

<b>Introduction</b>	<b>1</b>
<b>Field Equipment</b>	<b>1</b>
<b>Overview Of The Plot Designs</b>	<b>2</b>
Old 10-point plot .....	2
New standard plot .....	3
Plot record .....	4
Condition data .....	4
Condition record .....	5
Subplot record .....	5
Shrub record .....	6
Tree record .....	6
Site tree record .....	6
<b>Field Procedures</b>	<b>7</b>
Monumentation .....	7
Starting point tree .....	7
Subplot center .....	8
Subplot witness trees .....	8
Subplot reference trees .....	9
Sample trees .....	9
Plot Record: Items 2-5, 68-73, 76 .....	10
Sample Kind (SK) 1 digit: Item 2 .....	10
Plot Location: Item 3 .....	10
Establish Baseline .....	10
Starting Point .....	10
Azimuth and Distance Computation .....	11
Chaining .....	12
Location Correction .....	12
Chaining to Other Than PC .....	13
Plot Location Procedure For Remeasurement Plots .....	13
Subplot Location .....	16
If unable to locate a remeasurement plot .....	16
Remeasurement plot in the wrong location .....	17
Denied access plot .....	17
State (ST) 2 digits: Item 72 .....	17
Unit (UNIT) 1 digit: Item 72 .....	17
County (CTY) 3 digits: Item 72 .....	17
PI Land Use (PILU): Item 4 .....	18
PI NF/F and PI F/NF 1 digit each: Item 5 .....	18
Current Date (CDAT) 4 digits: Item 68 .....	19
Nearest Water: Item 69 .....	20
Type Of Water (WTYP) 1 digits .....	20
Area Of Water (WARE) 3 digits .....	20
Distance To Nearest Water (WDIS) 4 digits .....	20
Nearest Road: Item 70 .....	20
Type Of Road (RTYP) 1 digits .....	20

Distance To Nearest Road (RDIS) 4 digits.....	20
Sketch And Notes: Item 71 .....	21
GPS Location (GPSN) 7 digits: Item 76.....	21
GPS Location (GPSW) 8 digits: Item 76 .....	21
National Forest-Ranger District (NFRD) 4 digits: Item 73.....	21
Condition Class Records: Items 1, 6, 16-19, 54, 59, 62-64, 66, 75 .....	22
Ownership Class (OWNC) 2 digits: Item 1 .....	22
How To Collect Ownership Information.....	23
How to handle plots that may straddle two ownerships.....	24
Ground Land Use: Item 6 .....	24
Forest land.....	24
Commercial forest land uses .....	24
Noncommercial forest land uses .....	25
Nonforest Land with Trees.....	25
Nonforest Land without Trees.....	27
How to calculate stocking for land use determination.....	30
Ground Land Use Original (GLUO) 2 digits .....	35
Ground Land Use Current (GLUC) 2 digits .....	35
Reason For Change (CAUS) 1 digit: Item 6.....	37
Required Data Items By Ground Land Use .....	37
Ground land use 20, 21, 22, 40, 41, 45, 57, or 59:.....	37
Ground land use 46:.....	38
Ground land use 51-56, 58, 71, 72: .....	38
Ground land use 61-69, 80-99:.....	39
Position , Aspect, Slope, Slope Length, Slope Shape: Item 16 .....	40
Position (POS) 1 digit .....	40
Aspect (ASP) 3 digits.....	40
Slope (SLP) 2 digits .....	40
Slope Length (LEN) 4 digits .....	41
Slope Shape (SHP) 1 digit .....	41
Physiographic Class (PHYS) 1 digit: Item 17 .....	42
Stand Origin (SORI) 1 digit: Item 18 .....	42
Stand History (SHIS) 2 digits: Item 19 .....	43
Site Index (SI) 3 digits: Item 59.....	44
Site Tree Species (SPP) 3 digits: Item 54 .....	44
Forest Type-Stand/ Size Class (FTS) 3 digits: Item 62.....	44
Stand Age (AGE) 3 digits: Item 63.....	44
Stand Area (AREA) 3 digits: Item 64.....	45
Tree Cover Width (TCWD) 2 digits: Item 66 .....	45
Posting (POST) 1 digit: Item 75 .....	46
Subplot Records: Items 7-14 .....	46
Subplot center.....	46
Subplot Number (SUB#) 2 digits: Item 7.....	46
Condition Number (CON#) 1 digit: Item 8.....	46
Cover Class (COVC) 2 digits: Item 9.....	47
Percent Of Subplot Area (%SAR) 3 digits: Item 10 .....	47
Additional conditions on a subplot.....	48

Percent Of Subplot Area (%SAR) 3 digits: Item 10 .....	48
Azimuth Left (AZML) 3 digits: Item 11 .....	48
Azimuth Right (AZMR) 3 digits: Item 12 .....	48
Azimuth Corner (AZMC) 3 digits: Item 13 .....	48
Distance Corner (DISC) 2 digits: Item 14.....	48
Mapping nonforest conditions .....	55
Plot sketch map .....	56
Shifted subplot centers .....	57
Shrub Records: Items 22-29 .....	57
Subplot Number (SUB#) 2 digits: Item 22.....	57
Shrub Number (SNUM) 2 digits: Item 23.....	57
Species (SPP) 3 digits: Item 24.....	57
Shrub History (SHIS) 2 digits: Item 25.....	58
Diameter Class (DIAC) 2 digits: Item 26 .....	58
Frequency Of Stems Present (FREQ) 3 digits: Item 27 .....	58
Percent Cover (COV) 1 digit: Item 28.....	58
Evidence Of Browsing (BROW) 3 digits: Item 29.....	58
Tree Records: Items 30-43, 74 .....	59
Sample Kind 1 and 7 (new plots).....	59
Sample Kind 2 and 6 (remeasured plots) .....	59
Checking trees when subplot center is inaccessible.....	60
Subplot Number (SUB#) 2 digits: Item 30.....	61
Tree Number (TR#) 2 digits: Item 31 .....	61
Tree Species (SPP) 3 digits: Item 32.....	61
Tree History (THIS) 2 digits: Item 33 .....	62
New plots (Subplots 21-24).....	62
Remeasurement plots .....	62
Tree Distance (DIST) 2 digits: Item 34.....	70
Diameter Breast Height (DBHO, DBHC) 3 digits: Item 35 .....	70
Tree Azimuth (AZM): Item 36 .....	74
Condition Number (COND) 1 digit: Item 37 .....	75
Damage Or Cause Of Death (DAM) 3 digits: Item 38 .....	75
Tree Class/Decay Class (TCO, TCC) 2 digits: Item 39 .....	76
20--Growing Stock .....	76
30--Rough Cull, Salvable, and Salvable-down .....	76
31--Short-log Cull.....	77
40--Rotten Cull.....	77
41--Solid.....	77
42--Solid-punky .....	78
43--Punky .....	78
44--Disintegrating .....	78
45--Gone .....	78
Crown Ratio (CRO, CRC) 1 digit: Item 40.....	78
Crown Class (CCO, CCC): Item 41.....	79
Tree Cavities/Number Of Seedlings (TCAV) 2 digits: Item 42 .....	79
Tree Cavities .....	79
Number Of Seedlings .....	80

Tree Grade (TGRD) 3 digits: Item 43.....	80
Total Tree Height (THGT) 3 digits: Item 74 .....	84
Site Tree Records: Items 51-59.....	84
Site Tree Data.....	85
Site Tree Selection .....	85
Growth Intercept Method.....	86
Tree Height (HGHT) 3 digits: Item 55 .....	86
Bored Age (BAGE ) 3 digits: Item 56.....	87
Total Age (TAGE ) 3 digits: Item 57 .....	87
Years Added To Bored Age (YADD) 2 digits: Item 58 .....	87
Site Index (SI) 3 digits: Item 59.....	87
Site Tree Species (SPP) 3 digits: Item 54 .....	87

**Definition Of Terms** **1**

**Appendix** **1**

Biomass Study "Shrubs" (SPP): Item 24 .....	1
Illinois and Indiana Shrub Species .....	1
Tree Species (SPP): Item 32.....	2
Illinois and Indiana tree species.....	2
Damage Or Cause Of Death (DAM): Item 38 .....	5
Illinois and Indiana damage codes and coding criteria.....	5
Forest Type (FTS): Item 62.....	8
Central States Forest Types (Illinois and Indiana) .....	8
County (CTY): Item 72 .....	9
Illinois (State code 17 County Codes by Unit .....	9
Indiana (State code 18) County Codes by Unit.....	10
National Forest-Ranger District (NFRD): Item 73.....	11
Illinois National Forest-Ranger District Codes.....	11
Indiana National Forest-Ranger District Codes .....	11
Data Recorder .....	12
Hot keys.....	12
Screens .....	12
Global Positioning System (GPS) instructions.....	16
Setup Instructions .....	16
Operations in the Field.....	18
Collecting the Plot Center Coordinate .....	19
What to Do When You Can't Get to Plot Center .....	20
Maintenance.....	21
Recommended Site Index Curves for Illinois and Indiana .....	22
Additional Information.....	23
Tatum Guides .....	23
Site Index Curves .....	23
IL Forest Resources Districts .....	23
IN DNR District Foresters, State Forests, and Recreation Areas .....	23
Field plot sheets.....	23

# 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.

Federal legislation mandates that periodic inventories and assessments be made of the Nation's forest resources. The U.S. Forest Service has the responsibility for meeting this mandate.

"Anyone who establishes a permanent plot should recognize that he or she hereby assumes responsibility for furnishing workers with a complete picture of conditions on the plot at the time of its establishment. Not only must each plot be properly marked and all measures be in near perfect order, but all notes and records must be complete. Otherwise, the plots may fail to yield the desired results and those who in later years become responsible for their care and for the analysis of the data, may be led to serious mistakes."

(US. Department of Agriculture, Forest Service 1935)

Each forest experiment station has been assigned to provide statistics for a number of specific states (11 states for the North Central Station). Statistics from each station must be presented in a manner that permits aggregation with those from the other stations in order that uniform regional and national statistics may be produced. The experiment stations are further directed to cooperate with other agencies and individual states in order to provide additional resource information.

## Field Equipment

The following equipment is necessary to measure required items at field locations. Field personnel should check to make sure they have this equipment, and that it is in good working order.

- Pocket Stereoscope
- Plot Tape (100 ft. woven type) & chaining pin
- Clinometer (Suunto)
- Clip Board (With Tatum Guides & Photo Scales)
- Telescopic Height Pole (30 ft.) - 1 per crew or vehicle
- Cruiser's Vest
- Tree Marking Scribe
- One Yellow Stake
- Ten Metal Pins
- Data Recorder
- PLGR GPS Unit
- 37.5 Factor Prism
- Hand Ax
- Compass (Suunto)
- Increment Borer
- Diameter Tape
- Photo Holder
- Tree Paint
- Flagging
- Safety Pin
- Hip chain (1 per crew)
- Field plot sheet

# Overview Of The Plot Designs

The 1996 inventory of Indiana and Illinois will use a different field plot design than was used in the previous inventory. This new design is being adopted by FIA nationwide in an effort to establish a uniform system across the country. In order to institute this change, and to be able to obtain information about tree growth, field measurements will consist of two parts, 1) the remeasurement of the old 10-point plot that was measured in the previous inventory (a cluster of 10, 37.5 BAF variable radius subplots) and 2) the establishment of the new standard plot (a cluster of 4, 1/24th acre fixed radius subplots). These two plots will be measured at the same ground location, by a single field crew, on a single visit. Trees tallied on either plot will be permanently marked with paint (except in reserved areas). Blue paint will be used to mark all trees tallied on the new standard plot. White paint will be used to mark trees tallied on the old 10-point plot that are not tallied on the new standard plot. A brief overview of these two plot designs follows.

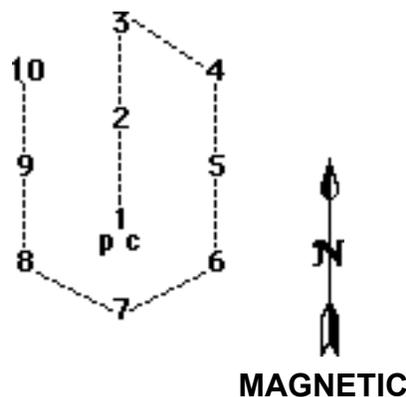
## Old 10-point plot

The basic old 10-point plot consists of 10 subplots. The layout of these subplots is shown in figure 1. Plot center is the term applied to the point used to locate the plot. It is the ground location that corresponds to the pin prick on the photography. The centers of the subplots are referred to as subplot centers. Subplot center 1 is the same as plot center. Each subplot consists of a variable radius (37.5 BAF) plot to sample trees 5.0 inches and larger. A fixed radius micro plot (6.8 ft. radius) to sample trees less than 5.0 inches was measured at subplots 1, 2 and 3. Subplots whose centers were determined to be in a different land use than plot center were rotated so that all ten subplots fell in forest land. Plots were not established if plot center did not fall in forest land even if it was near forest land and some of the subplots would have been in the forest.

The pattern of the old 10-point plot was designed to obtain a uniform distribution of subplots over approximately one acre of forest land. Distances between sequential subplot centers is 70 horizontal feet. (fig. 1).

**Figure 1. Old 10-point plot layout.**

<u>From subplot center</u>	<u>70' to subplot center</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°



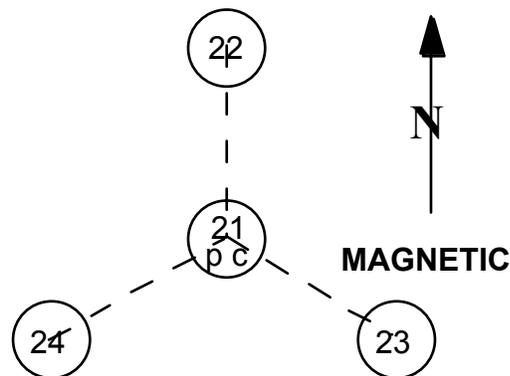
After subplot center 1 has been relocated, establish, locate, and mark the other nine subplot centers with metal pins and flagging in the **same** location that they were last measured. All trees measured in the previous inventory will be remeasured and any new trees that have grown on to this plot will also be measured. Previously rotated subplots will be remeasured in their rotated locations. No additional rotating or unrotating will be done.

**New standard plot**

The new standard plot design consists of a series of fixed-area, circular subplots tied to a cluster of four points that are spaced 120 ft (36.6 m) apart (fig. 2). The sampling unit for most tree measurements (trees  $\geq 5.0$ " DBH) is the 1/24-acre (1/60 hectare) subplot. The radius of this plot is 24.0 ft (7.32 m). A tree is on the subplot if its center (at the base of the tree) is within 24.0 ft of subplot center. Each subplot also includes a 1/300-acre (1/750 hectare) micro-plot centered at the same points (6.8 ft (2.07 m) radius). Seedlings, saplings, and other vegetation are measured on the micro-plot. To distinguish subplots on the new standard plots from subplots on the old 10-point plot, the new standard subplots will be given subplot numbers 21-24 and the old 10-point subplots will be numbered 1-10.

**Figure 2. New standard plot layout.**

<u>From subplot center</u>	<u>120' to subplot center</u>	<u>Azimuth</u>
21	22	0°
21	23	120°
21	24	240°



## Plot record

A number of data items are collected or assigned for plot center, that is, they are only collected once for any plot. These data items apply to both the new standard plot and the old 10-point plot because they share the same plot center. In general, items in the plot record identify the plot, help to locate the plot, or describe some attribute of plot center. These data items are:

State *	Forest/nonforest PI indicator ‡
Unit *	Township *
County *	Range *
New plot number *	Section *
Old plot number *	Subdivision *
Dot number ‡	Office - Photo number *
Sample kind *	Office - Photo scale *
PI land use ‡	GPS Latitude
Cruiser code	GPS Longitude
Tallier code	Weather conditions
County name *	Starting point description
Type of closest water *	Direction to first subplot
Area of closest water *	Distance to first subplot
Distance from closest water *	First subplot number
Type of closest road *	Data recorder
Distance from closest road *	Cruiser name
National Forest *	Tallier name
Ranger district *	Date
Original date *	Owner name
Current date	Owner address
Nonforest/forest PI indicator ‡	Owner contact

\* These data items are collected or assigned in the office and only verified in the field.

‡ Entered in office, do not change.

## Condition data

Both plot designs require the identification and location of condition boundaries that pass through the plot. A condition is defined as a land use classification or identifiable forest community that meets the following criteria:

- 1) It can be identified on the aerial photograph,
- 2) It is at least one acre in size, and
- 3) It is at least 120 ft in width (except in the case of rights of way, wooded strips, narrow windbreaks, shelter belts, linear water features and urban and other)

Data is collected at various levels. Except for the plot record data mentioned in the previous section, all other data is collected within a condition. Some data describes the condition, and other data describes the trees and or shrubs within a condition or the location of condition boundaries. These various levels of data are described here and the data items in each level are listed. A

complete description of each data item and how to measure them comes in later sections of this manual.

Data items are grouped into records for data entry purposes. The group of data items that directly describe a condition make up the Condition Record. The group of data items that describe the location of a condition or the border between two conditions make up the Subplot Record. The Tree Record is made up of data items collected on trees and the Shrub Record is made up of data items collected on shrubs. Trees and shrubs are measured within conditions. Also, a special Site Tree Record is used to record the information needed to compute the site index of a condition from the site tree measurements. The data items contained in each of these records are listed below with complete descriptions in later sections of this manual.

## Condition record

Each condition that occurs anywhere on one of the subplots must be identified and described. Each condition is assigned a condition number starting at 1 for identification purposes. The first condition (condition number 1) should be the condition found at plot center. If additional conditions are found on the plot they are assigned condition numbers sequentially, starting with 2. As each new condition is met, condition information is recorded on the Condition Record. The following data items make up the Condition Record:

Condition number (CON#)	Stand origin (SORI)
Original ground land use on CON# 1 (GLUO) (plot sheet only)	Stand history (SHIS)
Current ground land use (GLUC)	Forest type-stand size class (FTS)
Reason for land use change on CON# 1 (REAS)	Stand age (AGE)
Aspect (ASP)	Site index (SI)
Position (POS)	Site index species (SISP)
Slope percent (SLP)	Stand area (AREA)
Slope shape (SHP)	Ownership class (OWNC)
Slope length (LEN)	Posting (POST)
Physiographic class (PHYS)	Tree cover width (TCWD)

Any of these data items may be different from one condition to the next. A change in any one of these data items (except ownership class alone) can mark a condition boundary, however it must be identifiable on the aerial photograph, at least one acre in size and at least 120 feet wide (except in the case of rights-of-way, linear water features, wooded strips, narrow windbreaks, shelterbelts and urban and other).

## Subplot record

The data items in the subplot record identify and map the conditions that occur on each subplot. There will be at least 4 subplot records for every completed plot and an additional 10 subplot records if it is a remeasured plot. The first subplot record for a subplot corresponds to the condition present at subplot center. Whenever the boundary between any two conditions clearly cuts through the area defined by a 24 ft radius circle around any subplot center, an additional subplot record must be recorded for that subplot. This additional subplot record identifies the additional condition and locates its boundary. If two adjacent subplots are in different conditions

and the boundary between these two conditions does not clearly cut through the 24 ft circle it will be assumed that the boundary occurs between the two subplots. When only one subplot record is entered for a subplot it is assumed that the entire subplot is within the condition identified at subplot center. The data items that make up the subplot record are:

Subplot number (SUB#)	Azimuth left (AZML)
Condition number (CON#)	Azimuth right (AZMR)
Percent of subplot area (%SAR)	Azimuth corner (AZMC)
Cover class (COVC)	Distance corner (DISC)

### **Shrub record**

The data items in the shrub records describe the shrubs that are measured. Shrubs are measured (only from May 1 to September 30) in the NE quadrant of the micro plots only on new subplots (21-24). The data items in the shrub record are:

Subplot number (SUB#)	Percent cover (COV)
Condition number (CON#)	Diameter class (DIAC)
Shrub number (SNUM)	Frequency of stems present (FREQ)
Species (SPP)	Browse (BROW)
Shrub history (SHIS)	

### **Tree record**

The data items in the tree records describe the trees that are measured. Trees < 5.0 inches DBH are measured on a micro plot (6.8 ft. fixed radius at base of tree-horizontal distance) trees 5.0 and larger inches are measured on either the 1/24th acre fixed radius plot (new subplots) or the variable radius (37.5 BAF) plot (old subplots). The data items in the tree record are:

Subplot number (SUB#)	Crown ratio original (CRO)
<b>Tree number (TR#)*</b>	Crown ratio current (CRC)
Distance (DIST)	Crown class original (CCO)
DBH original (DBHO)	Crown class current (CCC)
DBH current (DBHC)	Azimuth (AZM)
Species (SPP)	Condition number (CON#)
Damage/cause of death (DAM)	Tree cavity/Number of seedlings (TCAV)
Tree class original (TCO)	Tree grade (TGRD) subplots 21-24 only
Tree class current (TCC)	Total tree height (THGT) subplot 21 only
Tree history (THIS)	

\* Do not change.

### **Site tree record**

The data items in the site tree record describe the trees measured to determine the site index of a condition or conditions. Two adjacent conditions may have the same site index and do not require the measurement of different site index trees, however if the same trees are being used for more

than one condition they must be entered for each condition that they are being used for. The data items in the site tree record are:

Tree number (TR#)	Bored age (BAGE)
DBH (DBH)	Total age (TAGE)
Species (SPP)	Years added (YADD)
Height (HGHT)	Site index (SI)
	Condition number (CON#)

## Field Procedures

Permanent forest inventory plots measured during the previous survey are remeasured to obtain information on changes that have taken place between surveys. Some of these changes are reflected in land use, growth, and removals. Therefore, it is important that every plot and every tree tallied previously be accounted for at the time of remeasurement.

Uniform measuring and recording methods ensure efficiency in the collection of forest resource statistics and comparability of the resource data compiled by different units. Precise measurement and classification is essential to keep field-technique errors to a minimum. Errors in classification or tree measurement are expanded several hundred times in the processing phase of the Forest Survey. An accumulation of even small errors may lead to erroneous inventory results.

