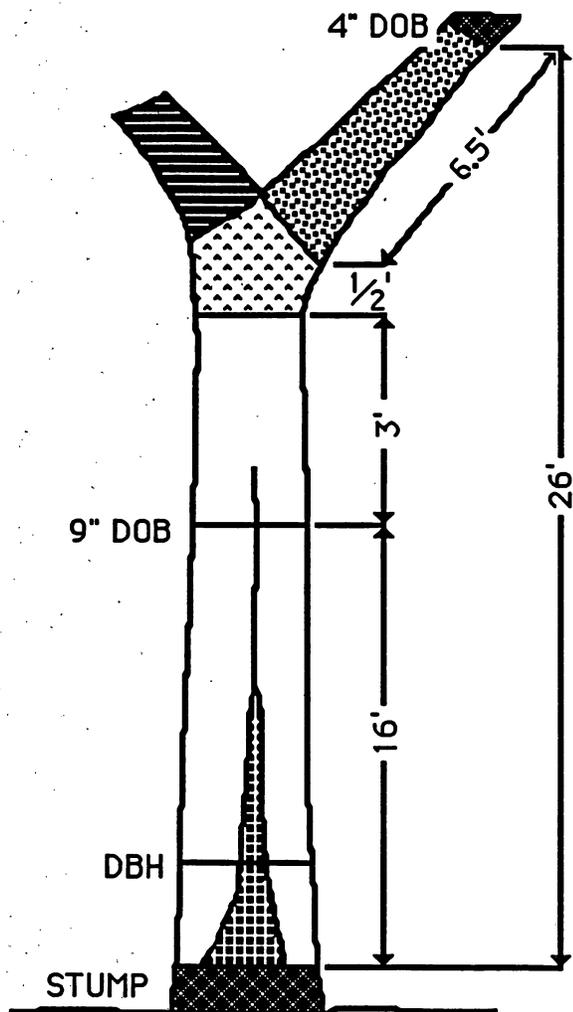


Figure 11 continued



10.



10. A dead tree. The tallier must estimate the amount of cull present at the time of death. In determining what to record for salvable- mortality trees, the tree should be looked at in its present condition. Bole length may still be 26 feet and the cubic foot cull may be the same as recorded for mortality, or there may have been some further decay since death. This would increase the cubic foot cull. Sawlog length may also be the same as that recorded for mortality (16 feet), as may be the amount of board foot volume loss. Again, if the tree has been dead a long time, the decay may increase.

More decay and deterioration occurs the longer the tree has been dead. It is possible that the sawlog portion which was sound at the time of death, is now checked and split. The sawlog length, sawlog top DOB, and board foot cull would then be dashed out because there would be no merchantable sawlog present. Bole length information would still be recorded as the wood is probably sound. Only rot and missing wood would be taken out in the cubic foot section.

Cause of death and tree class are reflected back to the time of death for mortality trees. For salvable mortality trees, cause of death and tree class are looked at in terms of the tree's present condition. The tree in the example was a 20 class tree at the time of death according to survey standards. If this is a mortality tree, a tree class of 20 is still recorded, because that item must be projected back to the time of death.

Crown Ratio. Item 29.

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 DBH or larger. For trees that have uneven length crowns, ocularly transfer branches to fill holes in the upper portion of the crown, until an 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.

If the original crown ratio on remeasurement plots is missing, record an estimate. Otherwise, record the original crown ratio.

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

Crown Class. Item 30.

Record a one-digit code to show crown class of all live trees 1.0 inches DBH and larger. Crown class should be determined based on the individual tree's dominance in relation to adjacent trees in the stand, as indicated by crown development and amount of light received from above and the sides. If the original crown class on remeasurement plots is missing, record an estimate; otherwise, record the original crown class.

Code Crown Class

- 1 Open grown. Trees with crowns which have received full light from above and from all sides throughout all or 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.

Stocking Percent. Item 31.

There are two tables for assigning stocking percent. The table to be used is determined separately on each point by the point description given at the top of each table listed below. Following the order of point occupancy assigned to trees on a particular point, stocking percent is assigned to live trees according to the tree's DBH class.

A maximum of 16.0 percent stocking will be assigned to each point. The last tree to contribute to 16.0 percent total will not usually be assigned its full stocking percent value possible for that DBH 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 which would bring the total to the 16.0 percent stocking necessary for that point.

One or more 5.0" or larger DBH live trees on the point

No live trees 5.0" DBH or larger on the point

<u>DBH</u>	<u>Stocking Percent</u>	<u>DBH</u>	<u>Stocking Percent</u>
5.0"+	4.7	4.0-4.9	4.0
4.0 - 4.9	4.0	3.0-3.9	3.5
3.0 - 3.9	2.4	2.0-2.9	3.0
2.0 - 2.9	1.2	1.0-1.9	2.5
1.0 - 1.9	0.4	Seedling	2.0

Stocking percent is used to determine forest type and the number of trees to be tallied. It is not necessary to record stocking percent on the tally sheet. If the tallier chooses to record stocking percent it should be recorded on all ten points using a two digit code. Example: .4% recorded as 04, 2.4% recorded as 24.

Point Occupancy. Item 32.

Show the order of occupancy by ranking those trees tallied on a point that are making the most use of the site. Crown class, crown ratio, and DBH 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 point occupancy using the following one-digit codes:

<u>Code</u>	<u>Point Occupancy</u>
1	Most controlling tree
2	Second most controlling tree
3	Third most controlling tree
4	Fourth most controlling tree
5	Fifth most controlling tree
6	Sixth most controlling tree
7	Seventh most controlling tree
8	Eighth most controlling tree and all remaining trees on the point.

No code greater than 8 is recorded.

Note: For seedling points follow the rule on page 42 for order of preference.

Tree Cavities. Item 33.

At each sample point, examine all live and dead trees 5.0" DBH and larger for cavities that could be used as nesting, resting or storage by birds or mammals. For the largest cavity record a 2-digit code to indicate the size of the cavity entrance hole and location of the cavity in the tree. The first digit will indicate the cavity hole size, the second digit indicates the location of the cavity.

To qualify as a cavity, the entrance hole must be 1.0" or larger in the main stem, fork, or larger limb. (A large limb must be greater than 8.0" in diameter o.b.) Cavity size is largest diameter circle that can be made from existing hole.

(Codes on next page)

(Tree cavities, continued)

First digit		Second digit	
<u>Code</u>	<u>Size of opening</u> (inches)	<u>Code</u>	<u>Location of cavity</u> (feet)
1	1	1	0-1
2	2	2	2-5
3	3	3	6-9
4	4	4	10-19
5	5	5	20-29
6	6	6	30-39
7	7	7	40-49
8	8	8	50-59
9	9+	9	60+

Sawlog Length, Item 34.

Sawlog length on live or dead sawtimber size trees is the distance from the top of the one foot stump to a minimum top of 7.0" D.O.B. (diameter outside bark) for softwoods sawtimber and 9.0" D.O.B. for hardwood sawtimber or to the point on the bole above which no merchantable sawlog exists.

Record sawlog length on live or dead 20 and 31 class sawtimber size trees.

Record sawlog length to the last whole foot. Example: Sawlog length of 14.8' would be recorded as 14.

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 or "stoppers" for hardwoods grades 1, 2, and 3 and for all softwoods are any limb or group of 2.0" or larger limbs within a one-foot span whose sum exceeds DOB 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 $\frac{1}{3}$ the stem DOB of that section.

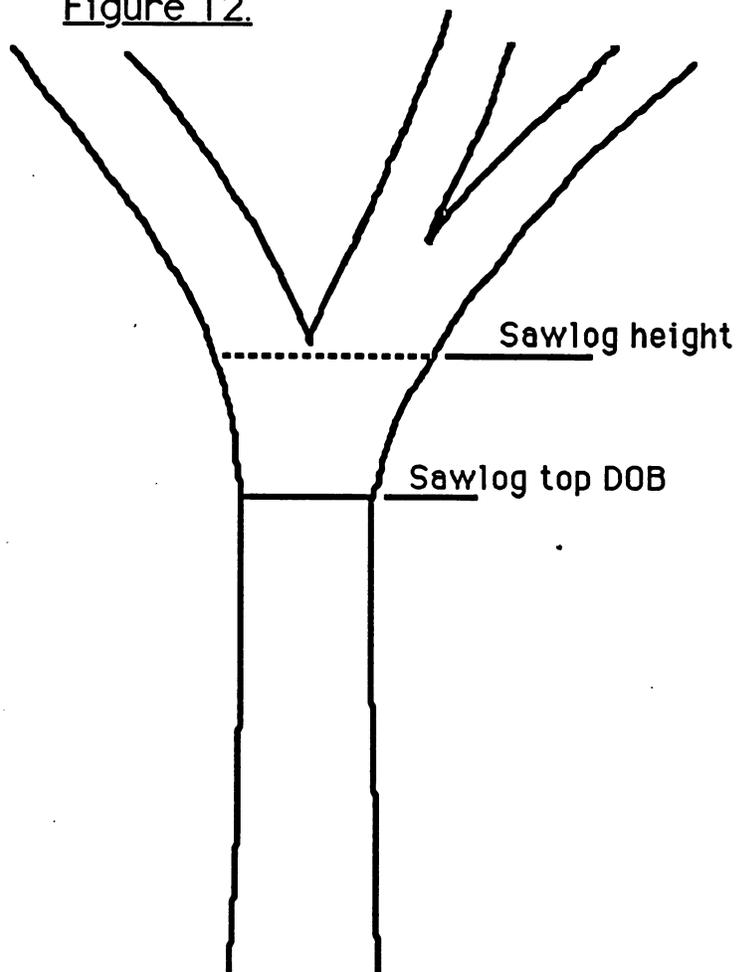
Minimize limb limitations by logical log making, aimed at obtaining the longest sawlog length. For example, bucking between staggered limbs within a one-foot span whose combined diameters exceed the D.O.B. at point of occurrence may give a longer sawlog length.

In situations where limbs are a limiting factor in determining merchantable length, length will be taken to the point where the limbs divide the diameter of the merchantable section. (See Figure 12).

No sawlog length reduction will be made because of an unmerchantable section as long as a merchantable 8' or longer log is present above the unmerchantable piece.

In the case of trees forking above DBH, sawlog length will be taken on the trunk yielding the greatest length.

Figure 12.



Sawlog Top Diameter Outside Bark, Item 35.

For each sawtimber-sized tree record sawlog top DOB to the last 0.1", using a three-digit code. For example, record 7.0" as 070. The minimum top D.O.B. recorded for softwoods will be 7.0" and 9.0" for hardwoods. For trees with sawlog length terminating before reaching minimum top D.O.B., or if the sawlog length is affected by a fork or the flare from a limb, the smallest diameter immediately below the swell is recorded.

Board Foot Cull, Item 36.

Board-foot cull is the volume within the sawlog portion of trees which cannot be recovered for use as lumber because of rot, sweep, crook, forks, or other defects.

Cull Volumes Include:

1. The entire volumes of tree sections which do not meet minimum log grade requirements.
2. The entire volume in any one foot or longer section of a tree which is less than 50% sound.
3. The cull volume only, in any one foot or longer section of a tree which is greater than 50% sound.
4. Computed volumes for sweep and crook.
5. Forks or stoppers.

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 in slabbing for lumber and rounding for veneer are ignored.

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 on the "Tatum Guides". 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 on the "Tatum Guides".