Plot numbers identify sample plot locations on aerial photographs. The 10 digit plot number is recorded by the photo interpreters. A new plot sheet is completed for all plots sent to the field offices.

For each plot, field crews receive new plot sheets and aerial photographs, with the sample location marked. A remeasurement plot also includes the original plot sheets and aerial photographs if found. Use the location of plots on old photos rather than new photos if the locations differ. For remeasurement plots, check that the plot number on the original plot sheet matches the "Old plot number" on the new plot sheet.

Information obtained at each sample location is recorded on an electronic data recorder and/or a new plot sheet. See the sample field plot sheets in the appendix.

It may be helpful to consult the previous survey manual for procedure or definition changes between the time of the previous and current surveys. Copies are available in the field offices.

The following pages describe tally items. Headings show the tally item name and number and the prompt (in parentheses) that appears on the data recorder.

Most instructions that apply to a new measurement plot also hold true for a remeasurement plot. When necessary, specific instructions are given for a remeasurement plot.

## Monumentation

It is important to be able to relocate plots, subplots, and trees measured during the inventory. The following instructions, along with detailed but concise sketches and notes, will make subsequent

relocation easier. In well-traveled areas, on private lands, and especially in reserved areas less visible markings are appropriate.

### **Starting point tree**

In the field, mark the starting point with paint facing the direction of normal approach. Paint "SP" (in letters four-inches tall) just above where the diameter breast height (DBH) measurement was taken. Paint a three-inches tall "SP" near ground level. Use discretion in painting trees on private lands and in well-traveled areas. Note when painting deviates from normal procedures. In reserved areas do not use paint. Instead, nail a tag marked with "SP" to the base of the tree.

Describe the starting point on the plot sheet under "Starting Point Description." Include the landmarks you used to locate SP. Specify details of the starting point such as:

- Species, DBH, and the face on which the tree is painted.
- Any nearby road, fence, pasture, etc. and the tree's location in relation to that feature.
- Any noticeable characteristic of the SP tree, such as a fork at 10 feet, multiple stems, deer stand, etc.

### **Subplot center**

Subplot centers are marked with wire, bent into a loop and wrapped with blue flagging. Leave about two inches of the wire projecting above the ground. In reserved areas do not attach flagging to the wire.

### **Subplot witness trees**

Designate a witnessed subplot on all established plots. Use Plot Center with three or more witness trees if possible. Witness trees should have the following characteristics:

- located within 120 feet of the witness subplot center
- not likely to die or be cut before the next survey
- species easily located in the stand
- at least 5.0" DBH (or at least 2.0" DBH if no 5.0"+ DBH is available).

Subplots 22, 23, or 24 can be used to witness when subplot 21 has no suitable witness trees. Witness subplots should be within forest conditions if possible.

Record the subplot number of the witness subplot in the "Notes" and the following witness tree data on the plot sheet.

- Species
- DBH
- Azimuth
- Slope distance (to nearest 1/10th foot from witnessed subplot center to the center of the tree at the base)

Some items require measurements to decimal fractions of inches or feet. For these items, the last digit represents a decimal fraction. For example, a tree DBH of 23.4 inches is coded 234. Decimal

points are never placed in coded entries. Mark each witness tree above DBH and at the base with a scribe and paint "X" on the side of the tree facing the witness subplot center. In reserved areas nail a tag with the letter X on it to the base of the tree. facing subplot center.

When an acceptable witness tree is absent, a rock or other permanent feature may be used instead of a witness tree. Describe it and give distances, etc. in the "Notes" section of the plot sheet.

For remeasurement plots, find and inspect the witness trees established on the last survey. 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. Remove the witness paint --scrape the old paint off-- if new witness trees are used.

### **Subplot reference trees**

On many plots, certain subplots within the plot lack information useful in determining their location on future surveys. Examples of this are cover classed subplots, subplots where only seedlings are tallied, and subplots that fall in a nonforest land use.

All established subplots without data that could be used to re-establish its location (i.e. no azimuth or distances to any tree) must be referenced. Mark reference trees above DBH and at the base with a scribe mark and paint on the side of the tree facing the subplot center. Unlike witness trees, there is no set rule for painting a reference tree, but it is best to paint the tree with a number corresponding to the subplot being referenced. This method makes it easier for field crews on the next survey to identify which subplot they have located. In reserved areas a tag with the subplot number is nailed to the base of each reference tree.

There is no need to reference subplots that fall entirely within a nonforest condition. In many cases this would be impossible. For example, there would be no reason to reference a subplot that is entirely in cropland.

Reference trees should have the following characteristics:

- located within 70 feet of the subplot center
- not likely to die or be cut before the next survey
- species easily located in the stand
- at least 5.0" DBH (or at least 2.0" DBH if no 5.0 +" DBH is available).

Record the subplot number, azimuth, slope distance to the center at the base (to the nearest tenth of a foot), and DBH (to the nearest tenth of an inch) for the reference tree in the "Reference Tree" grid of the plot sheet.

### **Sample trees**

Most sample trees are scribed and painted to mark the location of the DBH measurement. **Note that subplots 21-24 are scribed and painted differently than subplots 1-10.** For subplots 21-24, scribe and paint a **blue** two-inch horizontal mark just **below** the **lower** tape at the point where DBH is measured. Do this on the side of the tree facing subplot center. For subplots 1-10, scribe and paint a **white** two-inch horizontal mark just **below** the **lower** tape at the point where DBH is measured. Use only blue paint if a tree is on both 1 and 21. Within the one-foot stump facing

subplot center, scribe and paint a vertical mark to facilitate remeasurement in the event the tree is cut. Paint but do not scribe small, thin-barked trees and trees < 3.0" DBH. Scribe marks should not penetrate the cambium. All standing-dead trees measured are also painted.

In reserved areas mark each sample tree 5.0" DBH and larger with a nail at ground level either facing subplot center or on the uphill side of the tree if there is a slope. If only saplings are on the subplot, mark a couple of them with nails at ground level and note which are so marked. Measure DBH at exactly 4.5 feet above the nail. If DBH needs to be taken at a different location, record the location above the nail to the nearest inch in the DBH High or Low section.

## **Plot Record: Items 2-5, 68-73, 76**

### **Sample Kind (SK) 1 digit: Item 2**

The plot sample kind indicates the information to be collected and identifies whether the plot was previously measured. The following is a list of sample kind codes and their descriptions.

<b>Code</b>	<b>Sample kind</b>
0	Lost (can't be relocated) or denied access plot.
1	Full New Measurement. Install and measure a new standard plot (subplots 21-24). Also, on subplot 21 only, measure total tree height (item 74) if leaves are off deciduous trees.
2	Full Remeasurement Relocate. Measure all old trees, also measure new trees on the old subplots. Install and measure a new standard plot (subplots 21-24). Take total tree height measurements as in Sample Kind #1.
6	Partial Remeasurement Relocate. Measure all old trees and also measure new trees on the old subplots. Install and measure a new standard plot (subplots 21-24). Total tree heights (item 74) are not measured.
7	Partial New Measurement. Install and measure a new standard plot (subplots 21-24). Total tree heights (item 74) are not measured.

**Note: for sample kind 2 and 6 previous inventory data should be uploaded to the data recorder prior to going to the field. See auxiliary manuals for upload instructions.**

### **Plot Location: Item 3**

#### **Establish Baseline**

The first step in locating the forest sample location is finding two features on the ground that are easily noticed on the photograph. The two features should be at least 10 chains apart for scale 1:20,000 and 20 chains apart for scale 1:40,000 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.

Pinprick both features on the photograph and circle the pinpricks on the back of the photos. Draw the baseline 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 half-degree and record it on the back of the photograph. Disregard magnetic declination.

## Starting Point

A starting point (SP) is established for the purpose of locating a sample plot. It should be as near as possible to the sample location, yet not on the same acre as the sample plot.

When selecting the starting point, make sure it is readily identifiable on the ground and on the photograph. Select a prominent tree located at the edge of a field or clearing, at a bend in a stream, or any landmark easy to find on the next survey.

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.

## Azimuth and Distance Computation

On the back of the photograph, connect the pinpricks for the starting point and plot center with a straight line. Extend this line to intersect the baseline. 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.

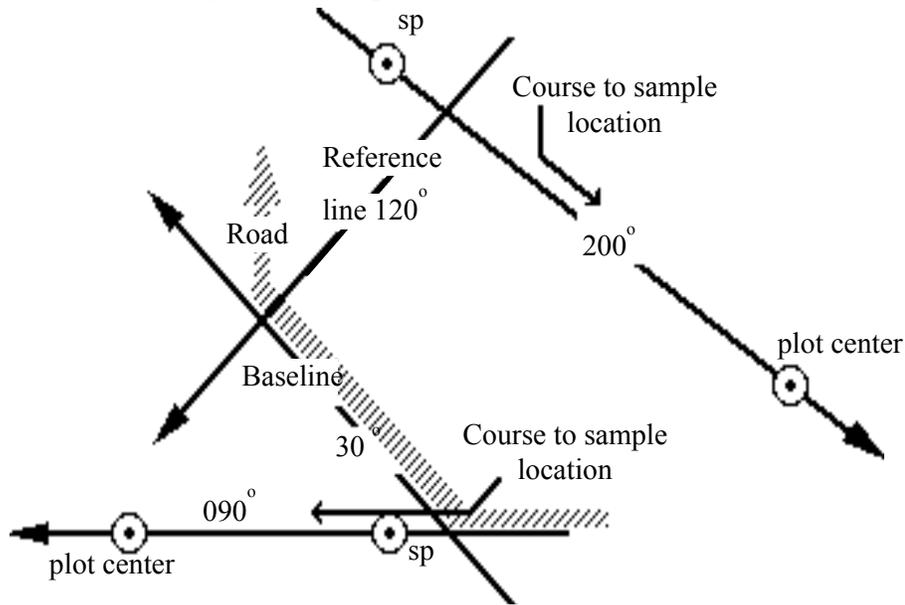
If the baseline and the line to the sample location do not intersect on the photograph, draw a straight line that will intersect the baseline and the course to sample location line. Indicate the directions of the sample location line and the baseline by putting an arrow at the end of each line. Measure the angle between these lines, starting from the baseline.

Be sure to use an inverted 360° protractor or flip a standard 360° protractor over. Align the 360-degree protractor over the azimuth of the baseline to get the azimuth of the sample location line. The azimuth is read directly off the protractor once the azimuth of the baseline is correctly aligned on the inverted 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) is 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 the protractor is precisely aligned.

**Important:** East-west azimuths are reversed when working on back of photo with standard protractor. Inverted protectors are available.

Refer to Figure 3. Measure on the photograph the distance from the starting point (SP) to the plot center (PC) to the nearest quarter chain using a transparent photo scale. (Photo scales, corresponding to the aerial photography, are supplied.) Hold the photo up to the light and carefully measure, from the center of one pinprick to the center of the other. (Sometimes it helps to use your stereoscope as a magnifier.) Record both distance and direction on the back of the photograph and on the plot sheet under "Course to Sample Location".

Figure 3. Azimuth settings (back of photo)



### Chaining

Using compass and tape, run a course on the computed azimuth. Distance correction for slope is necessary when slope exceeds 10 percent. Using the Suunto clinometer, 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. The appropriate slope correction can then be found in Table 1. The correct adjustment should be added at the same percent slope. For example, to chain a horizontal distance of 66.0 feet on a 25 percent slope, chain 68.0 feet (66.0 + 2.0) on the slope.

**Table 1.** Slope Correction in feet  
(Distance is measured on slope)

Percent	Feet		
	66'	70'	99'
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

## Plot Location *Continued*

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

---

Once the computed course has been run, place a permanent stake at the end of the computed course. **Important:** Make sure that photograph location agrees with ground location.

### Location Correction

If the ground location is clearly not the point pinpricked on the photograph (more than 2 chains error), 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 under "Course to Sample Location" on the plot header sheet and remove the first pin. The initial pin is referred to as a turning point. The second pin becomes the location of the plot.

### Chaining to Other Than PC

In chaining to plot center, you may encounter some condition that makes it impossible or impractical to physically reach plot center and put in a pin. Plot center may be in water, the center of a barn, or on a busy highway. Other subplots on the plot may be in a forest condition and the plot must be installed. In this case you can chain to any one of the subplots and establish it first. This can be done by using the data recorder program to compute the direct distance and azimuth to take from the starting point to any subplot center and chaining directly to a given subplot. This method is best when you can see you will have trouble reaching plot center before you start chaining. **Note:** This program works only if you are farther than 140 ft. away from PC.

A turning point can also be used at any point when chaining to reach another subplot center. At any point while chaining, establish a turning point, chain the distance and azimuth from plot center to the subplot you wish to chain to, and then continue on your original course. For example, the course from the starting point to plot center is  $200^{\circ}$ , 700 ft. After chaining 600 ft you can see that plot center will be in a river and it would be best to chain to subplot 3. At 600 ft, establish a turning point and go  $0^{\circ}$ , 140 ft (the distance and azimuth from plot center to subplot 3). Establish another turning point and complete the original course ( $200^{\circ}$ , for the remaining 100 ft) to reach subplot 3.

### Plot Location Procedure For Remeasurement Plots

Using both the old and new photographs, locate the starting point, or SP. If the SP pinprick is missing from the old photo, refer to "Starting Point Description" on the old plot sheet and determine the SP location according to the azimuth and distance to plot center, PC. Pay close attention to any openings on the photo, such as clearings, roads, woods trails, lakes, and streams,

## Plot Location *Continued*

where the SP might logically be located. Also check the sketch of the area on the back of the original plot sheet.

Once the SP tree is located, inspect to see that it is suitable. If the SP is suitable, the cruiser rescribes (not in reserved areas), repaints (not in reserved areas), and remeasures DBH. The tallier checks the "Course to Sample Location" on the plot sheet to see if it seems reasonable. The tallier then transfers the original course to sample location, SP description, and the remeasured DBH to item 3 on the new plot sheet. On the new photo, pinprick the SP and record the course to sample location on the back of the photo.

Establish a new starting point if the original SP is not suitable, cannot be found, or the plot location is visible. Record the course to sample location, SP description, and SP DBH on the new plot sheet. After re-establishing the SP, chain the computed azimuth and distance along the approach line and mark the location.

Search the area for evidence of the old plot. Items to look for are paint on the tree bases (vertical line) and at breast height (horizontal line). Look for 10-inch wire pins and bits of flagging at each subplot, and witness trees (painted with an "X").

After finding plot center, establish a turning point if the distance between plot center and the end of the approach line exceeds 3% of the chaining distance.

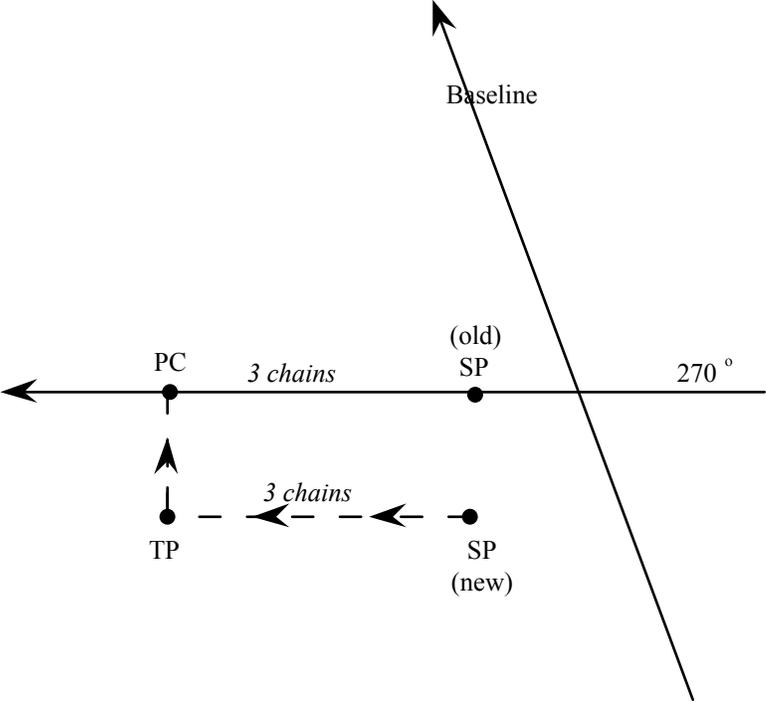
In the event that, after chaining the prescribed distance, no evidence of the old plot can be found, the following alternatives for locating PC are available.

- Using the original SP, look for landmarks to discern if the plot is in the area. Look especially for mistaken openings, trails, etc.
- Search an area of five chains around the end of the approach line(s).
- Return to the SP, check the photo work, and try re-chaining.
- Check the photo work to see if the original crew chained in the opposite direction.
- Pick a new SP, establish a new approach line, and chain in from there.

An easy way to establish a new SP, when needed, is to inspect the vicinity of the original SP for a suitable replacement. The following three options are available once you've found a replacement (fig. 4A, 4B, 4C). Note that fig. 4 shows the plot sketch—east-west azimuths would need to be reversed if drawn on the back of the photo.

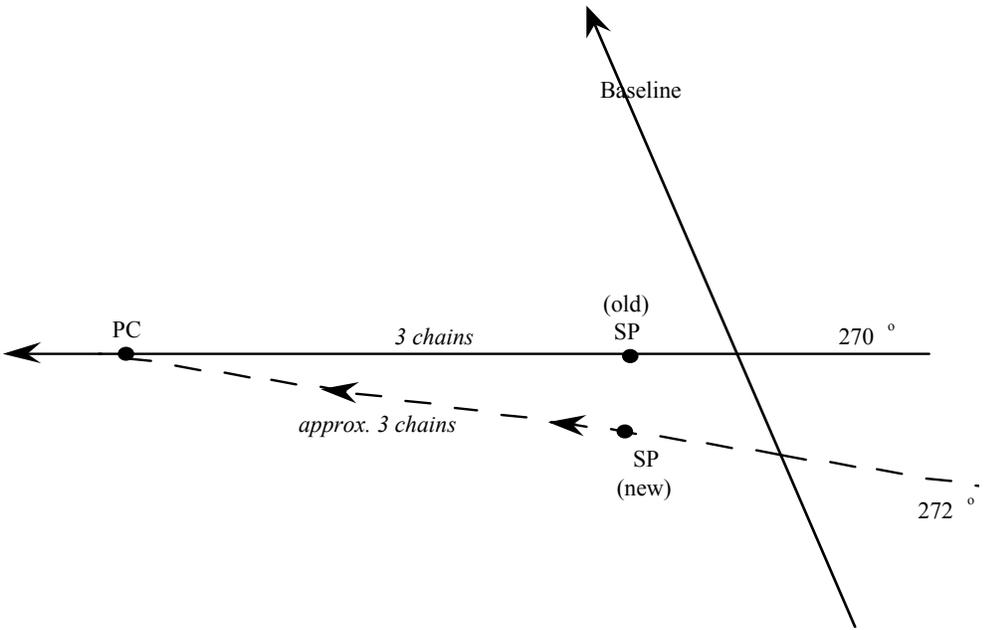
**Plot Location Continued**

**Figure 4A.**



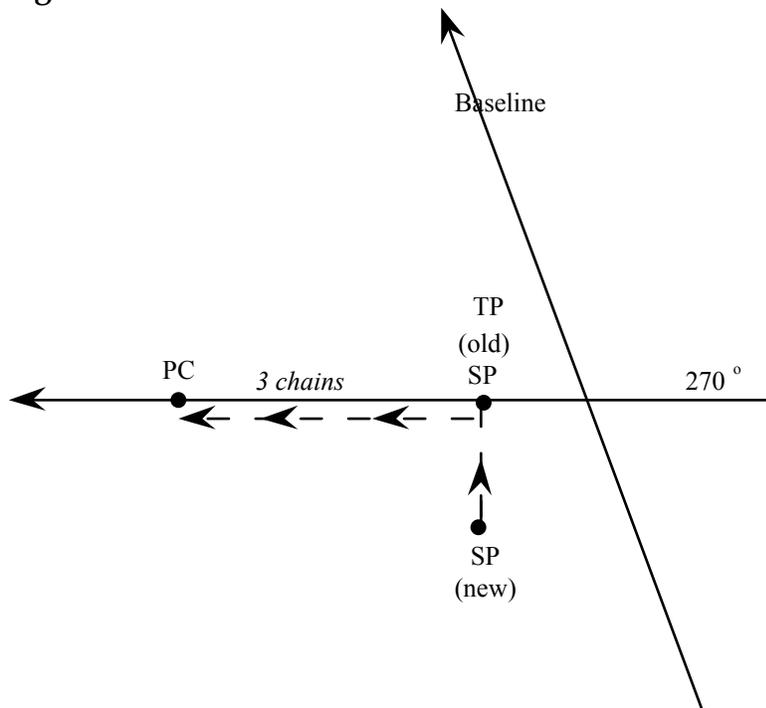
If the new SP is close by, pick the tree on the photo and use the original course to sample location. Leave a marker at your destination and look for plot center. It should be approximately the same distance and azimuth that the old SP is from the new SP. Once PC is found, make a turning point from your marker to PC.

**Figure 4B.**



Depending on how far the new SP is from the old SP, you may try adding or subtracting a degree or two (whichever is appropriate) and follow this azimuth into the plot. Adding a few feet onto the old distance may be helpful. Use a marker to show where you ended your chaining. Scan the area for the plot center and then make the necessary turning point to plot center.

Figure 4C.



Measure the distance and azimuth from the new SP to the original SP. Record this information in "Course to Sample Location". Record the old course to sample location to the right of this new course. At this time, a new SP has been established and the original SP is used as a turning point in the course to sample location. Note: This is the least desirable choice, for it may result in having two turning points--one at the beginning and one at the end.

Occasionally, while chaining in you may pass near or over PC. Minimize the length of a turning point, or perhaps eliminate the need for a turning point, by reducing the chaining distance--backtrack along the line of approach.