Use a four-digit code to record cull volume, to the last board foot. When no sawlog is present, record a dash " - " in Board-Foot Cull on sawtimber-sized trees.

Log Grade. Item 37. 3 digits

First Digit

Grade the first sawlog in each live sawtimber tree and record a one-digit code corresponding to the log grade number. If a tree does not have one 12' or two 8' sawlogs that meet minimum log grade requirements, it is a cull tree. For hardwood sawtimber (20 class) trees grade the best 12' of the lowest 16' section or the best 12' of an upper section if the butt log does not meet minimum log grade standards. "A Guide to Hardwood Log Grading (Revised)" and the "Tatum Guides" will be used in determining log grade.

For softwood sawtimber (20 class) trees grade first merchantable 16' log or shorter lengths down to 12' if a 16' log is not present. Use the grading rules in the "Tatum Guides" to assist in determining log grade.

Sawlog 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 sawlog length above the limitation. Limitations or

"stoppers" 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 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.

For 31 class trees grade the log that is present. Sawlog grade for all qualifying sawtimber trees on one-third of the plots in Minnesota will be recorded. For Minnesota, all sample kind 1, 2 and 6 plots will receive a log grade.

IOWA AND SOUTHERN MINNESOTA (UNITS 3 and 4)

For hardwood sawtimber trees (tree class 20), grade the sawlog portion of the tree using "Hardwood Tree Grades for Factory Lumber". The table on the next page contains the specifications for hardwood tree grades. Use the table on the next page and the following steps to determine tree grade.

- a) Measure DBH
- b) Establish the location of all defect indicators - "stoppers" - on the surface of the butt 16-foot log, and then locate the best 12-foot section.
- c) Estimate inside bark diameter at the top of the 12-foot section to the nearest inch.
- d) Estimate scalable defect in the 12-foot section selected previously.
- e) The grade of the 12-foot section becomes the tree's grade, unless the grade can be improved by using a 14- or 16-foot section

Table of hardwood tree grades for factory lumber

Grade factor	Tree grade 1			Tree grade 2		Tree grade 3
Length of grading zone (feet)	Butt 16			Butt 16		Butt 16
Length of grading section <u>a/</u> (feet)	Best 12			Best 12		Best 12
DBH, minimum (inches)	16 <u>b/</u>			13		11
Diameter, minimum inside bark at top of grading section (inches)	13 <u>b/</u>	16	20	11 <u>c/</u>	12	8
Clear cuttings (on the 3 best faces) <u>d/</u>						
Length, minimum (feet)	7	5	3	3	3	2
Number on face (maximum)		2		2	3	<u>e/</u>
Yield in face length (minimum)		5/6		4/6		3/6
Cull deduction (including crook and sweep, but excluding shake) - maximum within grading section (%)		9		9 <u>f/</u>		50

- a/ Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors such as diameter and cull deduction.
- b/ In basswood and ash, DIB at top of grading section must be 12 inches and DBH must be 15 inches.
- c/ Grade 2 trees can be 10 inches DIB at top of grading section if otherwise meeting surface requirements for small grade 1's.
- d/ A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.
- e/ Unlimited.
- f/ 15% crook and sweep or 40% total cull deduction are permitted in grade 2, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree's grade to 3 unless the cull deduction for rot is greater than 40%.

For hardwood sawtimber trees that do not qualify as tree grade 3, but meet the specifications for hardwood construction lumber logs (tie and timber) assign a grade 4 as we have in the past.

For hardwood sawtimber trees that do not meet minimum tree grade specifications, but have a 12 foot section above the butt log or two 8 foot sections that meet log grade requirements, assign a log grade of 5.

2nd digit

For trees given a hardwood factory log grade of 2, 3 or 4 record the limiting quality factor that is keeping the log from moving into a better quality grade.

<u>Code</u>	<u>Limiting Factor</u>
0	Not applicable, already a grade 1
1	Diameter
2	Length
3	Clear cuttings
4	Sweep and crook
5	Cull
6	Position in tree
7	Multiple factors
8	Diameter and and clear cutting

3rd digit - Walnut and White Oaks only - (White, Swamp white, Bur, Swamp chestnut, Chinkapin)

Indicate the presence of veneer with the following codes. For sawlog-sized 20, 30, and 31 class trees.

<u>Code</u>	<u>Veneer status</u>
0	Not or never veneer or not walnut and white oak
1	Not veneer now but will be (diameter limiting factor)
2	6-7'
3	8-9'
4	10-11'
5	12-13'
6	14-15'
7	16-17'
8	18-19'
9	20' +

MINIMUM VENEER REQUIREMENTS

	<u>WALNUT</u>	<u>WHITE OAK</u>
LENGTHS	6' to 17'	7' 4" to 17'
DIAMETER	12" and up	14" and up
CONTENT (Doyle)	36 BF (6' & 14" 7' & 13")	50 BF (8' & 14" 7' 4 & 14.5")
ALLOWABLE DEFECT	90% clear (2 pcs.) Min. cutting 5'	14"-22" 90% clear (2 pcs.) 22" up 85% clear (4 pcs.) Min. cutting 6'

DEFECTS TO BE CONSIDERED IN STANDING TIMBER

1. Blind knots/catfaces
2. Worms/birdpeck - more than 2 birdpecks, removes log from veneer
3. Scars
4. Crook - no more than 1"/6'
5. Twisted grain - no more than 1"/6'
6. Grubs/pinworms
7. Rot/dote (old age)
8. Frost cracks
9. Abnormal swells
10. Metal
11. Ingrown bark
12. Pinknotes

Bole Length, Item 38.

Bole length of all trees 5.0" DBH and larger should be determined between the top of a one-foot stump and 4.0" diameter outside bark, or to the point where the central stem or branch breaks into limbs and above which there is no 4.0" D.O.B.

In the case of 20 class sawlog size trees forking above DBH, bole length is taken on the same trunk as sawlog length.

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.

Note: NEVER ZERO OUT BOLE LENGTH EVEN IF NO MERCHANTABLE VOLUME IS PRESENT.

Bole Length Top D.O.B., Item 39.

Top D.O.B. will be measured to the highest possible 4.0" D.O.B. or where the central stem or branch breaks into limbs and above which there is no 4.0" D.O.B. Use a 3 digit code to record bole top D.O.B. to the last 0.1". Bole length top D.O.B. is measured at the smallest point before the bole length terminates. If the bole length is taken to the bottom of a fork or the flare from a limb, the smallest diameter immediately below the swell is recorded.

Cubic-Foot Cull, Item 40.

For all live and dead trees, cubic-foot cull is the cubic-foot volume of decayed or missing wood up to the bole length top.

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", "Cubic Foot Volumes of Short Logs", item 57. 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).

Site Index. Item 42.

Site index is the height attainable by the average dominant and codominant trees of one species in a stand at an index age (usually 50 years in the eastern states). It reflects the combined effects of different environmental factors, and is used as an indicator of stand productivity.

For Forest Survey, site index will be determined in the field using available site index curves appropriate for the area.

For remeasurement plots, a new site index will be recorded.

Site Tree Selection. On each site plot that site index entries are required, a minimum of three site index trees of one species will be measured. Site tree species selection will be based on availability of suitable site trees. As a general rule, you should first use tree species that are of the plot forest type. If none are available, use any suitable tree, as long as a site index curve is available for it.

An exception to this is eastern redcedar. To use redcedar as your site index tree, the plot forest type must be Eastern Redcedar (35) or Eastern Redcedar-Hardwood (42).

Generally, site trees should be vigorous in growth and still putting on height. Avoid trees declining in vigor or stagnated. All site trees should have been dominant or codominant throughout their lives. Do not use trees that have been 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. Avoid trees with major injuries. Finding vigorous, free growing trees is more important than finding the biggest trees in the stand. Site trees should be at least three inches in diameter and 15 feet tall for use with most site index curves. Site trees should be near the index age of the site index curves for that species. Look for trees that are 20 to 80 years old for curves based on an index age of 50 years.

Reliable site index curves are available for most tree species that are major components of forest types in the survey area. Crew members should be aware of what species have site index curves available. Do not collect site index data on a species unless curves are available.

Site trees should be well distributed over the plot area. If there are no suitable site trees on the plot, select nearby trees from the same general aspect, elevation, and soil type. Feel free to collect and record data on more than one species if it is needed to get a good site index estimate. Do not select permanent tally trees.

The location of the site trees from the nearest plot point will be noted on the sketch of the 10-point cluster layout on the header sheet.

Growth Intercept Method. In the event suitable trees are not available for use with site index curves the growth intercept method of measuring site index may be an alternative. This method has been proposed and tables developed for some tree species that have limbs showing distinct annual whorls (ex. red pine and southern pines). This method is applied in situations where only young trees (less than 25 years old) of these species are available for site index indicators. Crew members should be familiar with what species have these tables available and how to use them. Record that this method was used in the notes section and record height, age, and diameter as usual on plot sheet.

For red pine:

<u>Height growth during</u> <u>last 5 years</u>	<u>Site Index</u> (Estimated)
4 feet	46
5 feet	50
6 feet	53
7 feet	57
8 feet	60
9 feet	63
10 feet	67
11 feet	70
12 feet	74

Site Tree Data. For all trees measured for site index information record a tree history code of 99, site tree number starting with #41, species, DBH, total height under bole length, total age under bole length top DOB, and the years added to age at D.B.H. under cull cubic feet. All site index information collected should be coded on the front of the plot sheet, not in the notes.

Minimum Stand Productivity. In order for a stand to be classified as productive commercial land, there must be at least one tree in the plot area that has a site index that meets the minimum site indices below.

<u>Species</u>	<u>Minimum</u> <u>Site Index</u>
N. white cedar	15
Black spruce	20
Tamarack	20
E. red cedar	25
All other species	35

Remember, the productive tree need not be the same species as the forest type.

Techniques of Site Data Collection. Careful measurement of tree diameter, height, and age are essential to get a good estimate of site index.

Tree DBH. See DBH section of the survey manual.

Tree Height should be taken to the nearest whole foot. Use the 30' height pole on trees that are 30' tall or less. On trees greater than 30' tall use your clinometer and tape. The distance you stand from the base of the tree should be approximately equal to the total tree height. Make a visual estimate of tree height before choosing the scale on the clinometer that you want to use. Choose a place to stand that gives you a clear view of both the top and base of the tree. Try to keep the sun at your back.

Tree Age is taken at DBH using an increment borer. Keep your increment borer clean and sharp to get clean, smooth cores. WD-40, sharpening stones and instructions are available in the office. Ring porous hardwood are generally easy to count. Growth rings of many softwood and diffuse porous hardwood can be difficult to see. To get an accurate count on these species it can help to moisten the core and hold it up to the light. If growth rings are very difficult to see, put the core in a plastic straw, label it, and bring it into the office or motel with you. Try soaking the core, shaving one side of it clean and holding it up to or under a strong light. Winter is a good time to use this method. Count growth rings more than once and have your partner count them to reach agreement on the tree age.

It is probably wise, especially in winter, to collect site index information as soon as you have located the plot. Site index trees can also be measured as you come across suitable individuals while doing the plot rather than waiting until the end.

Site Index-Record the highest value obtained for site index on the front of the plot sheet. (Record the site index value for the species actually bored).

Site Tree Species - Record a three digit code for the species of tree bored in determining site index.

FIELD AND OFFICE PROCEDURES

Basal Area Per Acre. Item 43.