### Subplot Location

After finding some evidence of the old plot, look for trees 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 subplots.

Match by comparing current tree species, azimuths, distances, and DBH to the old figures for trees on the original plot sheet. Once it is determined to which subplot the trees belong, use triangulation to find the subplot center, marked with a piece of galvanized or aluminum wire--bent into a loop with a piece of blue flagging tied through it.

Triangulate by measuring back azimuths and distances of several known trees from the old plot sheet. The intersection of these back azimuths and distances provides a small area in which to search for the wire pin marking each respective subplot center.

After finding the old pin, place a new pin next to it. If the old pin cannot be found, triangulate to accurately re-establish the point in the original location.

It is very important to locate each individual subplot as accurately as possible. Finding each subplot is a challenge--most of the flagging disintegrates, the wires rust and appear just like twigs or roots. The best method is to run out 70 feet from the last subplot at the proper azimuth, mark the spot, and search by running your hands through the area.

## **Plot Location *Continued***

If several trees, identifiable from the paint, are available, use the triangulation method to relocate the subplot. If this is not possible, due to lack of trees or other circumstances, locate several adjacent subplots and use these to triangulate to the missing subplot. You can then determine the general location of the missing subplot and reduce the area to search.

### If unable to locate a remeasurement plot

If you and your partner can't find a remeasurement plot, bring it to the attention of the person in charge. After two crews have thoroughly searched for the plot without success, the second crew will establish the plot using the following guidelines.

When there has been a major disturbance (such as the area has been clearcut and bulldozed) and it is obvious that the plot can not be relocated because all or most of the old trees have been removed, a remeasurement plot is established as near as possible to the old PC. All new trees receive a tree history reflecting ingrowth or ongrowth (31 or 61). Transfer original tree data to the data recorder and collect current data for them indicating whether they have been cut or have died. See Tree History, item 33, for details about tally items needed for these trees.

When there has been no major disturbance to the area, two plots will be created. The first plot retains the old plot number, is given SK=0 and GLUC=98 and only plot record information is recorded. The second plot is a new plot that is established to replace the old lost plot. Give the new plot a sample kind of new full measurement (SK=1) if the lost plot was a full remeasurement (SK=2). Give the new plot a sample kind of new partial measurement (SK=7) if the lost plot was a partial remeasurement (SK=6). Record the sample kind change in the "Notes" section of both plot sheets. Call the photo room in St. Paul for a new plot number.

### Remeasurement plot in the wrong location

If a remeasurement plot was established in the wrong location (i.e. not in the same location as the photo pinprick), re-establish the plot in that wrong location. If the error is significant, re-pinprick the new photo where the plot is actually located.

In the "Notes" section of the plot sheet, indicate that the plot was put in a different location. Record the distance and azimuth (use photo scale) from the original pinprick on the new photo to where the plot is actually located.

Bring such plots to the attention of the person in charge. It is 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).

### Denied access plot

When the land owner refuses to give you permission to access a plot, bring it to the attention of the person in charge. When all attempts to obtain permission to take the plot have failed, the plot is given SK=0 and GLUC=99. Check the section in manual entitled "Required Data Items By Ground Land Use" for the list of items to record.

**State (ST) 2 digits: Item 72**

Record the appropriate two-digit state code (listed with the county codes in the appendix).

**Unit (UNIT) 1 digit: Item 72**

Record the appropriate one-digit code for unit number (listed with the county codes in the appendix).

**County (CTY) 3 digits: Item 72**

Record the appropriate three-digit county code listed in the appendix.

## PI Land Use (PILU): Item 4

The photo interpretation land use of plot center is assigned by the office staff and should not be changed in the field. This information is based on careful stereoscopic examination of the aerial photography in the office. These codes are included on the plot center record of the new plot sheet for your information. The codes used by the office photo interpretation staff are:

Code	PI land use
17	Urban natural forest land
18	Non-urban natural forest land
19	Reserved natural forest land
27	Urban plantation forest land
28	Non-urban plantation forest land
29	Reserved plantation forest land
30	Questionable
31	Questionable F/NF
32	Questionable NF/F
51	Nonforest with trees, cropland
52	Nonforest with trees, pasture
53	Nonforest with trees, wooded strip
54	Nonforest with trees, windbreak
55	Nonforest with trees, marsh
56	Nonforest with trees, farmstead/rural homestead
57	Field windbreak
58	Nonforest with trees, rural, non-agricultural
59	Nonforest with trees, reserved
61	Nonforest without trees, cropland
62	Nonforest without trees, pasture
65	Nonforest without trees, marsh
66	Nonforest without trees, farmstead/rural homestead
67	Nonforest without trees, urban
68	Nonforest without trees, rural, non-agricultural
69	Nonforest without trees, reserved
72	Nonforest with trees, urban
80	Noncensus water
89	Noncensus water, reserved
90	Census water

## PI NF/F and PI F/NF 1 digit each: Item 5

PI NF/F and PI F/NF are items assigned by the photo interpreter to identify plots that have both forest and nonforest conditions on them. A value of 1 for PI NF/F is assigned to plots that appear to be nonforest at plot center but portions of the plot appear to extend into a forest condition. A value of 1, for PI F/NF, is assigned to plots that appear to be forest at plot center but portions of the plot appear to extend into a nonforest condition. Plots that are entirely within forest or entirely within nonforest will have a zero in both of these items. All plots with a 1 in either of these items will be sent to the field.

## Current Date (CDAT) 4 digits: Item 68

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

<u>First two digits</u>		<u>Second two digits</u>	
<u>Code</u>	<u>Month</u>	<u>Code</u>	<u>Year</u>
01	January	86	1986
02	February	87	1987
03	March	88	1988
04	April	89	1989
05	May	90	1990
06	June	91	1991
07	July	92	1992
08	August	93	1993
09	September	94	1994
10	October	95	1995
11	November	96	1996
12	December	97	1997
		98	1998
		99	1999

**Example:** A plot completed in June, 1992 is coded as 0692.

## Nearest Water: Item 69

Determine the permanent water source nearest to the sample plot location. A permanent water source is present year-round, as opposed to an intermittent stream. A lake, swamp, pond, or reservoir must meet the minimum area requirements of 120 feet in width and one acre in size. There is no minimum-size requirement for a stream or flowage.

Use the following codes to record Water Type, Water Area, and Water Distance.

### Type Of Water (WTYP) 1 digits

<u>Code</u>	<u>Type of Water (WTYP)</u>
1	Streams and Flowages (Permanent natural watercourse where water is present in the flow channel all year.)
2	Lakes (Natural body of standing water including ponds.)
3	Swamps (Wet, spongy land, saturated and sometimes partially or intermittently covered with water, supporting natural vegetation (predominantly shrubs and/or trees).)
4	Farm ponds (Artificially ponded water held for such uses as domestic livestock, fishing, and irrigation.)
5	Reservoirs (A body of water held back by a dam, dike, floodgate, or any other barrier. Primary uses are flood control and recreation.)

### Area Of Water (WARE) 3 digits

Record the width (in feet) of streams and flowages (000 to 999 feet) to the nearest 33 feet. For lakes, swamps and farm ponds, area is measured in acres (001 to 999 acres) to the nearest 5 acres.

### Distance To Nearest Water (WDIS) 4 digits

Measure the distance from PC to the nearest permanent water source. Record the distance to the nearest half chain (0000 to 999.5 chains).

## Nearest Road: Item 70

### Type Of Road (RTYP) 1 digits

Field crews should check the straight line distance from PC to the nearest maintained road, using the following codes for type and distance.

<u>Code</u>	<u>Type of Road</u>
1	Paved – Four lanes
2	Paved – Two lanes
3	Improved – gravel

## Distance To Nearest Road (RDIS) 4 digits

The distance to road is measured in chains to the nearest half chain (0000 to 999.5).

### **Sketch And Notes: Item 71**

Provide information on the location of the field sample, the layout of the plot and description of any disturbances within the area. Make sure that this information is legible and understandable. Any physical features that could assist in accurately relocating the plot should be drawn onto the plot diagram. Include changes in timber type, old logging roads, forest and nonforest boundaries, streams, drainages, particular disturbances, etc. This information is used primarily in re-establishing the plot on future remeasurements. However, plots may be visited by personnel other than Forest Service for their own purposes. The sketch should contain information necessary to enable one to find the starting point of the course to the plot. Include a reference to a town, a numbered or named road, intersections, or easily identified landmarks. Describe any particular procedure or situation encountered on the plot. Explain in the "Notes" section so that remeasurement crews can take them into consideration.

**Note:** Aerial photos are usually not the property of the project. They may or may not be available for the next inventory.

### **GPS Location (GPSN) 7 digits: Item 76**

### **GPS Location (GPSW) 8 digits: Item 76**

Upon locating plot center, use the GPS unit to determine latitude (GPSN) and longitude (GPSW). Record the values in the plot record. If the canopy causes poor reception, move to a nearby opening where the GPS unit can locate satellites. Enter these readings and the GPS Way Point (WP) number in the notes and be sure to also record distance and direction **from the location of the GPS reading to plot center**. Additional instructions are in the Appendix.

### **National Forest-Ranger District (NFRD) 4 digits: Item 73**

Record the appropriate National Forest (first 2 digits) and Ranger District (last 2 digits) codes listed in the appendix.

## Condition Class Records: Items 1, 6, 16-19, 54, 59, 62-64, 66, 75

### **Ownership Class (OWNC) 2 digits: Item 1**

Field personnel visit county courthouses to collect ownership data for all plot locations. Owner's name and address, ownership class, and size (timberland only) are acquired from tax and ownership records.

Ownership information for National Forest land may be obtained from the land status atlas located at the Ranger District or Forest Supervisor's office. Ownership information on other public lands usually can be obtained from their local field offices.

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

Record the ownership class on the condition record using the following two-digit codes.

<b>Code</b>	<b>Owner</b>
11	National Forest
12	Bureau of Land Management
13	Indian Tribal Trust and/or Allotted Trust lands
14	Miscellaneous Federal
15	State
16	County and Municipal
2*	Forest Industry (Must process own products.)
6*	Miscellaneous Private Corporate
7*	Farmer and miscellaneous Private Individual

\*For Ownership Class codes 2 through 7, the second digit indicates ownership size (commercial forest land only) in the United States. Indicate size in acres by using one of the following codes.

<b>Code</b>	<b>Acres of commercial forest land</b>
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 <u>actual</u> number of acres owned for all tracts 5000+ acres in the "Notes" section.)

## How To Collect Ownership Information

- Go to the county courthouse and find the Assessor's office. Explain who you are and what you are doing.
- To find the owner's name for each plot, you will need to use a current plat book or the large set of plat sheets. You may need to find a "parcel number" first, and then refer to a card file or a computer terminal to find the owner. Each courthouse is unique, so your methods may vary from county to county.
- By cross-referencing the plat book with the current aerial photography, you can get a pretty good estimate of acres in forest land owned by each individual. The courthouse may have another more accurate method. Make sure to watch in the plat book for other parcels of land owned by the same person. Total all of the forested parcels together to obtain the second digit of the ownership class.

Ownership Class is recorded for the following plots:

- All plot locations where some portion of the plot is on Ground Land Use (GLU) 20, 21, 22, 40, 41, 45, 46, 57 or 59.
- All remeasurement plots previously having a Ground Land Use (GLU) 20, 21, 22, 40, 41, 45, 46, 57 or 59 even if the land use has changed.

Owner contact is noted on the plot sheet for:

- Owner name and address
- Indicate on plot sheet if personal contact with the landowner was made while gaining permission to measure the plot.

Owner name and address:

There is a computer program\* for entering and storing ownership names and addresses. The data entered is periodically sent to the St. Paul office (usually when the data file has become large enough to fill a diskette).

Full name and street address is written on the plot sheet and then entered into the ownership program for the first forested condition.

Enter into the ownership program full name and street address for all field plots and modeled plots that require an Ownership Class. Street addresses are not needed for ownership class 11 (National Forest), 12 (Bureau of Land Management), or 15 (State).

NOTE: For large Forest Industry\*\* please use the address from the State Forest Industries Directory if available. If the Directory is not available please locate address as mentioned earlier in this section.

\* Directions for running the ownership program are in your field office or the St. Paul office.

\*\* Large Forest Industry is any company on the list of large forest industries provided at the start of the state inventory. This list may not be available in all states.

### How to handle plots that may straddle two ownerships.

It is possible for a plot to cover more than one ownership class. When this happens the second ownership class will not be recorded **unless both** of the following criteria are met.

- 1) The two owners fall into separate ownership classes. For this purpose consider OWNC 21-29 a single class and OWNC 61-79 a single class.
- 2) The ownership boundary also corresponds with a condition boundary.

When multiple ownerships are recorded a note should be made on the plot sheet. For example, if the PC is in timberland (GLU = 20) owned by the State (OWNC = 15) but part of the plot extends into cropland (GLU = 61) privately owned (OWNC = 76) it should be noted in the notes section on page one of the plot sheet. A short note such as "cropland portion of this plot has ownership class 76" would be sufficient in this case. If the plot covers two miscellaneous private owners, record the same ownership code for every condition found on the plot.

### **Ground Land Use: Item 6**

The following pages define the rules and codes to be used in assigning ground land use to a condition.

#### Forest land

Forest land is land not currently developed for nonforest use and has (or formerly had) at least a stocking value of 10.0 of all live forest trees of any size. 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, bodies of water, or clearings in forest areas are classed as forest if less than 120 feet wide. Streams less than 30 feet wide between mean high-water are classed as forest. The minimum area for classification of forest land is one acre and 120 feet in width. (See definitions--especially nonstocked forest land.) Codes 20, 21 and 22 are referred to as "commercial forest land uses" and codes 40, 41, 45 and 46 are "noncommercial forest land uses".

Use one of the following two-digit codes:

#### Commercial forest land uses

- 20 **Timberland** 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 Timberland** Forest land used for wood production and grazing. (If land has a stocking value of less than 10 in trees over 1.0" DBH or less than 25 in growing-stock trees of any size, see codes 52 and 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. The forest type, stand age, and stand size class should reflect the planted species. If the plantation has failed, give the plot a GLU code 20. (If

land is used for Christmas tree production, see code 46.) Unless the land is used primarily for grazing, code 22 is preferred over codes 52 and 59.

### Noncommercial forest land uses

- 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. Adverse conditions include sterile soils, dry climate, poor drainage, high elevation, steepness, and rockiness. Vegetation, if present, is widely spaced and scrubby, or tree growth cannot be established. Based on site index under 15 for northern white-cedar, under 20 for tamarack, under 25 for eastern redcedar, and under 35 for all other species. All commercial species must be unproductive. In cases where compaction or other negative impact by grazing is the cause for the low productivity use code 52 or 59.
- 41 **Reserved forest land - unproductive** Forest land that is withdrawn from timber utilization, by a public agency or by law, and 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 is sufficiently productive to produce at least 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 for Christmas trees.

**Note:** In a marginally productive forest condition, measure site index first. All commercial species found within the portion of the plot where the condition extends must be measured and determined unproductive (code 40) before classifying the condition as unproductive forest land. The tallier judges whether the unproductive area is over one acre in size; if it is, the condition is classified as unproductive. Refer to Site Index, items 51-59, for more information.

### Nonforest Land with Trees

Nonforest land is land currently developed for use other than growing trees; and/or land that never had a stocking value of 10.0 or larger in forest trees of 5.0" DBH or larger. Some locations interpreted as nonforest on aerial photographs require a field check. Some locations, interpreted as forest on aerial photographs, turn out to be nonforest upon field examination.

These areas are nonforest conditions that have one or more trees, 5.0" DBH or larger, within the visual acre surrounding the subplot center. The visual acre must be in the same land use. When trees have been planted to create a nonforest with tree land use such as narrow windbreaks (GLU 56), wide windbreaks (GLU 57), or shelterbelts (GLU 58), the 5.0" DBH rule does not apply. Planted windbreaks and shelterbelts with trees of any size are recorded as windbreaks and shelterbelts, not nonforest without trees. Windbreaks and shelterbelts (56-58) do not need to be planted, they can be of natural origin. If they are of natural origin they must have one or more 5.0" DBH tree within the visual acre, otherwise they are nonforest without trees. Also guard against placing undo emphasis on a few scattered trees. If the trees 5.0" DBH or larger in the visual acre are from isolated inclusions or pockets that don't represent the overall situation, then nonforest without trees might be a more appropriate choice.

## Ground Land Use *continued*

Use one of the following two-digit codes for nonforest land with trees.

- 50 **Reserved, nonforest with trees** Nonforest land with trees that is withdrawn from timber utilization, by a public agency or by law.
- 51 **Cropland with trees** Cropland with scattered inclusions of single trees or small groups of trees. Orchards are also included in this class.
- 52 **Pasture and rangeland with trees** Land used for grazing with a stocking value of less than 10.0 in all live trees 1" DBH or larger. Examples of grazing evidence include:
- cattle trails
  - cow pies
  - water tanks
  - bush hogged periodically
  - evidence of being bush hogged (maximum height of seedlings three to four feet and basal scars present on trees)
  - area periodically treated with herbicides.
- 53 **Wooded strip** An acre or more of continuous forest land that meets the definition of forest land (code 20, 21, 22, 40, 41, 45) 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 has a stocking value of less than 10.0 in all live trees. **Caution:** Do not confuse this with non-stocked forest land which is GLU 20 and should have a stand-size class code 4.
- 55 **Marsh with trees** Land that has a stocking value of less than 10.0 in all live trees; characteristically supports low, generally herbaceous or shrubby vegetation and is intermittently covered with water.
- 56 **Narrow windbreaks** A group of trees, less than 120 feet wide, 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, protecting buildings in use. Area would qualify as commercial forest land except that the primary land use is protection of buildings. As a guideline, consider using code 22 if there are more than 12 rows of trees or the area is larger than 5 acres.
- 58 **Shelterbelt** A group of trees, less than 120 feet wide, used for the protection of soil and crop fields. Do not confuse this land use with an old fence line between two fields that contains a few trees.
- 59 **Wooded pasture** Grazed land with a stocking value of more than 10.0 in all live trees 1" DBH or larger, but less than 25.0 in growing stock (20 class) trees of any size. Two situations are possible. The first is that the land could qualify as pastured timberland except that the low stocking in growing stock trees indicates that the land is not being used for wood production. The second is that the land is unproductive for timber, due to livestock or intrinsic site factors, and is being used for forage. If evidence indicates that the primary use is wood production or the protection of buildings see code 21 and 57. The stocking value 25.0 rule applies when determining primary land use in fairly homogeneous areas. In clumps, openings, and other inclusions, use your best judgment.
- 71 **Urban forest land** Reserved land that normally would meet the criteria for commercial forest land, but is in an urban-suburban area surrounded by commercial, industrial, or residential development. It is extremely unlikely that such land is used for timber products on a continuing basis. Example: wooded creek bottom surrounded by houses.

- 72 **Urban and other with trees** Area with trees that is developed for residential, industrial, recreational, or other urban use. For example city park, cemetery, golf course, maintained backyard, farmsteads with trees. The 120 feet/one acre rule does not apply in the case of a maintained yard.
- 79 **In another country.**

### Nonforest Land without Trees

These areas are nonforest conditions (see Nonforest Land with Trees) that have no tree species present 5.0" DBH or larger, within the visual acre surrounding the subplot center. If there are widely scattered, individual trees or small, isolated inclusions of trees, nonforest without trees may still be an appropriate choice. Use your best judgment.

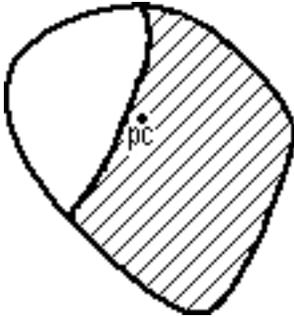
Use the following two-digit codes for nonforest land without trees.

- 61 **Cropland without trees** Presently cropped or fallow up to two years.
- 62 **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. Do not confuse with non-stocked forest land.
- 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. The 120 feet/one acre rule does not apply in the case of a maintained yard.
- 68 **Rights-of-way** Transportation, utility, and communication rights-of-way. This includes railroads, power lines, pipelines, and maintained roads. A right-of-way of any width qualifies as non-forest land--this is an exception to the one acre, 120 feet rule.
- 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). Linear water features at least 30 feet wide between mean high-water marks are also included.
- 89 **Noncensus Water** (reserved)
- 90 **Census Water** A body of water greater than 10 chains wide and greater than 40 acres (normal water level).
- 97 **Dropped plot** - Determined in office by field supervisor or crew leader.
- 98 **Lost (not relocated) plot**
- 99 **Denied access plot**

A right of way may create a strip of trees less than 120 feet wide that would otherwise be forest land if the right of way were not there. In this case the field crew should use its judgment to determine if the strip that has been created is being managed the same as the forest on the other side of the right of way or not. If it is being managed or is likely to be managed the same (just as likely to be harvested or receive other treatment) consider it part of the forest on the other side of the right of way. If there is reason to believe that the strip will not be managed the same it should receive a land use of wooded strip. For example, a strip of trees about 40 feet wide between a railroad line and a major highway should be given a land use of wooded strip because it would probably not be harvested with the forest on the other side of the railroad or the highway. However, a strip 100 feet wide between a gravel county or township road and very narrow utility right of way would probably receive the same management as the forest on the other side of the

right of way and should be give a land use of forest. See figure 5 for some examples of determining ground land use.

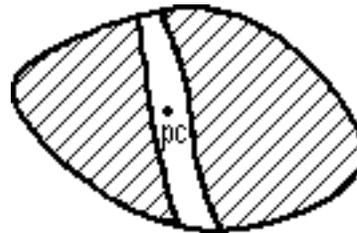
**Figure 5. The following examples have been included to aid in assigning Ground Land Use to plot center. Shaded areas represent forest.**



1.

**Forest**

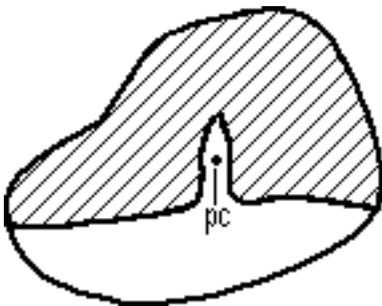
Dot falls on forest land larger than one acre in size.



2.

**Forest**

Dot falls on strip of nonforest land (less than 120 feet in width) that is bounded by forest land on at least two sides.



3.

**Forest**

Dot falls on strip of nonforest land (less than 120 feet in width) that is bounded by forest land on at least two sides.

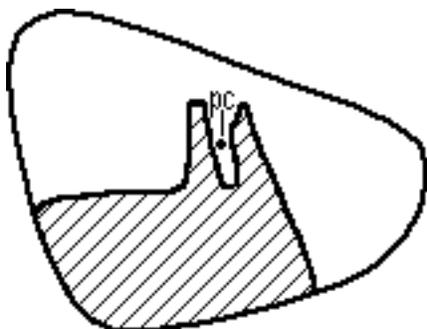


4.

**Forest**

Dot falls on nonforest land (less than one acre in size) that is surrounded by forest land.

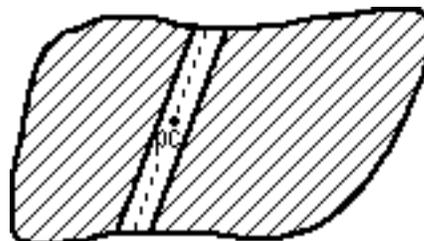
Figure 5 CONTINUED



5.

**Forest**

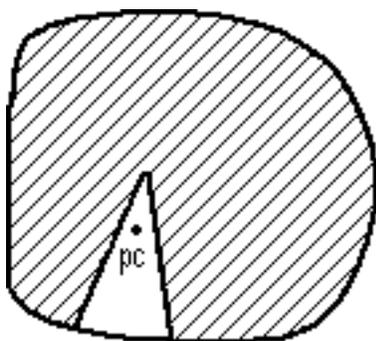
Dot falls in area of more than two adjacent strips of clearly defined forest and nonforest land (each strip less than 120 feet in width). As the band of strips in the acre is comprised of more forest than nonforest, the classification is forest.



6.

**Nonforest**

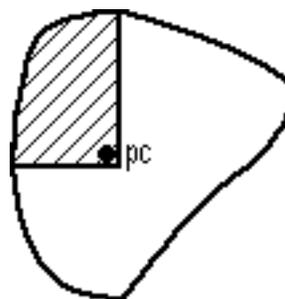
Dot falls in improved road less than 120 feet wide. Improved roads and power line clearings of any width are nonforest.



7.

**Forest**

Dot falls on nonforest land (less than 120 feet in width). If point had fallen in area 120+ feet 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°) 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.

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

## How to calculate stocking for land use determination

Stocking values are required to determine the land use of a condition and decide what items must be recorded for that condition. When the land use is in question, assign stocking values to each tally tree on the new standard plot (subplots 21-24) based on each tree's diameter, the diameter of the largest tree in the condition (visual 1 acre area) and the portion of the plot that is in the condition. These stocking values are not recorded on the plot sheet or in the data recorder. They are only used to determine land use. Stocking is computed using table 2. All trees on subplots 21-24, in a condition must be tallied to calculate stocking.

**Table 2. Stocking values for tally trees on subplots 21-24**

Tree DBH	DBH of largest tree in the condition					
	5.0+	4.0-4.9	3.0-3.9	2.0-2.9	1.0-1.9	seedling
seedlings*	0.5	1.0	1.5	2.0	2.5	7.5
1.0-1.9*	2.5	3.7	5.0	6.2	7.5	
2.0-2.9*	3.7	5.0	6.2	7.5		
3.0-3.9*	5.0	6.2	7.5			
4.0-4.9*	6.2	7.5				
5.0-6.9	1.1					
7.0-8.9	1.7					
9.0-10.9	2.3					
11.0-12.9	3.1					
13.0-14.9	4.0					
15.0-16.9	4.9					
17.0-18.9	6.0					
19.0+	7.0					

\* Consider a clump of trees less than 5" DBH to be a single tree for stocking.

Steps to compute stocking of a condition based on the tally trees in the condition are:

1. On subplots 21-24, assign each live tally tree in the condition the appropriate stocking value based on its DBH and the diameter of the largest tree in the condition (visual 1 acre area). Any clump of trees less than 5.0" DBH is considered a single tree for stocking purposes.
2. Sum up the total live stocking for each subplot.
3. If the total live stocking for a subplot is greater than 20.0, reduce the stocking value of every tree on the subplot so that the total stocking is 20.0. This is done by multiplying each stocking value by the adjustment factor of 20.0/total live stocking.
4. If the condition does not cover subplots 21-24 entirely, stocking must be expanded by an expansion factor. The expansion factor is equal to 400/sum of the percent of subplot

## Ground Land Use *continued*

area (%SAR) for the condition. The stocking value of every tree is multiplied by this expansion factor.

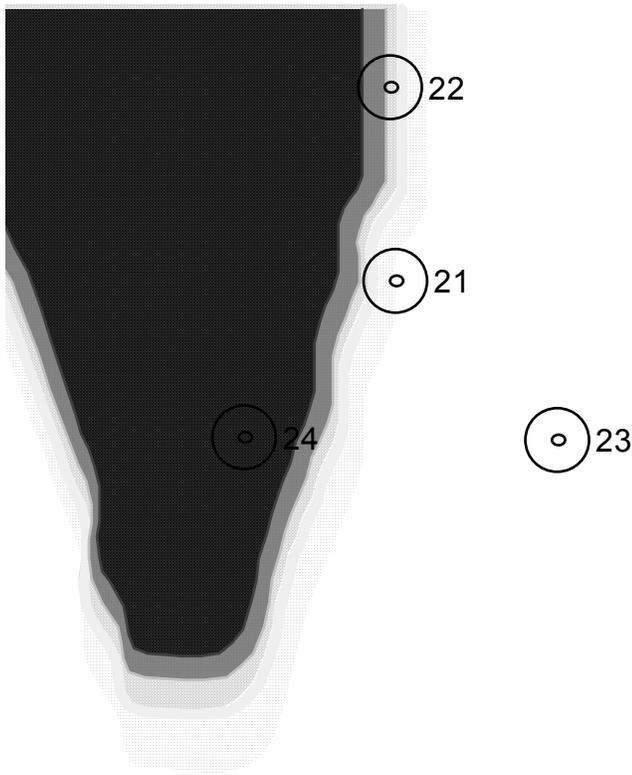
5. The stocking for each tree class is computed by summing the stocking values for each tree in that tree class.
6. If the condition occurs on only a small portion of the plot, (half the plot or less), use your best judgment in assigning a land use. You may place several additional temporary subplots in the condition in order to get a larger sample to base stocking on. When additional temporary subplots or judgment is used to assign land use, a note should be made on the plot sheet. Use the following procedure to establish these temporary subplots in a condition:
  - A. Consider locations 120 feet horizontal distance from the highest numbered subplot in the condition. First consider the location 0 azimuth from the subplot center. If this location is unsuitable, consider in turn locations at azimuth 120<sup>o</sup>, and 240<sup>o</sup>. When a suitable location has been found, establish the temporary subplot. Temporary subplots should be entirely within the condition (locations should not be within 24 ft. of a mapped boundary).
  - B. If Step A fails to yield a suitable subplot location, repeat Step A at each of the next highest numbered regular subplot in the condition.
  - C. If Steps A and B have been exhausted and a suitable temporary subplot still has not been found, repeat Step A at each temporary subplot in turn beginning with the first temporary subplot that was established.

If more than one temporary subplot is to be established, repeat Steps A and B to establish the second lowest numbered temporary subplot next, and continue in order until you have enough temporary subplots established in the condition to get a good, representative estimate of stocking. The general rule for establishing temporary subplots is:

Install the lowest temporary subplot off the highest established subplot, until all the established subplots have been exhausted.

Then establish the lowest temporary subplot yet to be established off the lowest one already established (lowest off highest, then lowest off lowest).

If there is a transition zone between two conditions use your best judgment to be sure that trees tallied in the transition zone do not have too much weight in the assignment of a land use.



**Figure 6.** Here the dark shaded area is trees, surrounded by a treeless area or an area with only scattered trees. It could be a forest island surrounded by marsh/bog, a wooded draw in a grazed area, or a farm woodlot that is invading an abandoned field. Between the forest and the nonforest is a transition zone that is about 40 to 80 ft. wide. Because there is a transition zone, not an abrupt forest/nonforest edge, no mapping is done. Subplots 21 and 23 are recorded as 100% in condition 1 and subplots 22 and 24 are put in the condition 2. To determine the stocking in condition 2 you could exclude subplot 22 because it is in a transition zone. If needed, several temporary subplots could be installed off subplot 24 to have an adequate sample for determining the stocking of condition 2. Similarly, to get a stocking for condition 1, subplot 21 would be excluded and, if needed, several temporary subplots could be installed off subplot 23.

**Simplest case: One condition, no subplot exceeds 20.0 total live stocking.**

Live tally trees and computation of stocking for this simplest case are shown below.

SUB#	TR#	DBH	TCC	Stocking value from the table	Total subplot stocking
21	1	15.3	20	4.9	4.9
22	1	3.5	20	5.0	11.2
	2	4.5	20	6.2	
23	1	9.3	30	2.3	4.6
	2	10.2	30	2.3	
24	--	--	--	--	--

All live stocking 20.7  
 Growing-stock stocking 16.1  
 Cull stocking 4.6

The total all live stocking here is 20.7, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use should be 59 because the total stocking in growing stock trees (16.1) is less than 25.0.

**Ground Land Use *continued***

**More difficult case: One condition on the plot, subplot 23 exceeds 20.0 total live stocking.**

Live tally trees and computation of stocking for this more difficult case are shown below.

SUB#	TR#	DBH	TCC	Stocking value from the table	Total subplot stocking	Adj. factor	Adj. stocking value	Total subplot stocking
21	1	7.5	20	1.7	1.7	--	1.7	1.7
22	1	10.3	30	2.3	2.3	--	2.3	2.3
23	1	7.3	30	1.7	21.7	20/ 21.7 = .92	1.6	20.0
	2	12.2	20	3.1			2.9	
	3	15.7	30	4.9			4.5	
	4	17.3	30	6.0			5.5	
	5	18.2	30	6.0			5.5	
24	--	--	--	--	--	--	--	--

All live stocking	24.0
Growing-stock stocking	4.6
Cull stocking	19.4

The total all live stocking here is 24.0, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use should be 59 because the total stocking in growing stock trees (4.6) is less than 25.0.

**Ground Land Use *continued***

**Most difficult case: Two conditions on the plot, subplot 23 exceeds 20.0 total live stocking.**

Live tally trees and computation of stocking for this most difficult case are shown below. A sketch of this plot is also shown in figure 7.

SUB #	T #	DBH	TCC	Stock. value from table	Total sub-plot stock.	Adj. factor	Adj. stock. value	%SAR in cond. 1	Expan. factor	Expan. stock.	Total expan. stock.
21	1	5.2	20	1.1	3.3	--	1.1	100	1.43	1.6	4.8
	2	6.1	20	1.1		--	1.1		1.43	1.6	
	3	5.7	30	1.1		--	1.1		1.43	1.6	
22	--	--	--	--	--	--	--	--	--	--	--
23	1	5.3	20	1.1	3.3	--	1.1	80	1.43	1.6	4.8
	2	5.9	20	1.1		--	1.1		1.43	1.6	
	3	6.6	20	1.1		--	1.1		1.43	1.6	
24	1	9.3	20	2.3	23.6	20/ 23.6 = 0.85	1.9	100	1.43	2.7	28.6
	2	17.2	20	6.0			5.1		1.43	7.3	
	3	10.2	20	2.3			1.9		1.43	2.7	
	4	18.1	20	6.0			5.1		1.43	7.3	
	5	21.5	30	7.0			6.0		1.43	8.6	

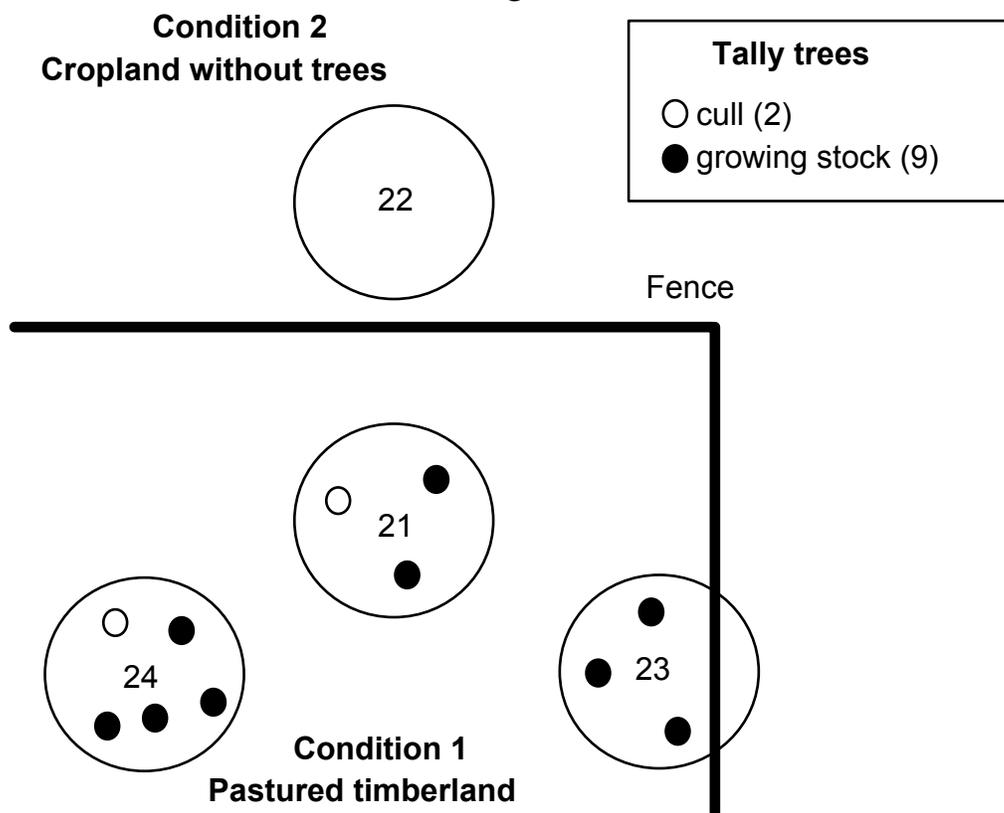
Sum = 280

Expansion factor = 400/280 = 1.43

All live stocking 38.2  
 Growing-stock stocking 28.0  
 Cull stocking 10.2

The total all live stocking here is 38.2, which exceeds the minimum stocking value for forest land. If the condition meets the other standards for timberland (minimum site index and is not being grazed) it should be given a land use of 20 or 22. If there is evidence of grazing the land use could be 21 because the total stocking in growing stock trees (28.0) is at least 25.0. Because this condition occurs on only half the plot and had there been one less growing stock tally tree the land use would have been 59, judgment can be used and/or additional temporary subplots could be installed to increase the sample in condition 1. If the field crew goes beyond the information in the tallied trees to assign a land use it should be noted on the field sheet. For example, the field crew may have observed that the plot was in a corner of the pasture with more trees than the rest of the pasture. Therefore they assigned a land use of 59.

Figure 7. Example plot where stocking is calculated. Two conditions exist on the plot, subplot 24 exceeds 20.0 total live stocking.



Ground Land Use Original (GLUO) 2 digits

With the exception of the new GLU code, 50 (Nonforest with trees (reserved)), the meaning of ground land use original codes are identical to current ground land use codes. Original ground land use will be printed on the plot sheet for only the first condition. This data item will not be entered into the data recorder.

Ground Land Use Current (GLUC) 2 digits

Record the observed ground land use existing at point center on the condition record. The condition found at plot center (subplots 1 and 21) is always condition number 1. If additional ground land uses are observed in the area, record them as different conditions.

On remeasured 10-point plots determine GLUC on each subplot. If any are different than condition number 1, record a new condition number. Likewise determine GLUC on each of the 1/24 ac subplots. **NOTE:** The same condition numbers should be used for subplots from either design sharing the same conditions.

An area must be at least one acre and 120 feet in width to receive a land use code. An acre is 43,560 square feet. To meet the minimum-size requirement, a strip of land 120 feet wide needs to be 363 feet long, a square area needs to be 209 feet on a side, and a circular area needs to be 235 feet in diameter.

## Ground Land Use *continued*

When determining the ground land use of a point or the location of the boundary between two land uses keep the following rules in mind.

Measure most abrupt forest/nonforest boundaries at the point where a vertical line is dropped from the edge of forest crowns (drip line). This point approximates the limit of influence of the forest canopy. Do not confuse this point with the line of shadows cast from the crowns. When uneven boundaries exist, the tallier must use an imaginary line to distinguish forest from non-forest. If you need to map a forest/nonforest edge, straighten this edge out over a stretch of about 50-75 ft. rather than going in and out with every branch.

In some instances a well defined edge that clearly divides the forest land from a nonforest land use exists under the drip line and should be used as the forest/nonforest boundary (both for mapping and for measuring the 120 ft minimum width). Examples of a well defined edge would be a maintained fence, the edge of plowing in an agricultural field, the shore of a lake or the limit of right of maintenance (mowing, brush cutting, herbicide application).

Most forest/forest and many forest/nonforest edges are transition zones and will not need to be mapped. Here are two examples:

- 1) There is a transition from an upland forest (an aspen stand) and to a marsh without trees (cat-tails and tag alder). You may be tempted to define a narrow strip of marsh with trees between the forest and the nonforest, but it would be less than 120 ft wide. Do not even try to map the edge of the forest. The forest canopy probably does not have a clearly defined drip line. At each subplot center simply decide which side of the center of the transition zone you are on and put the whole subplot in that land use. Don't worry if you call a subplot 100% marsh without trees and there happens to be a couple of trees within the 24 ft macro-plot. These trees are simply part of the transition zone and because you say they are part of a nonforest condition you do not need to tally them. You may want to use them as reference trees.
- 2) There is a transition from wooded pasture or pastured timberland to pasture without trees. Cattle are grazing the entire area, but the slope has trees that give way to grass in the flat area. Subplot 22 is clearly in an area with enough stocking to be wooded pasture or pastured timberland, and subplots 23 and 24 are out in the grass (pasture and range without trees). Subplot 21 is in a transition zone of seedlings and saplings and even a few scattered trees over 5" DBH that is not wide enough to have its own land use. At each of these subplot centers simply decide which side of the center of the transition zone you are on and put the whole subplot in one land use. Don't worry if you call a subplot 100% pasture and range without trees and there happens to be a couple of trees within the 24 ft macro-plot. Again, these trees are simply part of the transition zone and because you say they are part of a nonforest condition you do not need to tally them. You may want to use them as reference trees.

The boundary between two forest land uses (for example between GLU 20 and GLU 22) is the point on the ground where the crowns of the two stands come together. If there is a

feature between the two stands such as a fence, forest road, stream, or fire break, the center of the feature is used to determine the boundary.

**Reason For Change (CAUS) 1 digit: Item 6**

**NOTE: Only recorded on condition 1 of the plot.**

Record in the condition record reason for change (if any) that has taken place on condition one. If both original and current ground land uses are the same, reason for change is recorded as "0". If a change in ground land use on condition one has occurred, indicate the process that caused the change with one of the codes below.

<b>Code</b>	<b>Reason that caused the land use change</b>
0	No change.
1	Definition - Use only if current GLU code was unavailable on prior survey. (See section in manual on: Ground Land Use Original and GLU codes.)
2	Legislation.
3	Natural.
4	Disagree with the previous crew about the location of the plot (old photo usually is not available). Explain in the "Notes" section of the plot sheet.
5	Clearing, not utilized - Land cleared by mechanical, chemical, or hand means (or a combination of these), but timber not utilized.
6	Clearing, utilized - Includes land clearing where timber is utilized, and commercial clearcuts.
7	Partial timber cut.
8	Planting.
9	Other, Man - Includes fencing to exclude livestock.

For SK 1 and 7 (new subplots), no reason for change is recorded.

**Required Data Items By Ground Land Use**

If any portion of a subplot falls on timberland (code 20, 21 or 22), unproductive forest land (code 40), reserved forest land (code 41 or 45), wide windbreak (code 57) or wooded pasture (code 59) then the plot must be established and the trees within these land uses must be tallied. In this case the field crew must collect values for all data items described in this manual (the collection of some data items depends further on sample kind).

If no portion of any subplot falls on one of these ground land uses (20, 21, 22, 40, 41, 45, 57 or 59) then the plot does not need to be fully established. The plot center condition is the only condition that needs to be recorded. All required information for that land use must be recorded. For these plots, establish and paint a starting point (SP) the same as you would a plot that is fully established. Each of these plots will also be given a GPS location at plot center. Every plot sent to the field is a permanent plot that will be re-established at exactly the same location at the next inventory and will be checked to see if the condition has changed to GLU 20, 21, 22, 40, 41, 45, 57, or 59.

Ground land use 20, 21, 22, 40, 41, 45, 57, or 59:

Collect values for all data items listed on the plot sheet as described in this manual.

Ground land use 46:

**Required plot data items:**

All plot center data items are required when plot center falls in a condition that is a Christmas tree plantation (GLU 46). When no portion of the plot intersects a condition having land use 20, 21, 22, 40, 41, 45, 57, or 59 only the condition at plot center needs to be recorded. Pins do not need to be placed at every subplot center in the plot. It may not be possible to find suitable witness trees at plot center or it may be necessary to establish another subplot center and witness it. When no suitable witness trees are available anywhere in the plot it should be noted on the field sheet. Do not use Christmas trees as witness trees. If the plot is entirely in a Christmas tree plantation simply establish a starting point and put a pin at plot center.