Using a three-digit code record the basal area per acre for the plot. BA/Acre is determined by totaling all trees counted for basal area on all ten sample points, then multiplying the total number of trees counted by 3.75. Total BA/Acre may be determined directly from the "Basal Area Table" in the "Tatum Guides". For remeasurement plots, the original basal area per acre will be recorded on the plot header sheet in St. Paul.

Forest Type-Stand/Size Class. Item 44. New sample plots.

Forest type (first and second digit): Forest type is calculated in the St. Paul office based on plurality of stocking of all live trees. For new sample plots, field crews are to record the appropriate two digit code based on a visual estimate while in the plot area. Forest type is based on the flowchart on the state supplement sheet. If there is insufficient stocking, use your best judgment. St. Paul personnel will use your estimate as a check against your data, and as the forest type in cases of insufficient stocking. For remeasurement plots, the original forest type will be recorded on the plot header sheet in St. Paul and is not to be changed.

Stand Size Class (3rd Digit): Normally, this item is calculated in the St. Paul office. On new sample plots it is not necessary for field crews to exactly calculate stand size class in the field. A visual estimate will be sufficient. However, one primary use of stand size class is to correctly estimate the stand age of the sample location. If you don't know the stand size class, how can you accurately estimate stand age?

The best solution to this "Catch 22" is to record your best estimate for stand size class and stand age. If there is any doubt at all in your mind that the stand size class may be different, then record the stand age(s) for the other possible stand size class(s) in the Notes section of the Plotsheet.

If ten or fewer trees are recorded, enter the estimated size class. This will be assumed to be correct by the St. Paul office. For remeasurement plots, the original stand size will be recorded on the plot header sheet in St. Paul and is not to be changed.

Below are the rules to determine stand size class:

Use stocking percents of all live trees to calculate stand-size class. Separate and total the stocking percents of all live 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 "3"; if poletimber-sawtimber is higher, whichever one is greater will receive the stand size class. When ties occur, poletimber-sawtimber is favored over seedling-sapling and sawtimber is favored 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 codes: (See next page)

<u>Code</u>	<u>Stand-size Class</u>	<u>Stand Age ranges (years)</u>
1	Sawtimber stands	> 40 for hardwoods > 30 for softwoods
2	Poletimber stands	Minimum 20; maximum 80
3	Sapling and seedling stands	<20
4	Nonstocked stands	

Note: (new sample plots)

The use of the size and stocking percent (Item 31) codes is optional. If you are fairly sure of forest type and stand size class, you may skip these entries. Stocking percent and size are not recorded in St. Paul and are for your benefit in determining forest type and stand size class. The stocking rules still apply.

IOWA FOREST TYPES

Code Type-description

- (42) Eastern redcedar-hardwood--Forests in which hardwoods (usually upland oaks) comprise a plurality of the stocking but in which eastern redcedar comprises 25 to 50 percent of the stocking. (Common associates include post oak, black oak, chinquapin oak, blackjack oak and hickory.)
- (53) White oak - red oak - hickory--Forests in which white oak, northern red oak, black oak, northern pin oak, bur oak, shagbark or bitternut hickory, singly or in combination, comprise a plurality of the stocking. Common associates include white or green ash, sugar maple, and occasionally black cherry, butternut, bigtooth aspen, and black walnut. The type is often referred to by the generic term "oak-hickory"
- (54) White oak--Forests in which white oak comprises more than 50 percent of the stocking of the primary typing species for the oak-hickory type. Associated species are black oak, northern red oak, bur oak, shagbark and bitternut hickories, white ash, and bigtooth aspen.
- (59) Bur oak--Forests in which bur oak comprises more than 50 percent of the stocking of the primary typing species for the oak-hickory type. Associated species include northern pin oak, northern red oak, white oak, black oak, basswood, American elm, green ash, boxelder, hackberry, cottonwood, and hophornbeam.
- (70) Elm-ash-cottonwood--Forests in which elm, ash, or cottonwood, singly or in combination, comprise a plurality of the stocking. Associates include black willow, sycamore, boxelder, silver maple, river birch, and other moist site hardwood species.
- (73) Cottonwood--Forests in which cottonwood comprises a plurality of the stocking of the major typing species of the elm-ash-cottonwood type.

Iowa Forest Types, continued

- (82) Maple-basswood.--Forests in which sugar maple or basswood, singly or in combination, comprise a plurality of the stocking. Associated species include American elm, green ash, yellow birch, white pine, and northern red oak.
- (91) Aspen.--Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. Associates include bur oak, green ash, American elm, paper birch, and boxelder.

MINNESOTA FOREST TYPES

Code Type-description

- (01) Jack pine.--Forests in which jack pine comprises a plurality of the stocking. Common associates include eastern white pine, red pine, aspen, birch, and maple.
- (02) Red pine.--Forests in which red pine comprises a plurality of the stocking. Common associates include eastern white pine, jack pine, aspen, birch, and maple.
- (03) White pine.--Forests in which eastern white pine comprises a plurality of the stocking. Common associates include red pine, jack pine, aspen, birch, and maple.
- (12) Black spruce.--Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. Common associates include tamarack and northern white-cedar.
- (13) Balsam fir.--Forests in which balsam fir and white spruce comprise a plurality of the stocking with balsam fir the most common. Common associates include white spruce, aspen, maple, birch, northern white-cedar, and tamarack.
- (14) Northern white-cedar.--Forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. Common associates include tamarack and black spruce.
- (15) Tamarack.--Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. Common associates include black spruce and northern white-cedar.
- (16) White spruce.--Forests in which white spruce and balsam fir comprise a plurality of the stocking, with white spruce the most common. Common associates include balsam fir, aspen, maple, birch, northern white-cedar, and tamarack.
- (50) Oak.--Forests in which northern red oak, white oak, or bur oak, singly or in combination, comprise a plurality of the stocking. Common associates include elm, maple, and aspen.