**GPS coordinates are required**

**Required condition class data items:**

Condition number	Slope percent	Stand age
Ground land use	Slope shape	Stand area
Aspect	Slope length	Ownership class
Position	Forest type/stand size class	Posting

Ground land use 51-56, 58, 71, 72:

**Required plot center data items:**

New plot number	County name	Photo age
Old plot number	National Forest	Flight number
Dot number	Ranger district	Photo number
State	Original date	Photo scale
Unit	Current date	Data recorder
County	Township	Cruiser name
Sample kind	Range	Tallier name
PI land use	Section	Date
Cruiser code	Subdivision	Photo location
Tallier code		

**GPS coordinates are required**

**Required condition class data items:**

Condition number	Forest type	Stand area
Ground land use	Stand size class	Ownership class (when part of plot is GLUO or GLUC 20, 21, 22, 40, 41, 45, 57, 59)
Reason for ground land use change		

Ground land use 61-69, 80-99:

**Required plot center data items:**

New plot number	County name	Subdivision
Old plot number	National Forest	Photo age
Dot number	Ranger distract	Flight number
State	Original date	Photo number
Unit	Current date	Photo scale
County	Nonforest/forest PI indicator	Data recorder
Sample kind	Forest/nonforest PI indicator	Cruiser name
PI land use	Township	Tallier name
Cruiser code	Range	Date
Tallier code	Section	Photo location

**GPS coordinates are required**

**Required condition class data items:**

Condition number	GLU Reason for use change
Ground land use (original)	Ownership class (when part of plot is GLUO or
Ground land use (current)	GLUC 20, 21, 22, 40, 41, 45, 57, 59)

**See Tree History, item 33, for details about accounting for old trees in unusual situations.**

## Position , Aspect, Slope, Slope Length, Slope Shape: Item 16

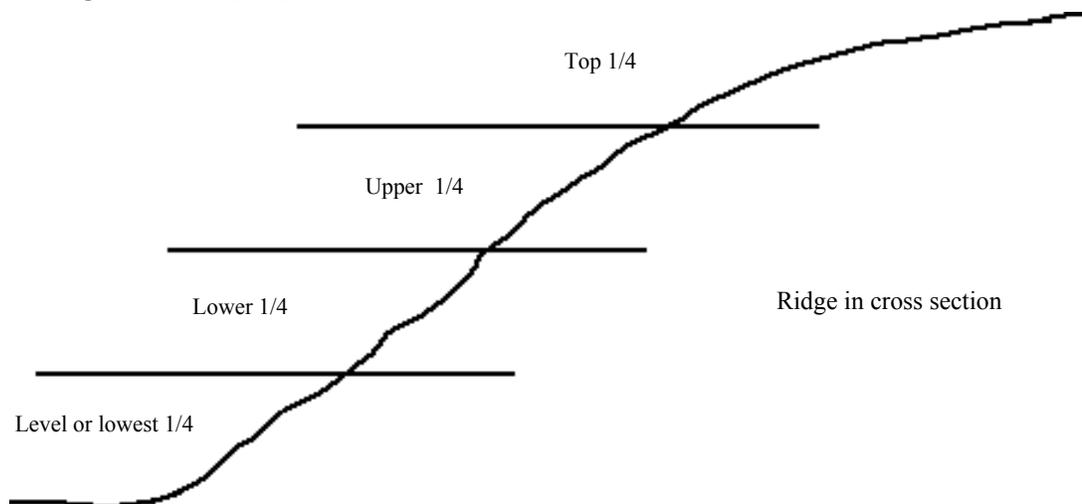
To determine how position, aspect, slope, slope length and slope shape affect a stand, these five items are measured. It is important to understand that all five items tie together or complement each other. Thus, record the macro features only. Record the appropriate codes in the condition class record.

### Position (POS) 1 digit

Position represents the location of the majority of the subplots within the condition in reference to topography of the immediate area (fig. 8).

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

**Figure 8. Slope position.**



### Aspect (ASP) 3 digits

Aspect represents the direction of drainage for the majority of the subplots within the condition. It is recorded as the azimuth of this direction. For instance, if the direction of drainage is  $36^\circ$ , the code is 036. Direction due North is recorded as 360.

### Slope (SLP) 2 digits

Slope is the average percent deviation from horizontal over all of the subplots within the condition. The recorded code is a measure of this percentage. For example, record 35 percent slope as 35. Slope percentages  $>99\%$  receive code 99.

## Slope Length (LEN) 4 digits

On the slope where the majority of the subplots within the condition fall, estimate total slope length to the nearest half chain (from 0000 to 999.5 chains). Slope length is 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.

Slope length is easily determined by looking at the aerial photos in stereo and measuring along the direction of aspect. For flatland and bottomland with zero slope, record slope length as 0000. For all slope percents other than zero, record slope length.

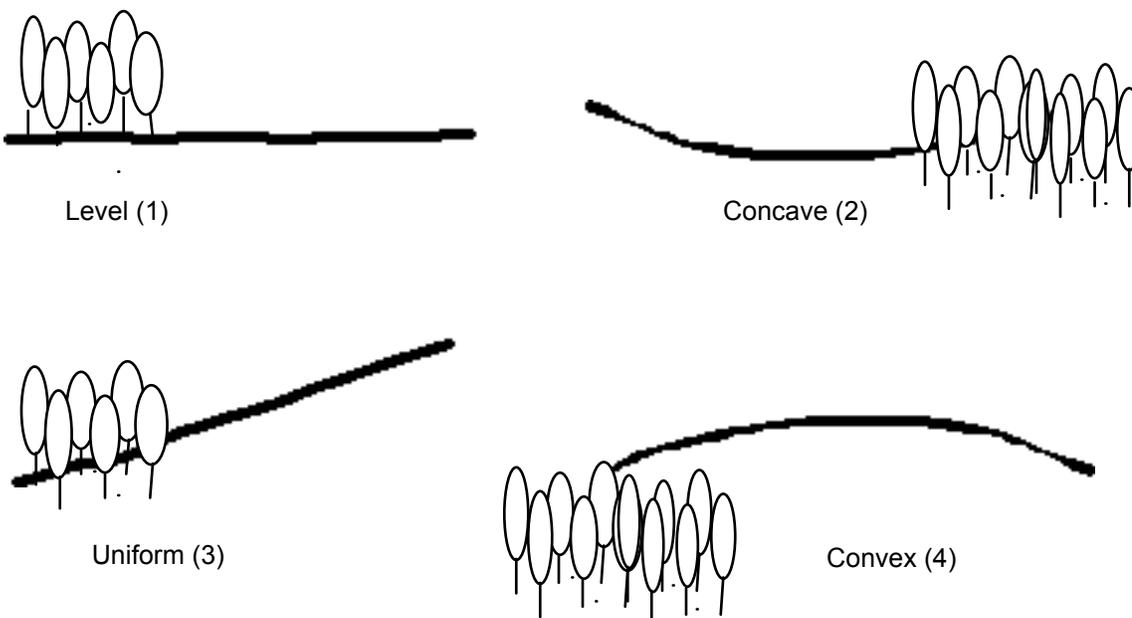
## Slope Shape (SHP) 1 digit

Slope shape, along with slope percent, indicates the relative erodibility of the majority of the subplots within the condition. A convex shape (code 4) is often found on the upper part of a slope and indicates an area with potential erodibility and rapid runoff. A concave shape (code 2) is found on the lower part of the slope profile and has good water holding capacity. (fig. 9)

Record the appropriate code for slope shape.

Code	Slope Shape
1	Level
2	Concave
3	Uniform
4	Convex

**Figure 9. Slope shape**



## Physiographic Class (PHYS) 1 digit: Item 17

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

### Cod Physiographic Class

e

- 3 **Xeric sites** Very dry soils where excessive drainage and/or very limited precipitation seriously limit both growth and species occurrence. Central States habitats include ridge tops with very dry, shallow soil and only limited tree occurrence, e.g. eastern redcedar, hardwood barrens.
- 4 **Xeromesic sites** Moderately dry soils where excessive drainage limits growth and species occurrence to some extent. Central States habitats include ridges with thin dry soils where upland oaks such as post oak commonly occur.
- 5 **Mesic sites** Deep, well-drained soils. Soil and water relationship most favorable to management opportunities. Growth and species occurrence is limited only by climate. Central States habitats include well-drained soils where white oak, northern red oak, black oak, and hickory commonly occur.
- 6 **Hydromesic sites** Moderately wet soils where insufficient drainage limits growth and species occurrence to some extent. Central States habitats include better drained bottomland hardwood sites found in upper benches along streams where silver maple, American elm, pin oak, and sweet gum commonly occur.
- 7 **Hydric sites** Very wet sites where excess water seriously limits both growth and species occurrence. These sites typically have soils with a high organic content such as peat or muck. Central States habitats include sloughs and swamps with interior drainage where willow and cottonwood and sometimes cypress occur.
- 8 **Bottomland sites** Sites where flooding influences growth and/or species occurrence. Flooding may be frequent (annually) or periodic (every 5-10 years). Soils may range from sand to silt and typically have a large inorganic component. These sites are always associated with a river, perennial stream, or intermittent stream. Woody shrubs are usually not present in these stands because of flooding however a very thick herbaceous layer may be present and vines may be numerous. Central States habitats include frequently flooded floodplains and riverbottoms where river birch, green ash, sycamore, cottonwood, willow, and hackberry commonly occur.

## Stand Origin (SORI) 1 digit: Item 18

Record the stand origin of the condition using the following one-digit codes. Consider only trees in the predominant stand size class of the condition.

### Code Stand Origin

- 1 Natural stand with no evidence of artificial regeneration in the predominant size class.
- 2 40% or more of the sample trees originating from artificial regeneration.

- 3 Less than 40% of the sample trees originating from artificial regeneration.
- 4 Planting has occurred in a non-predominant size class (for example, underplanting).

If stand origin is anything other than code 1, explain in the "Notes" section of the plot sheet.

### Stand History (SHIS) 2 digits: Item 19

Stand history reflects the kind of disturbance on half or more of the subplots within the condition. For new sample plots, stand history reflects this disturbance over the last 20 years. For remeasurement plots, this code reflects the most significant disturbance in the current stand since the last inventory. When GLU changes from nonforest to forest, the most significant disturbance is an 8 or 9. Record an 8 or 9 unless there is evidence that the pin prick has moved. In which case stand history should be something other than 8 or 9 and reason for GLU change should be 4 (previous GLU incorrect). Stand history cannot exceed the remeasurement period.

- 1st digit Use the appropriate code for the first digit to classify the disturbance.**
- 0 **No Disturbance** No evidence to indicate any of the following.
  - 1 **Grazing** Significant disturbance caused by livestock grazing. Evidence of livestock grazing includes: absence of an understory, exposed tree roots and mineral soil, dead standing timber, severe erosion, and cow pies.
  - 2 **Timber Stand Improvement** There is evidence that some trees have been killed or removed (or vines cut) through some type of pre-commercial thinning, pruning, or selective firewood harvest.
  - 3 **Clear Cut** More than 50% of merchantable stems have been removed. Some large diameter cull-trees may have been left, but generally all merchantable material has been removed.
  - 4 **Partial Harvest Cut** Less than 50 percent 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 from fire, wind, flooding, insect or disease.
  - 6 **Man-caused** Significant disturbance has resulted directly or indirectly as a result of human activities, i.e. 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 more than trees per acre).
  - 9 **Natural Regeneration of Non-Forestland** Areas that are reverting to forest vegetation. Areas that were once old field sites, marshes, etc.

Explain the kind and extent of any disturbance in the "Notes".

- 2nd digit Use the following codes for the second digit to indicate how long ago the disturbance took place.**
- 0 No disturbance
  - 1 1-4 years
  - 2 5-10 years
  - 3 11-15 years

4 16-20 years

**Site Index (SI) 3 digits: Item 59**

**Site Tree Species (SPP) 3 digits: Item 54**

Record the appropriate site index and site tree species for each condition from the site tree record.

**Forest Type-Stand/ Size Class (FTS) 3 digits: Item 62**

**Forest type (first and second digit)**

For all plots, record the appropriate two-digit code based on visual estimate while in the plot's area. If stocking is insufficient, use your best judgment. North Central analysts use your estimate as a check against the calculated forest type. Listing and brief descriptions of the forest types are found in the appendix.

**Stand Size Class (third digit)**

Normally, this item is calculated in the St. Paul office. On new sample plots it is not necessary for you to exactly calculate stand size class in the field. A visual estimate is 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(es) in the "Notes" section of the plot sheet.

If 10 or fewer trees are recorded, enter the estimated size class. This is assumed to be correct by the St. Paul office. For remeasurement plots, the original stand size is recorded on the plot sheet in St. Paul and remains unchanged. A sample plot with a stocking value of less than 10.0 in growing-stock trees, but greater than 10.0 in all live trees is recorded as non-stocked. Record stand size class using the following codes:

<b>Code</b>	<b>Stand size class</b>
1	Sawtimber stands
2	Poletimber stands
3	Sapling and Seedling stands
4	Nonstocked forest stands

**Note:** A forested plot with a stocking value of less than 10.0 in growing-stock trees is recorded as nonstocked (code 4).

**Stand Age (AGE) 3 digits: Item 63**

Stand age is recorded for each condition found on the plot. Determine the age of the predominant stand size class from three or more borings of trees in the condition (or other condition you feel is the same age). If there is an insufficient number of acceptable trees to determine stand age, record an estimate. Stand age must reflect stand size class.

Stand age is recorded with a three-digit code to the nearest year. A stand 49 years old is recorded as 049. Nonstocked stands (stand-size class code 4) receive an automatic stand age of 001.

### **Stand Area (AREA) 3 digits: Item 64**

Stand area is recorded in acres for each condition class found on the plot with ground land uses of 20, 21, 22, 40-46, 51-59, 71 and 72 and is used as an indicator of management feasibility. On the appropriate aerial photo measure the condition class area contiguous to the plot with the same overall forest type size density.

### **Tree Cover Width (TCWD) 2 digits: Item 66**

Tree cover width estimates the width of a forest canopy bordering a stream. The procedure for determining tree cover width in proximity to perennial streams is:

1. Tree cover width should be determined after all subplots have been located and other measurements have been completed. Only measure tree cover width if the wooded strip bordering the stream meets the definition of forest land (except that no minimum width or area restrictions apply).
2. If any subplot center (21, 22, 23, or 24) is within 100 feet of the mean high-water mark (indicated by the start of perennial terrestrial vegetation) of a perennial stream, follow the procedure outlined below. If a perennial stream is not within 100 feet of a subplot center record 00 for all conditions. Note: for sample kind 2 and 6 do not check subplot centers 1 through 10.
3. From the subplot center nearest the stream, go the shortest distance to the stream. At this point, measure perpendicular to the stream the total width of the tree cover on the side of the stream on which the subplot center lies. Estimation from the aerial photograph or by pacing is appropriate. Record width using the classification below:

<b>Code</b>	<b>TCWD</b>
1	<50 ft wide
2	51-100 ft
3	101-500 ft
4	501-1000 ft
5	1001-2640 ft
6	2641-5280 ft
7	>5280 ft

4. Each tree cover width measurement will be coded using 2 digits. The first digit is 1, 2, 3, or 4 depending on the last digit of the subplot from which the measurement was made. Thus, a 1500 foot wide tree cover, measured because the center of subplot 23 was less than 100 feet from the mean high-water mark and was the closest of all subplots to the mean high-water mark, would be recorded as "35," and so on.
5. A sketch, on the subplot diagram on the field data sheet, should be made showing the approximate direction of the line along which the width measurement was made. Indicate in the sketch which subplot center was the one closest to the stream.
6. If two subplot centers are equally distant from the center of the stream and within the same condition, select the lowest numbered subplot and proceed.

7. If the closest of all subplot centers is equally distant from two streams, select the stream to the north or east and proceed.
8. Record the same code for all conditions.

### **Posting (POST) 1 digit: Item 75**

For each condition class containing a forest subplot, record the code that best represents the situation involving the subplot. If multiple signs are posted in the same area, use the combination sign code. An example of a combination sign would be "No hunting, fishing, or trespassing."

<b>Code</b>	<b>Posting</b>
0	No evidence of restricted access.
1	Locked gate.
2	Keep out sign.
3	No trespassing sign.
4	No hunting/fishing sign.
5	Combination sign(s).
6	Sign that allows access solely with owners permission.
7	Other posted sign.
8	Combination of locked gate and sign.
9	Other evidence of restricted access.

### **Subplot Records: Items 7-14**

The purpose of the subplot records is to identify and map the conditions that occur on the macro plots. At least one subplot record must be recorded for each of the 10 subplots of the old design and the 4 subplots of the new design. The information in the subplot records is used to compute the percent of the area that each condition covers within the sample.

An entry is recorded for each condition found on the macro-plot in the subplot records. The condition found at subplot center must be recorded first.

### **Subplot center**

The first (and possibly only) subplot record entry for a subplot should have entries for only the following data items:

Subplot number	Percent of subplot area
Condition number	Cover class (if no trees are present)

### **Subplot Number (SUB#) 2 digits: Item 7**

Subplot number is a 2 digit number. For example 01 corresponds to subplot one, 10 corresponds to subplot ten, and 21 corresponds to the subplot at PC in the new design.

### Condition Number (CON#) 1 digit: Item 8

Condition number identifies the condition that exists at subplot center and refers to the condition number in the condition class record. The value of CON# is always 1 for the condition at Plot Center.

### Cover Class (COVC) 2 digits: Item 9

Cover class is only recorded at subplot center in conditions where the ground land use is 20, 21, 22, 40, 41, 45, 57, or 59, and no live trees are found on the subplot. When this happens the micro-plot (6.8 ft. radius) should be examined and one of the following codes recorded:

<b>Code</b>	<b>Cover Class</b>
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

Subplots that are cover classed should be referenced to assist in their relocation (see subplot Reference under item 15, Plot Design).

#### **For remeasurement plots**

If a subplot was cover classed on the prior survey, and is cover classed this survey, determine and record the current cover class and reference.

If a point was cover classed on the prior survey and live trees or seedlings are now present on the point, record them as ingrowth or ongrowth. There is no need to record the original cover class.

If a point was not cover classed on the prior survey, and is currently cover classed, record a cover class code on the subplot. Account for trees tallied during the previous survey and record as cut or dead.

### Percent Of Subplot Area (%SAR) 3 digits: Item 10

Percent of subplot area is the percentage of the total macro plot that the condition at subplot center covers. When the entire macro plot falls within a single condition, 100% is recorded. However, if two or more conditions are found on the macro plot, record the actual percent or area covered by the condition at subplot center.

**Note:** When using the Husky Data Recorder, the computer will figure actual percent of subplot area for you. If recording on a plot sheet, estimate area within plus or minus 5%.

## Additional conditions on a subplot

When two or more conditions exist on a macro plot, one additional subplot record entry is made for each condition. Record the following data items in the subplot record.

Subplot number	Azimuth corner (if needed to describe an irregular boundary)
Condition number	Dist. corner (if needed to describe an irregular boundary)
Azimuth left	Percent of subplot area
Azimuth right	

### Percent Of Subplot Area (%SAR) 3 digits: Item 10

Percent of subplot area is the percentage of the total macro plot that the additional condition covers. If a data recorder is being used to enter the data this item will be computed by the data recorder. If the data is being collected on a plot sheet this item should be estimated to within plus or minus 5%.

### Azimuth Left (AZML) 3 digits: Item 11

### Azimuth Right (AZMR) 3 digits: Item 12

### Azimuth Corner (AZMC) 3 digits: Item 13

### Distance Corner (DISC) 2 digits: Item 14

Azimuth left, azimuth right, azimuth corner and distance corner are used to describe the location of the condition boundary within the subplot. A condition boundary within the subplot must be approximated as either a straight line, or a line with one corner. If the boundary is approximated as a straight line record azimuth left and azimuth right. Azimuth corner and distance corner should be left blank. When the boundary is approximated by a line with one corner also record azimuth corner and distance corner.

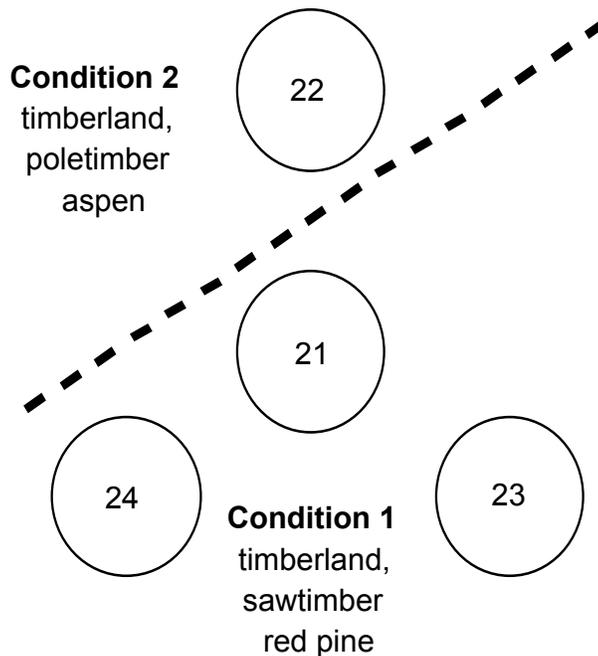
When a condition class boundary cuts through a subplot it may be useful to place pins or flagging at the subplot boundary every 60°. Marking the plot this way will help you visualize where the condition boundary intersects the subplot boundary. Azimuth are recorded from subplot center to the point where the condition boundary intersects the subplot boundary. Left azimuth should be the intersection to your left as you face the condition boundary and right azimuth is the intersection to your right. If there is a corner in the boundary record the horizontal distance between the corner and subplot center to the nearest foot (enter 1 for all distances less than 1 foot) and the azimuth to the corner from subplot center. For azimuth left, right and center use 360° for due north.

**Note:** Only when a well defined abrupt boundary between two conditions cuts through a subplot should an additional subplot record be recorded. This entry identifies the other condition and locates the boundary. When two adjacent subplots are in different conditions and the boundary between the two conditions is a transition zone, assume that the boundary occurs between the subplots.

**Simple example of a plot that contains two conditions but only one condition on any subplot.**

In figure 10 two conditions are shown on the plot but the condition boundary does not cut through a subplot. Both conditions are timberland and the condition boundary does not follow a change in ownership so therefore both conditions receive the same land use and ownership class. Condition 1 is a sawtimber red pine stand, condition 2 is a poletimber aspen stand. Subplots 21, 23, and 24 are in condition 1 and subplot 22 is in condition 2. The boundary between the two conditions does not clearly cut through any of the macro plots. Therefore every subplot is 100% within the condition at subplot center. The condition class and subplot records for this example are shown in figure 11.

**Figure 10. Simple case with two conditions on a plot and each subplot in one condition.**



**Figure 11. Condition class and subplot records for example shown in figure 10.**

CONDITION CLASS RECORDS																			
C O N #	G U O	G L U C	R E A S	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	P O S T	T C W D
(8)	(6)	(6)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(75)	(66)
XX	XX	XX	X	XXX	X	XX	X	XXX	X	X	XX	XX-	XXX	XXX	XXX	XXX	XX	X	XX
1	20	20	0	1	2	5	3	5	4	1	00	021	64	070	125	34	26	0	0
2		20		35	3	2	3	15	5	1	00	912	24	080	746	15	26	0	0
3																			

SUBPLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	100					
22	2	100					
23	1	100					
24	1	100					

In figure 10 the boundary between the two conditions is shown as an abrupt line, however it may be a wide transition zone between the two stands. When these transition zones are wide, it may be somewhat difficult to determine the condition class a subplot is in. The following procedures should be used by the field crew in determining which condition a subplot center falls in:

- 1) Delineate the two conditions on the photo by drawing the boundary as best you can. Boundaries should go down the middle of a transition zone.
- 2) Walk into one condition until you are clearly in that condition.
- 3) Walk through the transition zone until you are clearly in the second condition. Note when you pass subplot center.
- 4) If subplot center is nearer to your final position, assign the second condition to subplot center otherwise assign the first condition.

### **Examples of subplots that contain two or more conditions.**

Figures 12 and 13 illustrate how to tally condition class record and subplot record information when two conditions are present on the plot and a distinct boundary is present that cuts through some of the subplots.

Here both conditions are timberland. Again, condition 1 is a sawtimber red pine stand, condition 2 is a poletimber aspen stand. Subplots 23 and 24 are completely in condition 2. The condition boundary cuts through subplots 21 and 22.

Figure 12. Case with two conditions on a plot and a distinct condition boundary that cuts through subplots 21 and 22.

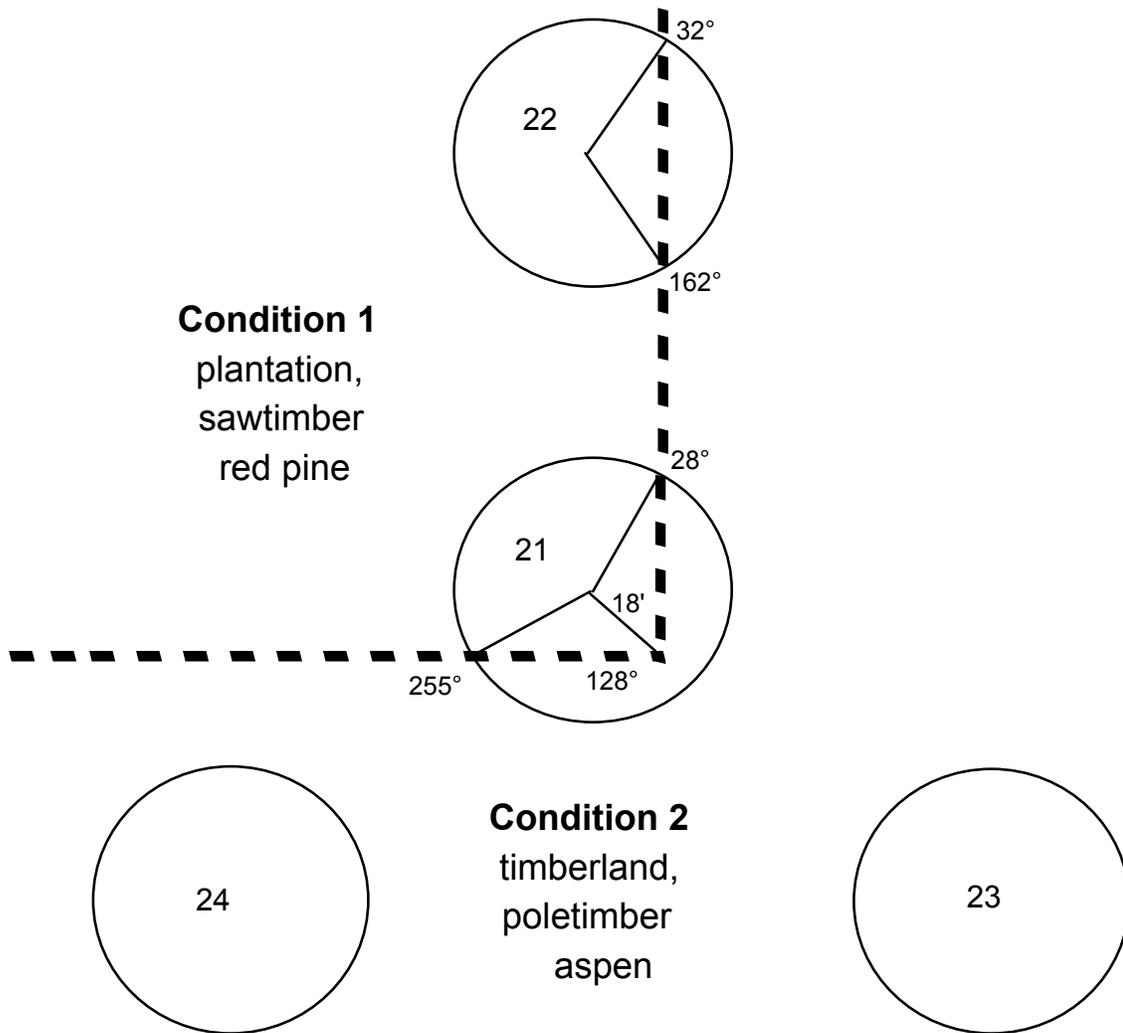


Figure 13. Condition class and subplot records for example shown in figure 12.

CONDITION CLASS RECORDS																			
C O N #	G L U O	G L U C	R E A S	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	P O S T	T C W D
(8)	(6)	(6)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(75)	(66)
XX	XX	XX	X	XXX	X	XX	X	XXX X	X	X	XX	XX- X	XXX	XXX	XXX	XXX	XX	X	XX
1	20	22	0	1	2	5	3	5	4	2	00	021	64	070	125	34	15	0	0
2		20		35	3	2	3	15	5	1	00	912	24	080	746	15	26	0	0
3																			

SUBPLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	70					
21	2	30		28	255	128	18
22	1	80					
22	2	20		32	162		
23	2	100					

24	2	100					
----	---	-----	--	--	--	--	--

**Note:** At subplot 21 and 22 the condition that is at subplot center (condition 1) is always recorded first and the second condition on the subplot (in this case condition 2) is always recorded second and contains the azimuth and distance information. It is very important that this is done correctly. Remember, the first subplot record is for the condition that occurs at subplot center and does not get any azimuth or distance entries. Additional subplot records are made for each additional condition that occurs on the subplot. Azimuth and distance entries must be made for these conditions to define where the condition boundary intersects the subplot boundary. Be sure to get the azimuth and distance information with the correct condition. Remember, when you are standing at subplot center to take the azimuth information that these azimuths go with the condition you are looking out at, not the one you are standing in.

Figures 14 and 15 illustrate what to do when three conditions are present on a plot. Here two of the conditions are timberland and one is nonforest. In this case the three conditions are:

- 1) Timberland, seed.-sap., aspen (recent clearcut), state owned
- 2) Timberland, poletimber, aspen, forest industry owned
- 3) Improved pasture and rangeland with trees, farmer owned.

The condition boundary is easy to locate. There are no broad transition zones. A fence separates the improved pasture and rangeland with trees from the timberland and the edge of the clearcut is very abrupt.

Figure 14. Case with three conditions on a plot and distinct condition boundaries that cut through subplots 23 and 24.

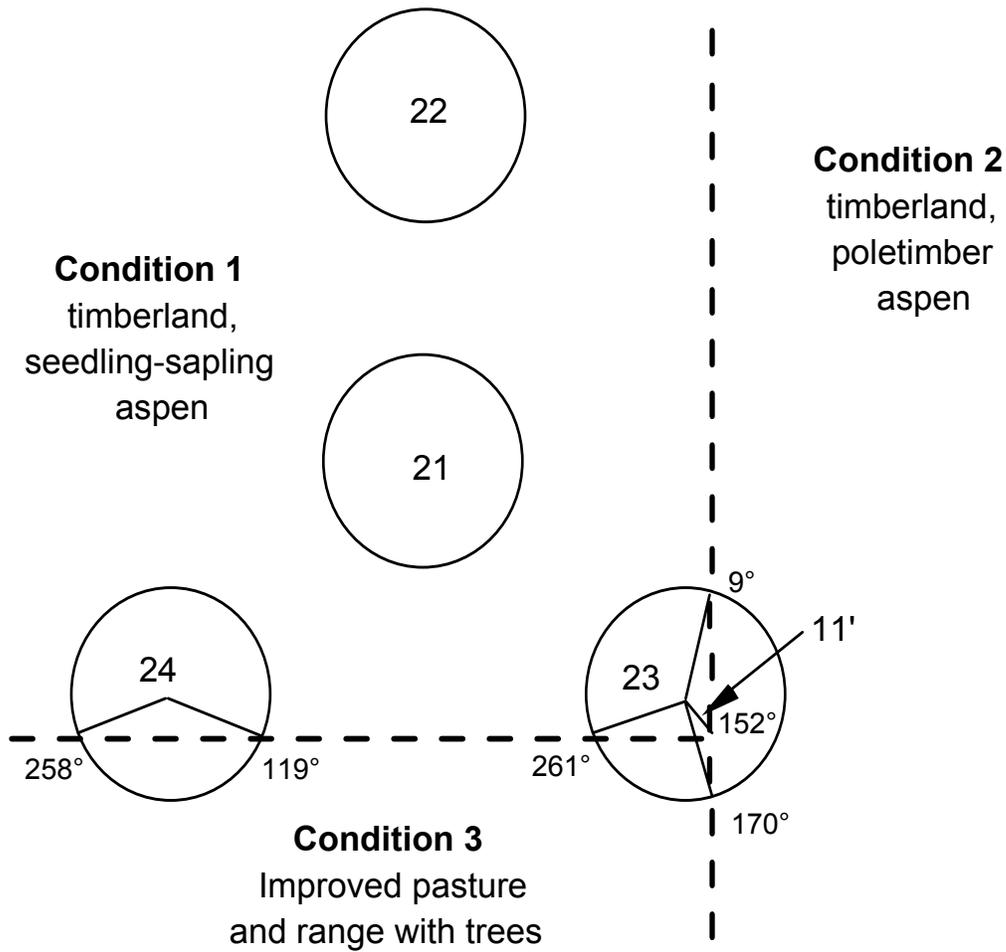


Figure 15. Condition class and subplot records for example shown in figure 14.

CONDITION CLASS RECORDS																				
C O N #	G L U O	G L U C	R E A S	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	P O S T	T C W D	
(8)	(6)	(6)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(75)	(66)	
XX	XX	XX	X	XXX	X	XX	X	XXX	X	X	XX	XX-X	XXX	XXX	XXX	XXX	XX	X	XX	
1	20	20	0	1	2	5	3	5	4	1	31	913	3	078	746	40	15	0	0	
2		20		35	3	2	3	15	5	1	00	912	24	078	746	15	28	0	0	
3		52										501				80				
4																				

SUBPLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	100					
22	1	100					
23	1	45					
23	2	35		9	170		
23	3	20		170	261	152	11
24	1	70					

24	3	30		119	258		
----	---	----	--	-----	-----	--	--

The corner azimuth recorded for condition 3, subplot 23, illustrates that the corner azimuth does not have to be between the left and right azimuths.

Figures 16 and 17 illustrate what to do when a narrow condition (such as a right of way, wooded strip, narrow windbreak or shelterbelt) cuts through the plot. These land uses can be less than 120 feet wide and could split a subplot. If the same condition exists on each side of the narrow strip and the strip cuts completely through a subplot you will have to make three subplot record entries even though only two conditions actually exist on the subplot. The situation shown at subplot 1 and 2 are the only situations where three entries should be made on a subplot where really only two conditions were found.

**Figure 16. Case where a right-of-way cuts completely through a subplot, dividing a condition into two pieces.**

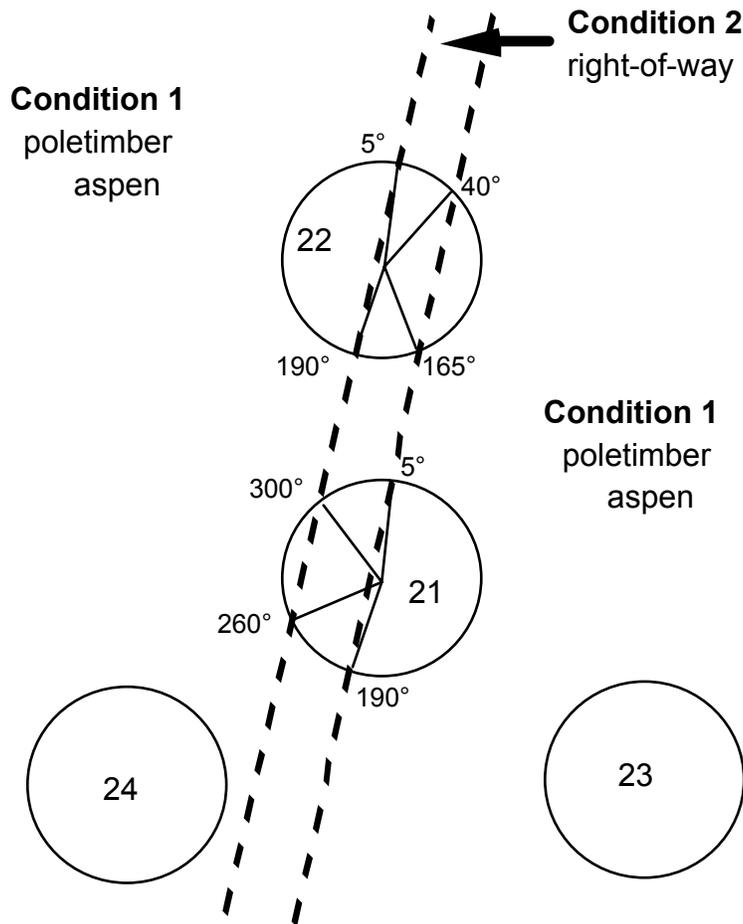


Figure 17. Condition class and subplot records for example shown in figure 16.

<b>CONDITION CLASS RECORDS</b>																			
C O N #	G L U O	G L U C	R E A S	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	P O S T	T C W D
(8)	(6)	(6)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(75)	(66)
XX	XX	XX	X	XXX	X	XX	X	XXX X	X	X	XX	XX- X	XXX	XXX	XXX	XXX	XX	X	XX
1	20	20	0	35	3	2	3	15	5	1	00	912	24	080	746	15	26	0	0
2		68																	
3																			

<b>SUBPLOT RECORDS</b>							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	60					
21	2	35		190	5		
21	1	5		260	300		
22	2	40					
22	1	15		40	165		
22	1	45		190	5		
23	1	100					
24	1	100					

### Mapping nonforest conditions

Plots without any land use 20, 21, 22, 40, 41, 45, 57 or 59 are not be mapped. Even if they contain more than one condition. Record only the condition at plot center. For these plots you just need to enter one condition class record, and no subplot records. For example, plot center falls on a wooded strip and the rest of the plot is partly in cropland and partly in pasture and range without trees. Record the wooded strip as condition 1, get a forest type, stand size class and stand area and go to your next plot. No need to record any other conditions, enter any subplot records or do any mapping.

When plots do contain land use 20, 21, 22, 40, 41, 45, 57 or 59 only these land uses and any adjacent nonforest conditions need to be recorded. Consider everything beyond the adjacent nonforest condition to have the same land use. This can easily happen with a right of way. For example subplots 1, 6, 7 and 8 could be in timberland, and the rest of the plot in cropland without trees, except for subplot 3, which goes into a right of way. Do not record the right of way as a condition, although you would want to draw it on the sketch map for future reference.

## Plot sketch map

A sketch must be made on the plot sheet. This map must show the location of all condition boundaries that pass through the plot. Conditions should be labeled by GLU, CFTS and any other item that was used to distinguish them. Figure 18 is an example sketch map and figure 19 shows the associated condition class and subplot records. Boundaries that pass through subplots should be drawn carefully with a straight edge to show the location of the intersections and corner points. These sketch maps will be helpful in resolving problems in the data edit and to show the locations of old moved plots.

**Figure 18. Sample sketch map.**

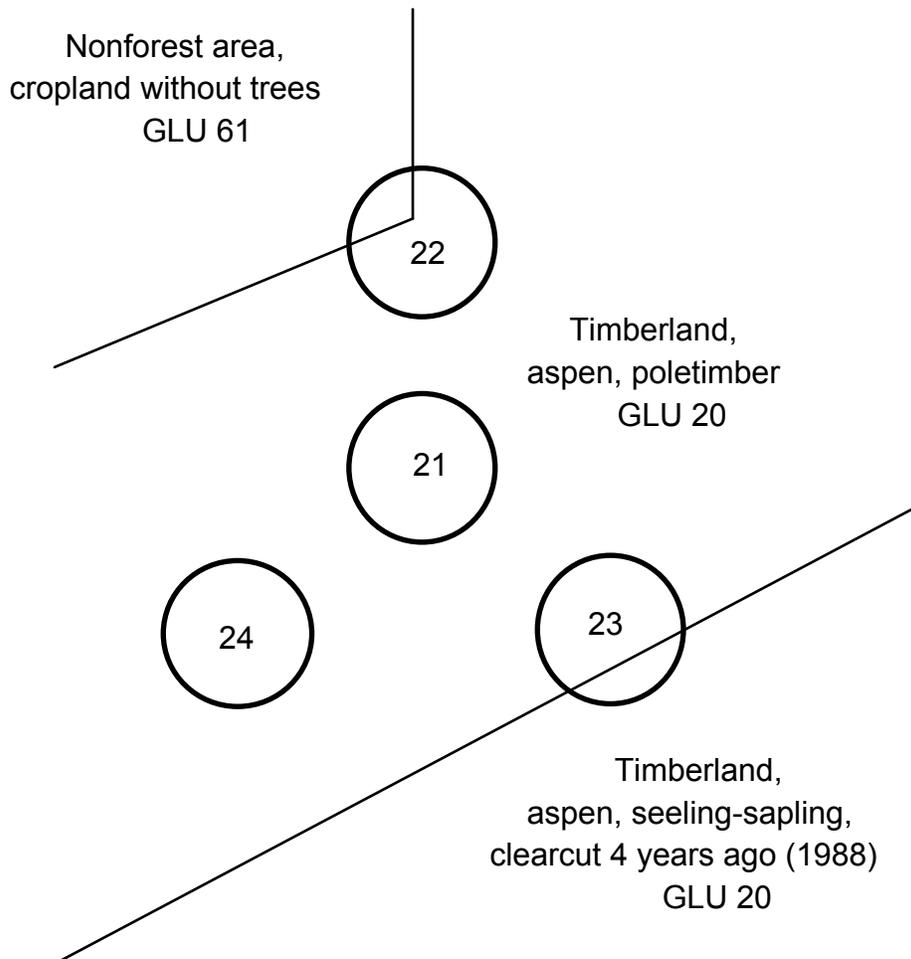


Figure 19. Condition class and subplot records for plot shown in figure 18.

CONDITION CLASS RECORDS																			
C O N #	G L U O	G L U C	R E A S	A S P	P O S	S L P	S H P	L E N	P H Y S	S O R I	S H I S	F T S	A G E	S I	S I S P	A R E A	O W N C	P O S T	T C W D
(8)	(6)	(6)	(6)	(16)	(16)	(16)	(16)	(16)	(17)	(18)	(19)	(62)	(63)	(59)	(54)	(64)	(1)	(75)	(66)
XX	XX	XX	X	XXX	X	XX	X	XXX	X	X	XX	XX-	XXX	XXX	XXX	XXX	XX	X	XX
1	20	20	0	35	3	2	3	15	5	1	00	912	24	080	746	15	26	0	0
2		61																	
3		20		35	3	2	3	15	5	1	31	913	4	080	746	20	26	0	
4																			

SUBPLOT RECORDS							
SUB# (7)	CON# (8)	%SAR (10)	COVC (9)	AZML (11)	AZMR (12)	AZMC(13)	DISC (14)
XX	XX	XXX	XX	XXX	XXX	XXX	XX
21	1	100					
22	1	85					
22	2	15		270	350	230	8
23	1	85					
23	3	15		120	240		
24	1	100					

### Shifted subplot centers

If subplot center falls within a tree trunk, shift the subplot center back, along the approach line, a distance of two feet from the edge of the tree trunk and mark with a pin or stake. Measure distance to the next subplot center from the pin or stake. Record such changes in the "Notes" section of the plot sheet.

### Shrub Records: Items 22-29

The following information is recorded for forest subplots (21, 22, 23, and 24) in the NE quadrant, 0° to 90°, of the micro plot from leaf flush to leaf fall (May 1 to September 30). All information is recorded on the shrub record. It is assumed that all shrubs are in the condition present at subplot center, therefore condition is not recorded in the shrub record.

#### Subplot Number (SUB#) 2 digits: Item 22

Record the subplot number for each entry in the shrub record.