Minnesota Forest Types. continued.

- (70) Elm-ash-cottonwood.--Forests in which lowland elm, ash, cottonwood, and red maple, singly or in combination, comprise a plurality of the stocking. Common associates include basswood and balsam poplar.
- (80) Maple-basswood.--Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. Common associates include white pine and elm.
- (91) Aspen.--Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. Common associates include balsam poplar, balsam fir, and paper birch.
- (92) Paper birch.--Forests in which paper birch comprises a plurality of the stocking. Common associates include maple, aspen, and balsam fir.
- (94) Balsam poplar.--Forests in which balsam poplar comprises a plurality of the stocking. Common associates include aspen, elm, and ash.

Stand Age. Item 45 - Determine the age of the predominant stand size class from three or more borings of trees on or near the plot. If there is an insufficient number of acceptable trees to determine stand age, record an estimate. Stand age must reflect stand size class. If you have estimated stand size, record the stand age for other possible stand size classes in the notes section. Example:

Pole 050

Saw 078

Stand age will be recorded with a three digit code to the nearest year. A stand 49 years old will be recorded 049.

Nonstocked stands (stand size class code 4) receive an automatic stand age of 001.

For remeasurement plots the original stand age will be recorded on the plot header sheet in St. Paul.

Stand Area. Item 46

The size of the forest type stand-size density condition that the plot falls in will be determined by the photo interpreter in St. Paul and recorded on the plot sheet in acres. Stand area is the extent of a continuous forested area of the same forest type, stand-size class and stand density.

Distance to Water, Item 47.

Photo interpreters will record from PC, and field crews should check, the straight line distance to the nearest type of water, the actual size, and the actual distance from the plot.

Type of water (One Digit)

<u>Code</u>	<u>Type of Water</u>
1	Streams and Flowages
2	Lakes
3	Swamps
4	Farm ponds
5	Reservoirs

Area (Three Digits):

Area is measured in width for streams and flowages in feet. (000 to 999 feet) + 33 feet

Area is measured in acres for lakes, swamps and farm ponds. (000 to 999 acres) + 5 acres

Distance (Four Digits):

The distance to the body of water measured to the nearest chain. (0000 to 999.5 chains)

Distance to Road, Item 48.

Photo interpreters will record and field crews should check the straight line distance from PC to the nearest maintained road, using the following codes for type and distance:

Type of Road (One Digit)

<u>Code</u>	<u>Type of Road</u>
1	Paved - 4 lane
2	Paved - 2 lane
3	Improved - gravel

Distance (Four Digits):

The distance to road will be measured in chains to the nearest chain.(0000 to 999.5 chains)

Distance to Agricultural Lands, Item 48a

Photo interpreters will record and field crews should check the straight line distance from plot center to the nearest agricultural lands for commercial forest land plots only.

Type of Agricultural Land (One Digit)

<u>Code</u>	<u>Type of agricultural lands</u>
1	Cropland - row crops or cereal grains
2	Pasture, hay fields and idle farmland

Distance (Four Digits)

The distance to agricultural lands (measured in chains to the nearest 1/2 chain - 0000 to 99.5 chains).

Sketch and Notes, Item 49

Items on the back of the forest inventory sample record provide information on the location of the field sample, the layout of the 10-point cluster and description 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 procedure or situations encountered on the plot will be explained in the notes so that remeasurement crews can take them into consideration.

State, Item 51.

Record the appropriate two-digit code from the list of standard codes. State Code for Iowa is 19. State Code for Minnesota is 27.

Unit, Item 52.

Unit Codes, Iowa

Unit 1 - Northeastern Unit
Unit 2 - Southeastern Unit
Unit 3 - Southwestern Unit
Unit 4 - Northwestern Unit

Unit Codes, Minnesota

Unit 1 - Aspen-Birch Unit
Unit 2 - Northern Pine Unit
Unit 3 - Central Hardwood Unit
Unit 4 - Prairie Unit

County, Item 53.

Record the appropriate two-digit county code.

IOWA COUNTY CODES

Unit 1 Northeastern Unit

<u>Code</u>	<u>County Name</u>	<u>Code</u>	<u>County Name</u>
01	Allamakee	13	Fayette
02	Benton	14	Floyd
03	Black Hawk	15	Grundy
04	Bremer	16	Howard
05	Buchanan	17	Jackson
06	Butler	18	Johnson
07	Cedar	19	Jones
08	Chickasaw	20	Linn
09	Clayton	21	Mitchell
10	Clinton	22	Scott
11	Delaware	23	Tama
12	Dubuque	24	Winneshiek

Unit 2 Southeastern Unit

<u>Code</u>	<u>County Name</u>	<u>Code</u>	<u>County Name</u>
01	Appanoose	18	Lucas
02	Boone	19	Madison
03	Clarke	20	Mahaska
04	Dallas	21	Marion
05	Davis	22	Marshall
06	Decatur	23	Monroe
07	Des Moines	24	Muscatine
08	Guthrie	25	Polk
09	Hamilton	26	Poweshiek
10	Hardin	27	Story
11	Henry	28	Van Buren
12	Iowa	29	Wapello
13	Jasper	30	Warren
14	Jefferson	31	Washington
15	Keokuk	32	Wayne
16	Lee	33	Webster
17	Louisa		

IOWA - county codes, continued

Unit 3 Southwestern Unit

<u>Code</u>	<u>County Name</u>	<u>Code</u>	<u>County Name</u>
01	Adair	11	Monona
02	Adams	12	Montgomery
03	Audubon	13	Page
04	Carroll	14	Pottawattamie
05	Cass	15	Ringgold
06	Crawford	16	Shelby
07	Fremont	17	Taylor
08	Greene	18	Union
09	Harrison	19	Woodbury
10	Mills		