#### Shrub Number (SNUM) 2 digits: Item 23

For each subplot, number sequentially from 1. Each species-diameter class combination (tall woody perennials and tree seedlings) or species (other perennials) on a subplot is given a new shrub number. Begin to number shrubs at 1 on each subplot.

#### Species (SPP) 3 digits: Item 24

See tree species list (seedlings) and shrub species list (others) in the appendix.

## Shrub History (SHIS) 2 digits: Item 25

Classify tall, woody perennials as shrub history 80. Other perennials, classify as shrub history 81. See listing under shrub species in the appendix.

## Diameter Class (DIAC) 2 digits: Item 26

Classify shrub stem diameter, six inches from the ground. Use only for tall woody perennials (SHIS=80) and leave blank for other perennials (SHIS=81). See the table below for codes.

### Shrub History 80

Code	Diameter (measured along stem six inches from the ground)
01*	0.0 - .19" or less than 6" tall
02	.2 - .29"
03	.3 - .39"
04	.4 - .49"
05	.5 - .99"
10	1.0 - 1.49"
15	1.5 - 1.99"
20	2.0 - 2.49"
25...45	1/2" diameter classes continue

## Frequency Of Stems Present (FREQ) 3 digits: Item 27

Enter the number of stems present in each species diameter class for tall woody perennials (SHIS=80) and leave blank for other perennials (SHIS=81).

**Note:** Only seedlings may be recorded twice, once on the shrub record and once on the tree record when tallied in the micro plot. Any tree 1.0" DBH or larger on the subplot is not recorded in the shrub record.

## Percent Cover (COV) 1 digit: Item 28

Percent cover applies only to other perennials (SHIS=81) and is left blank for tall woody perennials (SHIS=80). Use codes listed in the table below

### Shrub History 81

Code	Percent ground cover
1	solitary plant, less than 1%
2	1 - 10%
3	11 - 20%
4	21 - 40%
5	41 - 70%
6	More than 70%

## Evidence Of Browsing (BROW) 3 digits: Item 29

The percent of the number of stems by species and stem diameter class for tall woody perennials and the percent of the ground cover by species for other perennials that show evidence of the stems, twigs and foliage being browsed. This data helps determine the impact of deer and other browsing animals on regeneration, species composition, and the lower vegetation layer. Record general percent categories (1-100%).

### Tree Records: Items 30-43, 74

#### Sample Kind 1 and 7 (new plots)

All live and standing-dead trees 5.0" DBH and larger within 24.0 feet of subplot center are tallied on new standard plots. If the **center of the tree at its base** is within 24.0 ft of subplot center, the tree is tallied. In addition, tally all live saplings (trees  $\geq 1.0$ " DBH, but  $< 5.0$ " DBH) within the micro plot. The micro plot radius of 6.8 ft is measured as the horizontal distance from the pin to the **center of the tree at its base**. See item 39, Tree Class, for more information on tallying dead trees.

Count or estimate the number of seedlings (trees  $< 1.0$ " DBH) by species and damage class that are on the micro plot. Record totals in item 42, Tree Cavities/Number of Seedlings. The Minimum height required to be considered a seedling is six inches for softwood and one foot for hardwood species. DBH for seedlings is recorded as 000. See item 42 for additional instructions.

#### Sample Kind 2 and 6 (remeasured plots)

Tally trees on the new subplots (21-24) according to the same rules as just described for SK 1 and 7. Also account for all trees tallied in the previous survey plus trees that have grown large enough to sample. Specific instructions follow.

#### The 37.5 BAF variable radius plot (trees $\geq 5.0$ " DBH)

Trees 5.0" DBH and larger are tallied if within the limiting distance of a 37.5 basal area factor prism (both previously tallied trees and trees now large enough to be "in" trees). Figure 20 illustrates a tree within the variable radius plot, a tree outside the variable radius plot, and a questionable tree. Check a questionable tree for its limiting distance. The limiting distance for all trees 5.0" DBH and larger is measured as the horizontal distance from the pin to the **center of the tree at DBH**. The limiting distance is shown on the tatum guide in the appendix. For example, a tree with a DBH of 14.6 inches, must be within 20.7 feet (horizontal distance) at DBH to be considered "in" using a 37.5 basal area factor prism.

Use your prism carefully. Hold the prism directly above point center. Watch out for flat or triangular trees. On steep slopes, "in" trees may appear to be "out". Check all questionable trees. Because the variable radius plot is only used to tally trees 5.0" or larger there is no reason to look at trees less than 5.0" DBH with the prism.

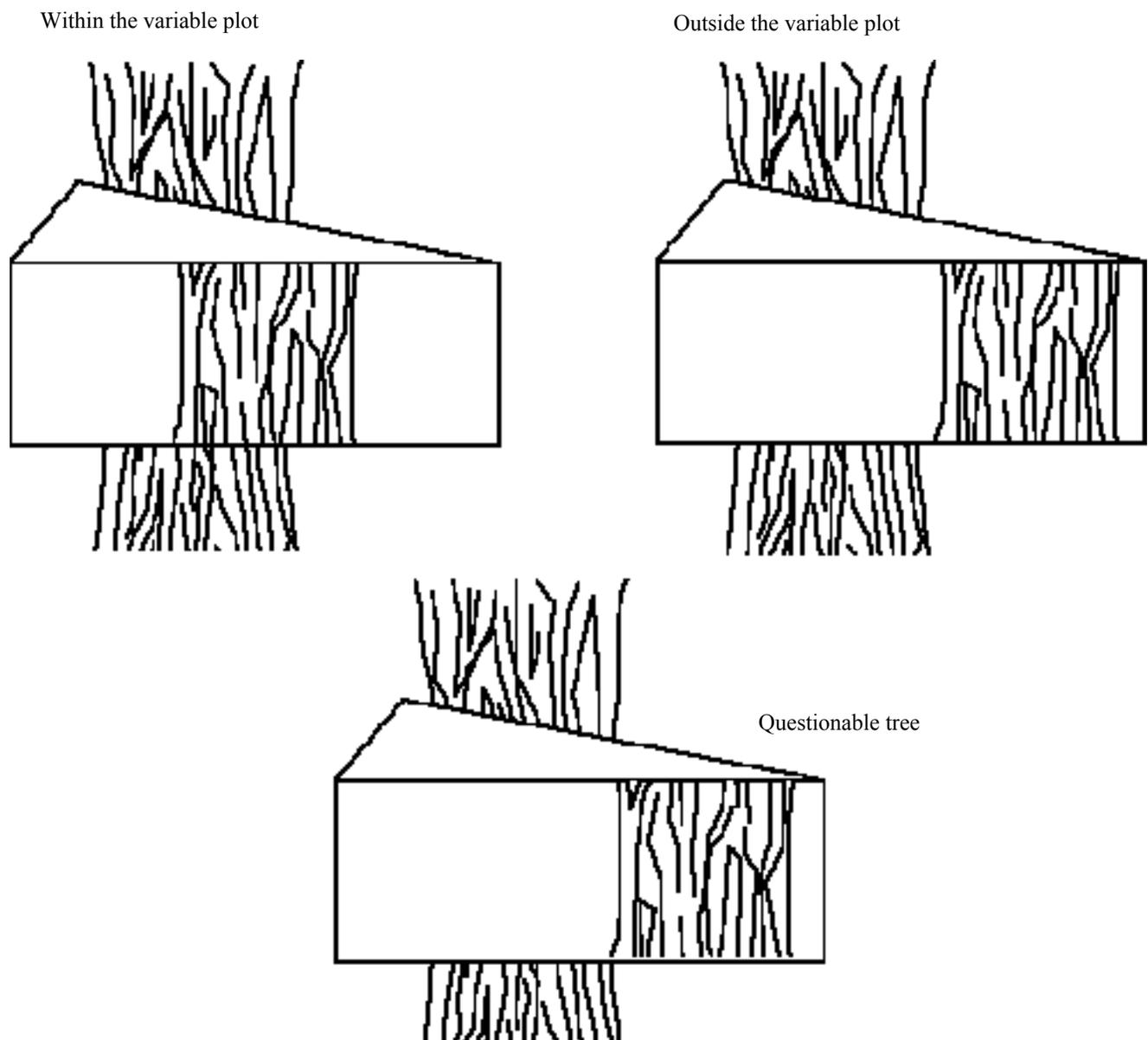
**Note:** A leaning tree,  $< 5.0$ " DBH, outside the micro-plot (6.8 ft radius) but within the limiting distance is not tallied.

#### The micro plot (6.8 ft radius)

Measure seedlings and saplings on micro plots in the same way as mentioned for SK 1 and 7 at subplots 1-3 and 21-24.. Be sure to account for every sapling tallied on micro plots in the previous inventory. **The limiting distance for trees < 5.0" DBH is measured as the horizontal distance from the pin to the center of the tree at the base.**

**Note:** A leaning tree, 5.0" DBH or larger, within the micro plot, but outside the limiting distance of the prism, is not tallied unless it was measured at the previous inventory. If a tree was < 5.0" DBH last time, tallied on the micro plot, and  $\geq 5.0$ " DBH now but not on the variable radius plot because it is leaning or has moved, it still needs to be measured and the appropriate tree history recorded (see item 33).

**Figure 20. Variable radius plot**



## Checking trees when subplot center is inaccessible

It may be physically impossible for you to reach a subplot center and you may need to check and possibly tally trees on that subplot. This will most often occur when subplot center is in deep water within 24 ft. of land. To obtain a distance and azimuth for these trees establish a temporary pin (shifted subplot center) a known distance and azimuth from subplot center. Measure that same distance and azimuth from each check tree to get a shifted tree location. The distance and azimuth from the shifted subplot center to the shifted tree location is the appropriate distance and azimuth for each tree.

For example, in chaining from subplot 2 to subplot 3 a river bank is encountered, making it impossible to chain beyond 55 ft. A pin placed 55 ft., 0° from subplot center 2 will be 15 ft, 180° from subplot center 3 and can be used as a shifted subplot center. To get a distance and azimuth for trees near the river bank simply measure 15 ft, 180° from each tree you wish to check and establish a shifted tree location. The distance and azimuth from the shifted subplot center to each shifted tree location is the appropriate distance and azimuth for each tree.

### Subplot Number (SUB#) 2 digits: Item 30

Record the subplot number for each entry in the tree record.

### Tree Number (TR#) 2 digits: Item 31

Record a tree number (two digits if required) on the tree record for each entry including trees, stumps and seedlings. Use numbers 1 through 99.

#### For remeasurement plots

All old trees 5.0" DBH and larger (live or dead but not stumps) are retallied using the old tree number. On subplots 1-3, remeasure all trees  $\geq 1.0$ " DBH using original tree numbers. On subplots 4-10 remeasure trees  $\geq 5.0$ " DBH using original tree numbers. Stumps, seedlings, and saplings on subplots 4-10 are disregarded, and their old tree numbers are not used. **Use old tree numbers as printed on the new plot sheet, do not change them.**

### Tree Species (SPP) 3 digits: Item 32

Record a three-digit species code for all trees, live or dead. Codes from 010 to 299 are for softwoods, and from 300 to 998 are for hardwoods. Within these groups, species codes are listed alphabetically by scientific name.

Verify the tree species codes for trees tallied in the previous survey and correct if necessary. If you change a tree species code, explain it in the "Notes" section on the plot sheet. Assign tree species codes as needed for new trees. For a tree identified as a noncommercial species on the prior survey (species code 999), assign the proper species code on the current survey. If the tree is missing, the tallier makes a best judgment in assigning a species. (See appendix for species list.)

## Tree History (THIS) 2 digits: Item 33

### New plots (Subplots 21-24)

Code	Tree History
01	Live
05	Standing-dead

#### Live (Tree history 01)

If the tree is alive at breast height, it is considered a live tree. For a tree dead at breast height but with a new leader originating below breast height, record the new leader as a live tree. The DBH of this leader determines its size class.

#### Standing-dead (Tree history 05)

Standing-dead A dead tree that is  $\geq 5.0$ " DBH and is free standing to a height of 4.5'.

Enter data for these items:

- Subplot number
- Tree number
- Distance
- DBH (current)
- Species
- Damage/Death
- Decay Class (current)
- Tree History
- Azimuth
- Condition number
- Tree Cavity

### Remeasurement plots

Code	Tree History
00	No status
01	Live
05	Standing-dead
06	Down-dead (only on previously measured trees)
07	Stump of salvable-dead
08	Stump utilized
09	Stump not utilized
31	Ingrowth live
35	Ingrowth standing-dead
61	Ongrowth live
65	Ongrowth standing-dead

Code	Tree History No Longer Used
04	Salvable-dead

**Tree History Descriptions for remeasurement plots (subplots 1-10)**

On remeasurement plots tree history is used to identify the tree's status in the current inventory. It is used in processing to divide trees into three groups:

- old sample trees (first digit = 0),
- new sample trees that came onto the micro plot due to growth, regeneration or land use change (first digit = 3), and
- new sample trees that came into the variable radius plot due to growth or land use change (first digit = 6).

On remeasurement plots, all trees printed on the plot sheet summary from the data base for the past inventory must be accounted for; none can be dropped. The plot sheet will list all live and dead trees 5.0" DBH and greater plus live trees 1.0"-4.9" DBH on subplots 1-3 if the plots were measured before 1987. No old stumps, dead trees less than 5.0" DBH, or seedlings on any subplot should be listed. In addition, any tree less than 5.0" DBH on subplots 4-10 should not be listed on a plot last measured prior to 1987. If these trees are listed, please contact St. Paul.

Prior to 1987, the micro-plot was installed only on subplots 1-3. On subplots 4-10 trees less than 5.0" were only measured if they were needed for stocking or they were picked up on the variable radius plot. Not every tree within the micro plot was inventoried. Because trees less than 5.0" on subplots 4-10 were not sampled equally in the last inventory the old information we have on them is not useful and should be ignored and these trees are considered new sample trees.

**No status (Tree history 00)**

These are previously measured trees that meet one of the following descriptions. They receive a tree history of 00:

Trees on lands that have changed land use. The land use change is from one where trees were measured (20, 21, 22, 57, or 59) to a land use where trees are not measured (anything else). Every old live, standing-salvable-dead, or standing-dead tally tree must be accounted for when there is a land use change. If a tree was cut as a part of the land use change it would get a tree history that reflects the cutting of the tree. If the tree is still alive (or died/cut after the land use change and unrelated to the land use change) it should get a current tree history of no status. If the tree is still standing-salvable-dead or standing-dead it should get a current tree history of no status.

A tree was tallied last survey, but should not have been, and should not be tallied now. It is given a history of no status. Put reason in the note section of the plot sheet. Scrape the old paint off the tree.

Trees tallied during the previous survey and displaced from the plot are considered no status trees.

**Live (Tree history 01)**

If the tree is alive at breast height, it is considered a live tree. For a tree dead at breast height but with a new leader originating below breast height, record the new leader as a live tree The DBH of this leader determines its size class.

## Remeasurement subplots 1-10 *Continued*

### Dead trees (Tree histories 05 and 06)

Standing-dead A dead tree that is  $\geq 1.0$ " DBH (subplots 1-3) or  $\geq 5.0$ " DBH (subplots 1-10) and is free standing to a height of 4.5'.

Down-dead A dead tree that is  $\geq 1.0$ " DBH (subplots 1-3) or  $\geq 5.0$ " DBH (subplots 1-10) and is not free standing to a height of 4.5'. Dead trees that are leaning and supported by another tree are tallied as down-dead.

### Stumps (Tree histories 07, 08, and 09)

Stump-salvable-dead The stump of a tree that was salvable-dead at the time it was cut and which was utilized.

Stump-tree utilized The stump of a tree that was alive at the time it was cut and which was utilized.

Stump-tree not utilized The stump of a tree that was alive at the time it was cut and which was not utilized, that is it was not removed from the forest for forest products.

### Ingrowth (Tree histories 31 and 35)

Ingrowth trees are trees (alive or dead) that were not tallied (or were seedlings) on the previous survey. They are now being tallied and occur on the micro plot. A new live tally tree of any diameter that is within 6.8' of the pin (measured horizontally to the center of the base of the tree) should be given an ingrowth tree history. Dead ingrowth trees  $< 5.0$ " DBH are not measured. Tally all live trees  $\geq 1.0$ " DBH on subplots 1-3.

If a tree tallied at the last survey is dead at breast height but a new leader has originated below breast height, record the new leader as ingrowth if it is within the micro plot. Record the old tree as mortality.

All live seedlings are tallied as ingrowth and assigned a tree history 31. Tally all live ingrowth trees on subplots 1-3.

### Ongrowth (Tree histories 61 and 65)

Ongrowth trees are new tally trees (alive or dead) that are outside of the micro plot (**measured horizontally to the center of the base of the tree**). They are now  $\geq 5.0$ " DBH and occur on the variable-radius plot. Tally all ongrowth trees on subplots 1-10.

If an original tree is now dead at breast height and has a new leader  $\geq 5.0$ " DBH, record the leader as ongrowth and the original tree as dead.

**The following are instructions for tallying trees on remeasurement plots and assigning tree history codes.**

**1. Trees where land use was forest and is now nonforest (Tree history code 00)**

If the tree is still alive (or its death/cut occurred after a land use change (to nonforest) and was unrelated to the land use change) it should get a current tree history of no status. Enter data for these items:

- Subplot number
- Tree number
- Species
- Tree History
- Condition number
- DBH (orig.)
- Tree Class (orig.)
- Crown Ratio (orig.)
- Crown Class (orig.)

**2. Original live tally trees still alive (Tree History Code 01)**

Account for all trees tallied as alive during the previous survey and currently alive. Transfer old tree number, DBH, crown ratio and crown class from the plot sheet to the data recorder, and complete all new items to survey standards.

**3. Original live tally trees now dead and still standing (Tree History Code 05)**

Enter the following data.

Sawtimber-size and pole-sized trees, enter data for the items listed below:

- Subplot number
- Tree number
- Distance
- DBH (original and current)
- Species
- Damage/Death
- Tree Class (original)
- Tree Class (current)
- Tree History
- Azimuth
- Condition number
- Tree Cavity
- Crown Ratio (original)
- Crown Class (original)

Trees under 5.0" DBH on subplot 1-3, enter data for the items listed below:

- Subplot number
- Tree number
- Distance
- DBH (original and current)
- Species
- Damage/Death
- Tree Class (original)
- Tree Class (current)
- Tree History
- Azimuth
- Condition number
- Crown Ratio (original)
- Crown Class (original)

A smaller DBHC than DBHO is acceptable.

**4. Original live tally trees now down (Tree History Code 06)**

Sawtimber-size and pole-sized trees, enter data for the items listed below:

- Subplot number
- Tree number
- Distance (original)
- DBH (original and current\*)
- Species
- Damage/Death
- Tree Class (orig. tree class)
- Decay Class
- Tree History
- Azimuth (original)
- Condition number
- Crown Ratio (original)
- Crown Class (original)

**\* Use original DBH for current.**

**5. Original dead tally trees still standing (Tree History Code 05)**

Sawtimber-size and pole-sized trees, enter data for the items listed below:

- Subplot number
- Tree number
- Distance
- DBH (original and current)
- Species
- Damage/Death (use code 900)
- Tree Class (original)
- Tree Class (current)
- Tree History
- Azimuth
- Condition number
- Tree Cavity

A smaller DBHC than DBHO is acceptable.

**6. Original dead tally trees now down (Tree History Code 06)**

Sawtimber-size and pole-sized trees, enter data for the items listed below:

- Subplot number
- Tree number
- DBH (original and current\*)
- Species
- Damage/Death (use code 900)
- Tree Class (orig. tree class)
- Decay Class
- Tree History
- Condition number

**\* Use original DBH for current.**

## Remeasurement subplots 1-10 *Continued*

### 7. Trees now cut and either alive or dead at the last survey (Tree History Codes 07, 08, and 09)

For trees tallied as live on the last survey that have since been cut, enter data for the items listed below (trees dead at the last survey will not have an original Crown Ratio or Crown Class):

- Subplot number
- Tree number
- DBH (original and current)
- Species
- Damage/Death (07 only)
- Tree History
- Condition number
- Tree Class (original)
- Crown Ratio (original)
- Crown Class (original)

For salvable-dead stumps (07), record cause of death. If there is no way to determine cause of death, record unknown (code 900) but make an effort, especially with recently dead trees. If current DBH can not be measured (that section of tree has been removed) enter the original DBH.

When the land use was Forest and is now Nonforest and the tree was cut as part of the land use change, assign a tree history that reflects the cutting of the tree. Enter the following:

- Subplot number
- Tree number
- DBH (original and current)
- Species
- Damage/Death (07 only)
- Tree History
- Condition number
- Tree Class (original)
- Crown Ratio (original)
- Crown Class (original)

### 8. New live trees (Tree History Codes 31 and 61)

For ingrowth and ongrowth live trees, tally all required items with the exception of original tree data (DBH, tree class, crown ratio, and crown class). These items are zeroed out. All seedlings receive an ingrowth tree history (31).

### 9. New dead trees (Tree History Codes 35 and 65)

For ingrowth and ongrowth dead trees, tally the following items:

Sawtimber-size and pole-sized trees (DBH  $\geq$  5.0"), enter data for the items listed below:

- Subplot number
- Tree number
- Distance
- DBH (current)
- Species
- Damage/Death
- Tree Class (current)
- Tree History
- Azimuth
- Condition number
- Tree Cavity

Trees under 5.0" DBH are not measured.

## 10. Trees tallied or omitted from the last survey by error

We assume that work completed on the last survey was done as accurately as possible and is 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 arise:

Tree History codes 00 If a tree was tallied last survey, but should not have been, and should not be tallied now, record tree history 00 and old information. Put reason in the note section of the plot sheet, scrape the old paint off the tree, and check instruction 1 for items to record.

Tree History codes 01, 05, 06, 07, 08, and 09 If a tree was tallied last survey, but should not have been, and should be tallied now, transfer old information and regard as if the tree was tallied correctly.

Tree History codes 31 and 61 If a tree was not tallied last survey, but should have been, and should be tallied now, record the tree as ingrowth or ongrowth.