Unit 4 Northwestern Unit

<u>Code</u>	<u>County Name</u>	<u>Code</u>	<u>County Name</u>
01	Buena Vista	13	Lyon
02	Calhoun	14	O'Brien
03	Cerro Gordo	15	Osceola
04	Cherokee	16	Palo Alto
05	Clay	17	Plymouth
06	Dickinson	18	Pocahontas
07	Emmet	19	Sac
08	Franklin	20	Sioux
09	Hancock	21	Winnebago
10	Humboldt	22	Worth
11	Ida	23	Wright
12	Kossuth		

MINNESOTA COUNTY CODES

Unit 1 -Aspen-Birch Unit

<u>Code</u>	<u>County Name</u>
01	Carlton
02	Cook
03	Koochiching
04	Lake
05	St. Louis

Unit 2. Northern Pine Unit

<u>Code</u>	<u>County Name</u>	<u>Code</u>	<u>County Name</u>
01	Aitkin	07	Hubbard
02	Becker	08	Itasca
03	Beltrami	09	Lake of the Woods
04	Cass	10	Mahnomen
05	Clearwater	11	Roseau
06	Crow Wing	12	Wadena

MINNESOTA - county codes, continued

Unit 3 Central Hardwood Unit

<u>Code</u>	<u>County Name</u>	<u>Code</u>	<u>County Name</u>
01	Anoka	15	Morrison
02	Benton	16	Olmsted
03	Carver	17	Otter Tail
04	Chisago	18	Pine
05	Dakota	19	Ramsey
06	Douglas	20	Rice
07	Fillmore	21	Scott
08	Goodhue	22	Sherburne
09	Hennepin	23	Stearns
10	Houston	24	Todd
11	Isanti	25	Wabasha
12	Kanabec	26	Washington
13	Le Sueur	27	Winona
14	Mille Lacs	28	Wright

Unit 4 Prairie Unit

<u>Code</u>	<u>County Name</u>	<u>Code</u>	<u>County Name</u>
01	Big Stone	22	Murray
02	Blue Earth	23	Nicollet
03	Brown	24	Nobles
04	Chippewa	25	Norman
05	Clay	26	Pennington
06	Cottonwood	27	Pipestone
07	Dodge	28	Polk
08	Fairbault	29	Pope
09	Freeborn	30	Red Lake
10	Grant	31	Redwood
11	Jackson	32	Renville
12	Kandiyohi	33	Rock
13	Kittson	34	Sibley
14	Lac qui Parle	35	Steele
15	Lincoln	36	Stevens
16	Lyon	37	Swift
17	McLeod	38	Traverse
18	Marshall	39	Waseca
19	Martin	40	Watonwan
20	Meeker	41	Wilkin
21	Mower	42	Yellow Medicine

National Forest, Item 54.

When a sample plot falls on National Forest lands, record a 2-digit code for this item. Zero out this item for sample locations on other lands.

National Forest Codes for Minnesota

09 Superior National Forest

03 Chippewa National Forest

Superior Ranger Districts

01 Aurora
02 Gun Flint
04 Isabella
05 Kawishiwi
06 La Croix
07 Tofte
08 Two Harbors
09 Virginia

Chippewa Ranger Districts

01 Blackduck
02 Cass Lake
03 Deer River
04 Marcell
05 Walker

Definition of Terms. Item 56.

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.
2. Bureau of Land Management Land. Federal land administered by the Bureau of Land Management.
3. Clear Panel. A section of hardwood 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.
4. 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. Same as timberland)
5. 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).
6. Cull. Portions of a tree that are unusable for industrial wood products, because of rot, form, or other defect.
7. 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 partly 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.
8. Diameter Classes. A classification of trees based on diameter outside bark, measured at breast height (4-1/2 feet above the ground). (Note: DBH 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 DBH inclusive).
9. Face. A section of the tree surface one-fourth the circumference of the tree extending the full length of the log.
10. 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.
11. Farm Operator. A person who operates a farm, either doing the work himself or directly supervising the work.
12. Farmer-Owned Land. Land owned by farm operators. (Note: This excludes land leased by farm operators from nonfarm owners, such as railroad companies and states.)
13. Farmer-Owned Leased. Land owned by farm operators, but leased to forest industry.
14. Forest Industry Land. Land owned by companies or individuals operating wood-using plants.
15. Forest Land. Land not currently developed for nonforest use and having at least 16.7 percent stocking of all live forest trees of any size or formerly having 16.7 percent stocking. Roadside or streamside strips of land 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 will be classed as forest if less than 120 feet wide. The minimum area for classification of forest land is 1 acre and 120 feet in width.

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.

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

17. Forest Type. 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 commercial trees that contribute to stocking; that is, up to maximum of 16 percent of each plot point.)
18. Growing-stock Trees. Live trees of commercial species qualifying as acceptable trees. (Note: Excludes rough, rotten, and dead trees.)
19. 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.
20. Hardwoods. Dicotyledonous trees, usually broad-leaved and deciduous.
21. 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.
22. Improved Pasture. Land currently improved for grazing by cultivation, seeding, irrigation, or clearing of trees or brush.
23. Indian Land. Tribal lands held in fee by the Federal government but administered for Indian tribal groups and Indian trust allotments.
24. 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 Census, except minimum width of streams, etc. is 120 feet and minimum size of lakes, etc. is 1 acre.
25. Limb. That part of the tree above the stump which does not meet the requirement for sawlogs and upper-stem portions, including all live, sound branches to a minimum of 4 inches D.O.B.
26. Log Grades. A classification of logs based on external characteristics as indicators of quality or value.
27. Logging Residues. The unused portions of trees cut or killed by logging.
28. Maintained Road. Any road, hard topped or other surfaces, that is plowed or graded at least once a year. Right of ways that are cut or treated to limit herbaceous growth are included in this area.
29. Merchantable. Refers to a pulpwood or sawlog section that meets pulpwood or sawlog specifications, respectively.

30. Miscellaneous Federal Lands. Federal lands other than National Forest, lands administered by the Bureau of Land Management, and Indian lands.
31. Miscellaneous Private Lands. Privately owned lands other than forest-industry and farmer-owned lands.
32. Mortality. Standing or down dead trees that have died within the last three years.
33. 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.
34. Net Volume. Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.
35. 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.
36. 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.
37. 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.)
38. Nonstockable. Areas of forest land not capable of supporting seedlings of commercial species, because of the presence of rock, water, etc.
39. Nonstocked Land. Commercial forest land less than 16.7 percent stocked with growing-stock trees, but greater than 16.7% in all trees.
40. 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.
41. Overgrown Knot. The scar left in the bark by a limb completely overgrown, but still outlined by the circular configuration in the bark.
42. Overstocked Area. 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.)
43. Ownership. Property owned by one owner, regardless of the number of parcels in a specified area.

44. Poletimber Stands. (See stand-size class.)
45. Poletimber Trees. Growing-stock trees of commercial species at least 5.0 inches in DBH, but smaller than sawtimber size.
46. Productive-Reserved Forest Land. Forest land sufficiently productive to qualify as commercial forest land, but withdrawn from timber utilization through statute, administration, designation, or exclusive use for Christmas-tree production as indicated by annual shearing.
47. Prospectively. As used in this manual it refers to the moment a tree will reach sawtimber size at DBH.
48. Rangeland. Land on which the natural plant cover is composed principally of native grasses, forbs, or shrubs valuable for forage.
49. Primitive Roads. Roads that are not maintained and are primarily used by vehicles not intended for highway use (i.e. old logging roads).
50. Rotten Trees. Live trees of commercial species that do not contain at least one 12-foot sawlog or two sawlogs 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.
51. Rough Trees. (a) Live trees of commercial species that do not contain at least one 12-foot sawlog or two sawlogs 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 non commercial species.
52. Roundwood Products. Logs, bolts, or other round sections cut from trees for industrial or consumer uses. (Note: Includes sawlogs, 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.)
53. Salvable-mortality Trees. Standing or down dead trees that are considered merchantable by Regional standards and have died within the last 3-years.
54. Saplings. Live trees 1.0 inch to 4.9 inches in diameter at breast height.
55. Sapling-Seedling Stands. (See stand-size class.)
56. Sawlog. A log meeting minimum standards of diameter, length and and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter outside bark for softwoods of 7 inches (9 inches for hardwoods) or other combinations of size and defect specified by Regional standards.
57. Sawlog Portion. That part of the bole of sawtimber trees between the stump and the sawlog top, being a 9.0 DOB for hardwoods and a 7.0 DOB for softwoods whenever they are present. (Does not refer to sections meeting minimum log grade specifications.)

58. Sawlog Top. The point on the bole of sawtimber trees above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches DOB for softwoods and 9.0 inches DOB for hard woods.
59. Sawtimber Stands. (See stand-size class.)
60. Sawtimber Trees. Live trees of commercial species containing at least a 12-foot sawlog or two sawlogs 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.
61. Sawtimber Volume. Net volume of the sawlog portion of live sawtimber in board feet International 1/4-inch rule.
62. Seedlings. Live trees less than 1.0 inch in diameter at breast height.
63. Site Class. A classification of forest land in terms of inherent capacity to grow crops of industrial wood based on fully stocked natural stands.
64. Softwoods. Coniferous trees, usually evergreen having needles or scale-like leaves.
65. Sound Knot or Limb. Knots or limbs intergrown or encased with the surrounding wood and with no indication of decay. Bark may not be present on the limbs.
66. Stand-Size Class. A classification of forest land based on the size class of all live 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.
67. 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.
68. 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.)

69. 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.)
70. Tree Size Class. A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.
71. 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.)
72. Upper Stem Portion. That part of the bole of sawtimber trees above the sawlog top to a minimum top diameter of 4.0 inches outside bark or to the point where the central stem breaks into limbs.
73. Urban Forest Land - Locationally Reserved. Land that would otherwise meet the criteria for commercial forest land, but is in an urban-suburban area surrounded by commercial, industrial or residential development.
74. 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.
75. 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 of streams, etc. is 120 feet and minimum size of lakes, etc. is 1 acre.

Special Note:

Growth Plot (used only in Minnesota)

TALLY INSTRUCTIONS

The growth plot is a 1/15 acre, 30.4 foot fixed radius plot. It is installed only at point 1 (plot center) of the 10 point cluster on plots with a sample kind of 1, 2, or 6. Tally all live trees 5.0" DBH or larger whose stump centers fall within a 30.4 radius of the pin marking the point center. If no trees meeting these parameters exist at point 1, mention the fact in the notes section of page 1 on the data sheets.

The data for the growth plot is recorded on a separate continuation sheet. Record point number 11 in column 16 of the data sheet. Record tree data in columns 21-30 of the data sheet. Refer to the appropriate section of this manual for further information on these items.

Trees appearing on the growth plot will have their bark marked with a horizontal scribe at DBH and a vertical scribe at the base facing the point center. These scribe marks will be painted with blue paint. There is one exception. Often, a few trees will appear both on the variable radius (prism) plot and on the growth plot. These trees will have their scribe marks painted white.

Oak Drought Mortality Study (Minnesota)

Only from June 1, 1990 to mid-September, 1990

TALLY INSTRUCTIONS

If the tree is a dead oak, did it die during the period of 1988 to the present?

Record the answer in the distance column:

Yes 01
No 02

The new damage code is 909 - Oak with crown dieback or decline greater than 50%, that occurred within the last 3 years due to drought or unknown causes.