## 11. Displaced trees (Tree History Codes 00, 31, 34, 61, and 64)

A tree may have been physically moved either onto or off of the plot by 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 (see instruction 8 and 9).

Trees tallied during the previous survey and **displaced off** the plot are considered no status trees. They receive a tree history of 00 (see instruction 1). No current information needs to be recorded for these trees. Be sure to adequately explain the exact circumstances in the "Notes" section of the plot sheet. Trees tallied as live during the last survey, now dead and displaced off of the plot, are tallied as dead trees.

### **Special Instructions for trees in forest conditions where plot center was nonforest at the last measurement**

Unless the previous nonforest land use was wooded pasture or wide windbreak, do not reestablish the old plot. Carefully determine stand history and reason for change (see Stand History) and record them in condition 1.

If the previous land use was wooded pasture or wide windbreak, reestablish the old plot and retally trees from the previous survey. Also determine stand history and reason for change (see Stand History) and record them in condition 1.

### **Special Instructions for trees in nonforest conditions that were forest at the last measurement**

When a previously measured condition no longer needs to be measured because of a land use change, the original trees are accounted for according to the following guidelines.

**Remeasurement subplots 1-10 *Continued***

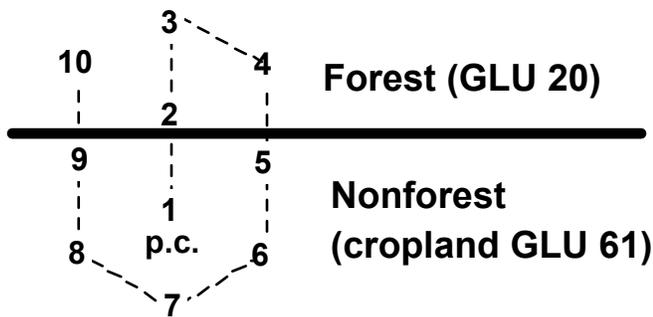
- **Nonforest areas that are a result of clearing (CGLU 61 - 69, 80, or 90)**

Trees are assigned a tree history of 08 or 09 depending on whether or not the cleared trees were utilized. Use your best estimate from owner contact, field examination, etc. if utilization isn't clear. Example: Owner says all the larger oaks were utilized and the other trees were pushed to the side of the field. All larger oaks receive a tree history of cut and utilized and other trees receive a not utilized tree history. The required tally items for stumps are listed in No. 7.

- **Nonforest areas that have been partially cleared (CGLU 46, 51-56, 58, 61-69, 80, or 90)**

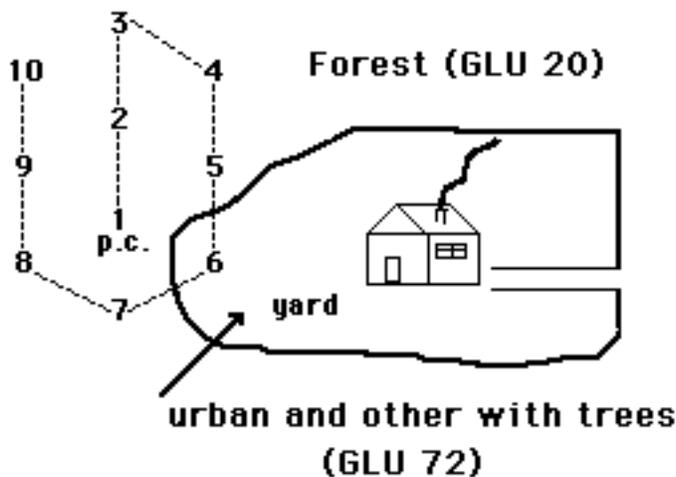
Determine the cause of the land use change. North Central data processing personnel are mainly concerned with getting an estimate of the cut and utilized portion of the sample. Make an effort to determine the cut and utilized trees and assign a cut and utilized tree history. Trees still standing receive a no status history. Required tally items for stumps and for no status trees are listed in No. 7 and No. 1 above. See the following examples.

**These three examples are all remeasurement plots that were timberland at the time of the last measurement and had no moved subplots.**



**Example 1**

Assign trees in the nonforest condition (subplots 1, 5, 6, 7, 8, and 9) a tree history of stump-utilized or stump-not utilized. Remeasure trees that are still in the timberland condition (subplots 2, 3, 4, and 10) and give them their normal two digit tree histories and other measurements.

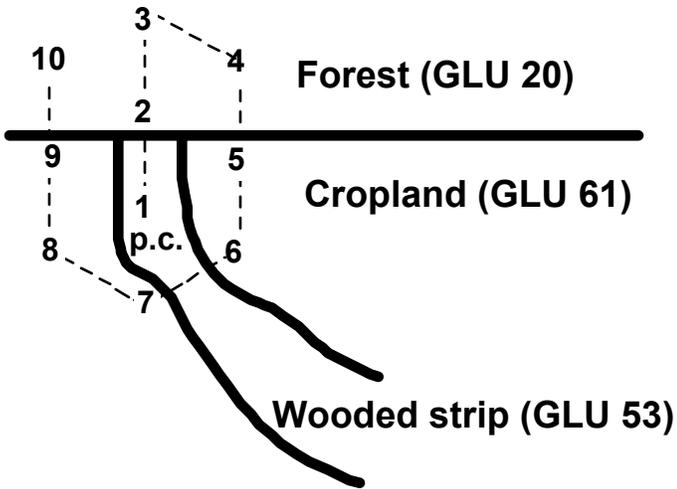


**Example 2**

The land use of the yard area has changed and we now have two conditions. In the yard assign trees that were not cut a tree history of 00 and any tree that has been removed a tree history of cut and utilized or cut and not utilized. Remeasure trees that are still in the timberland condition (outside of the yard) and give them their normal two digit tree histories and other measurements.

Example 3

Here we have gone from one condition to 3 conditions. Assign trees still alive and standing in the wooded strip a tree history of no status tree (00). Remeasure trees that are still in the timberland condition (subplots 2, 3, 4, and 10) and give them their normal two digit tree histories. Assign any tree that has been removed a tree history of cut and utilized or cut and not utilized.



## **Tree Distance (DIST) 2 digits: Item 34**

Record distances for all live and dead trees tallied (except seedlings). The distance recorded is the slope distance to the nearest foot from subplot center to the near face of each tree at its base. Record a two-digit code.

Record a three-digit code for all distances given in the witness tree grid and the reference tree grid of the plot sheet. The distance recorded is slope distance to the nearest tenth of a foot from subplot center to the center at the base of each tree. The last digit represents a decimal fraction.

## **Diameter Breast Height (DBHO, DBHC) 3 digits: Item 35**

Diameter at breast height (DBH) is taken 4.5 feet above the ground, measured on the uphill side of the tree. Record a three-digit code for all trees to the last tenth-inch. 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 < 1.0" DBH. See the earlier section on monumenting sample trees for instructions on how to mark the location of DBH.

It is essential that the measurements are accurate since trees are determined as "in" or "out" of the sample, depending in part on their DBH. For remeasured plots, it is important that DBH measurements are taken at the same point as in the last inventory. Missing paint, sloughing bark, cracks, splits, and other degradation may make it difficult to measure DBH of standing-dead trees. Estimate the likely location of breast height and measure DBH there. DBHC may be smaller than DBHO because of shrinkage, lost bark, or lost wood.

Irregularities at DBH (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. Measure butt-swelled trees 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 3.5' above the fork (apply this rule only once per tree).

Important: Use care in determining where the tree forks--extend the centerlines of the two stems to their junction. Don't equate the point where daylight can be seen with the point where the tree forks. Figures 19 and 20 illustrate the proper methods for measuring DBH.

### **DBH for remeasurement plots**

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. If there is an obvious error in the original measurement use what means you have to determine what the entry should have been and change it.

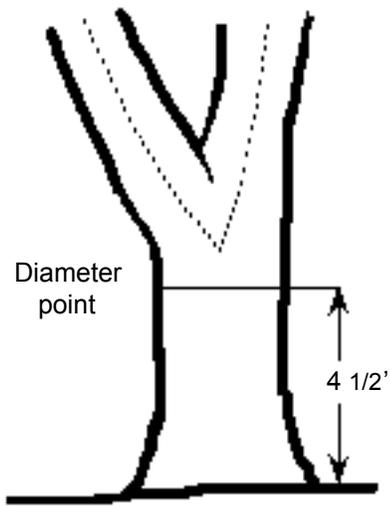
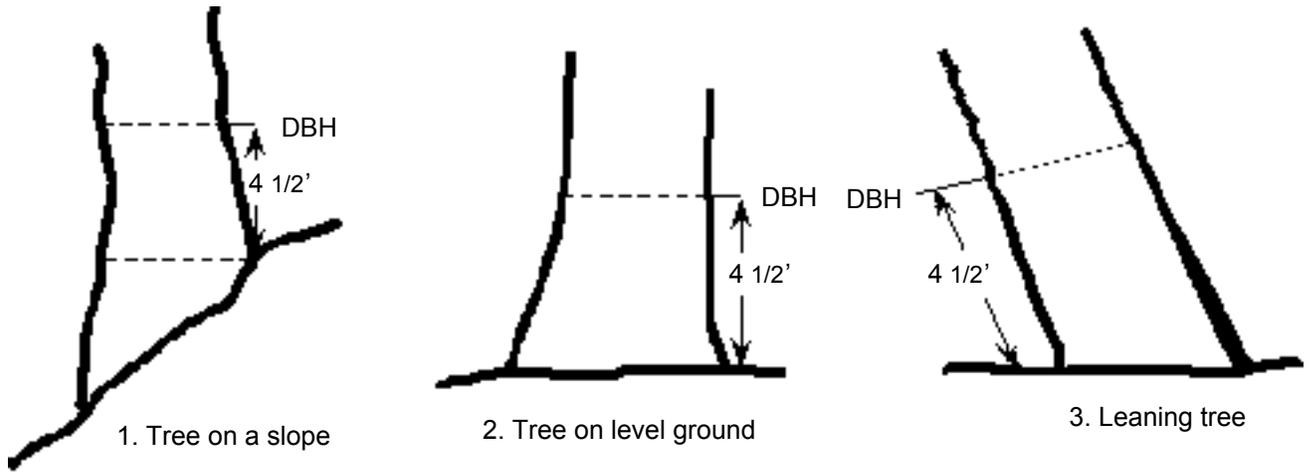
Current Check to see that the original DBH was taken in the correct place. If correct, remeasure, rescribe, and repaint this original measurement. It is extremely important to measure the same

place if the measurement was initially correct; look carefully for evidence of paint at DBH. If DBH was not measured in the correct place, remeasure DBH at the original location and make a note on the plot sheet stating whether DBH was measured high or low. Measure DBH at the correct place on the bole if the previous measurement was taken on a deformity or can not be relocated. **If DBH decreases more than 1.0" note the cause of the decrease.**

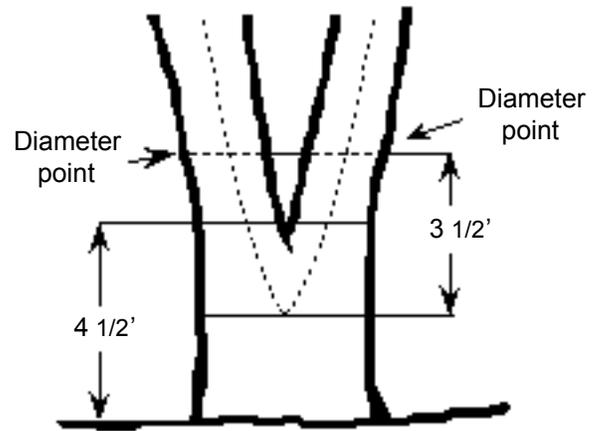
If the tree is now dead at DBH, it is considered a dead tree. If a new leader has taken over below DBH and is  $\geq 1.0$ " DBH, give it a tree history of ingrowth or ongrowth. If the tree is not at least 1.0" DBH, it is taken as a seedling and can be recorded twice--once as a dead tree and once as a seedling.

Forked trees may present unusual situations. If the original tree was measured as one stem, but it is obvious that the fork is below 4.5', then the DBH may decrease on this tree and the other stem will be a new tree if it is big enough to measure. When a tree was considered two trees at the last measurement but the fork occurs at 4.5' or higher, then one of the stems gets the new DBH (which will be much larger than the original DBH) and the other stem get no status.

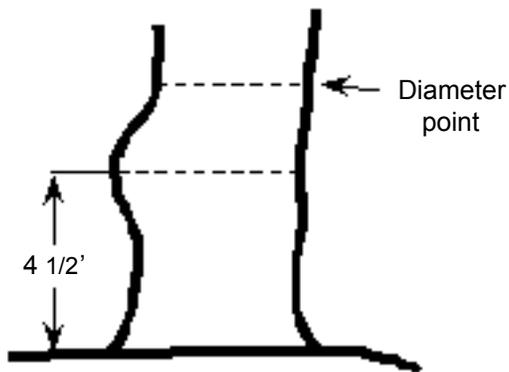
**Figure 21.** Diameter breast high measurement in a variety of situations



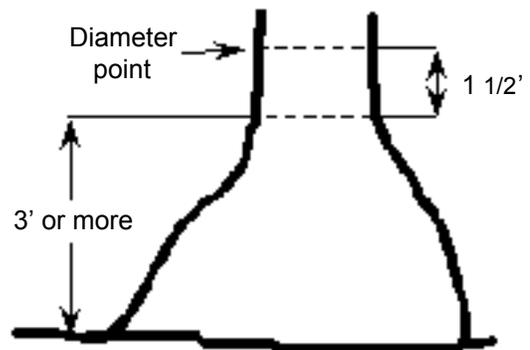
4. Tree forking at or above 4 1/2 feet



5. Tree forking below 4 1/2 feet



6. Tree deformed at 4 1/2 feet



7. Bottlenecked tree

**Figure 22.** Using the diameter tape

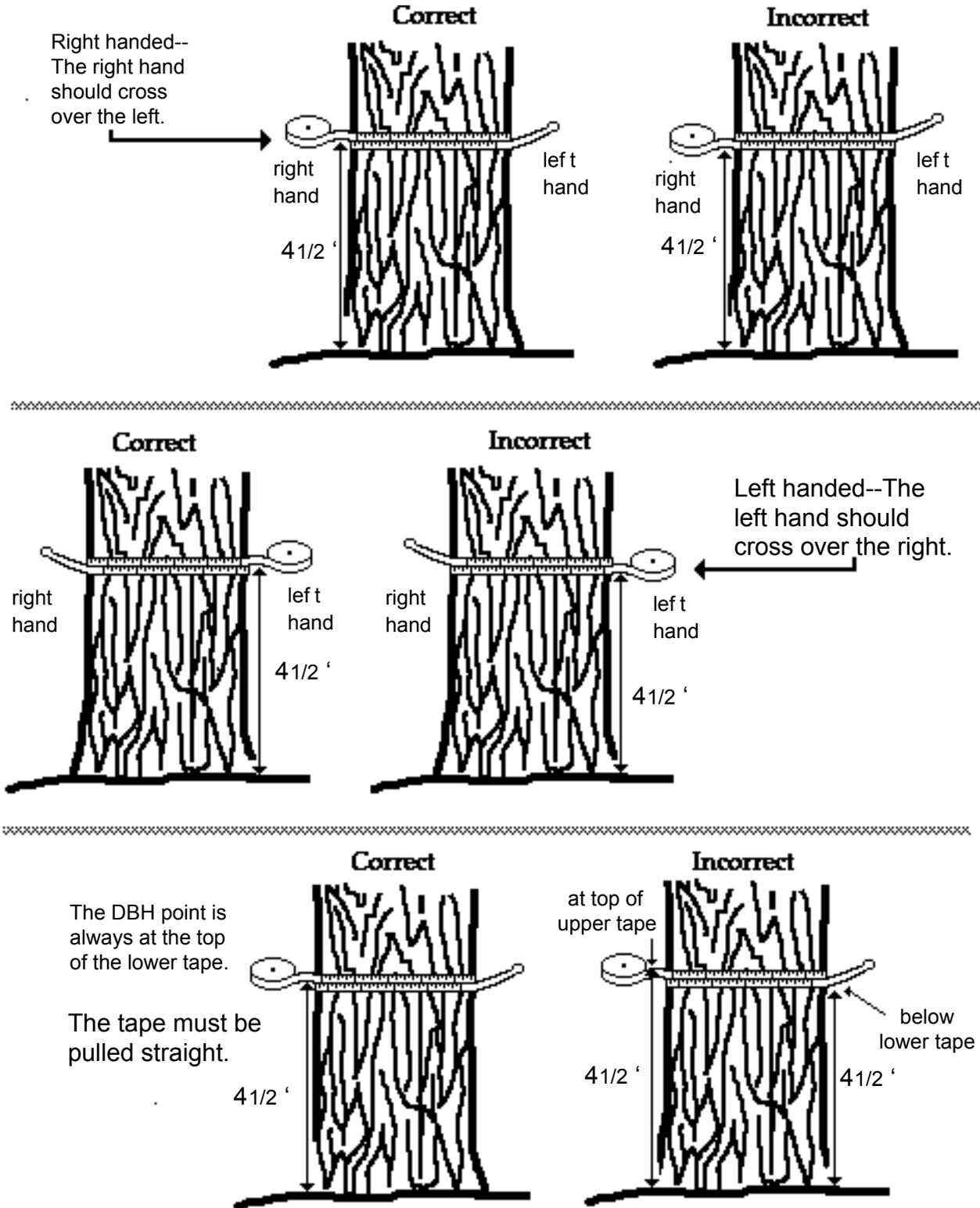
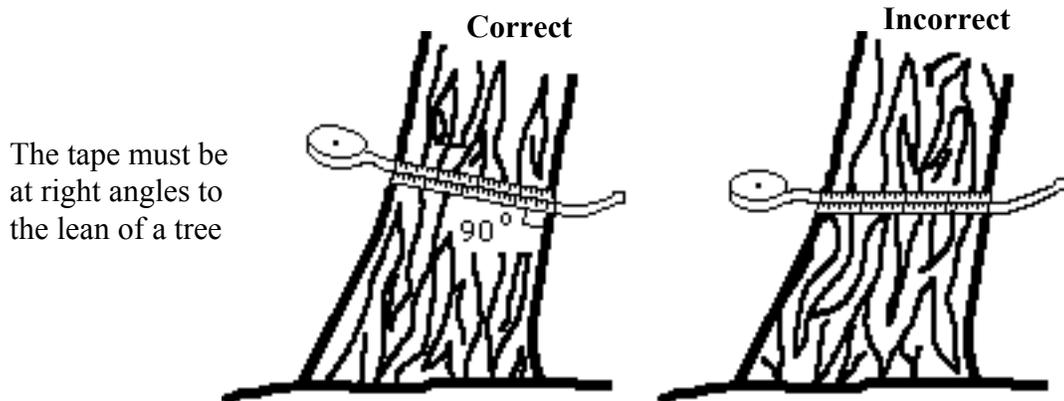
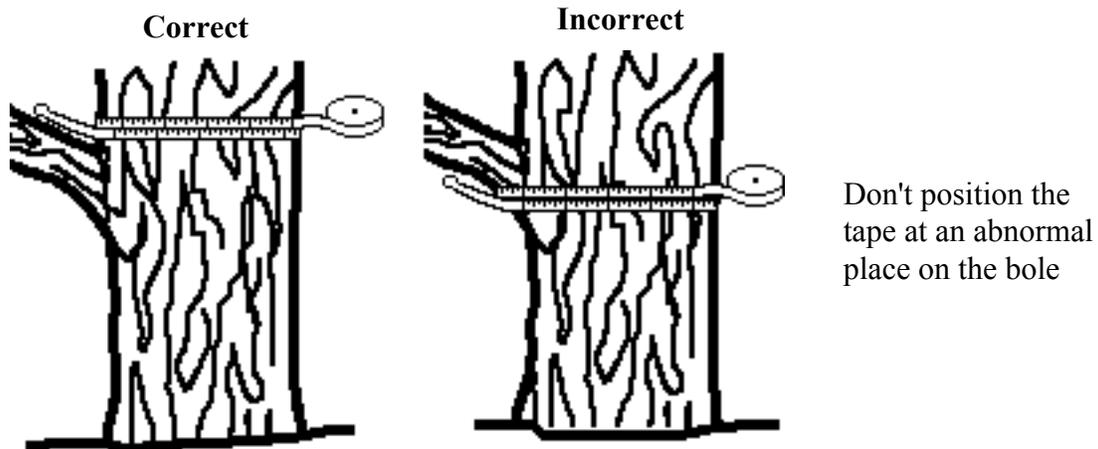


Figure 22 CONTINUED



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### Tree Azimuth (AZM): Item 36

Record azimuth on all live and dead trees tallied (except seedlings) The azimuth recorded is a three-digit code representing the magnetic azimuth from point center to the center of the tree at its base. Examples:  $9^\circ$  is recorded as 009;  $89^\circ$  is recorded as 089;  $347^\circ$  is recorded as 347. Zero-degree azimuth is not used. Any tree at  $0^\circ$  azimuth is tallied as 360.

Two trees on the same point cannot 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 current azimuth readings at the time of remeasurement. For example, a tree with an original azimuth of  $358^\circ$ , has a current azimuth of  $1^\circ$ , record the current azimuth as 001. This could lead one to presume changing the tree number. Do not do this. Never change a tree number.

## Condition Number (COND) 1 digit: Item 37

Record the condition number of the condition the tree occurs in. This item is required for all trees, including seedlings, stumps, dead trees and no status trees.

## Damage Or Cause Of Death (DAM) 3 digits: Item 38

For live trees, record presence of damage or pathogen activity if it is serious enough to reduce the quality or vigor of the tree. Record the cause of death for dead trees.

The pest or damage is identified using the coding criteria (minimum severity requirements). A complete list of damage codes and coding criteria appears in the appendix of this manual. Follow these guides for assigning damage/death codes:

- Use the most specific code. Avoid general injury codes if possible. For example, Eutypella canker code has preference over bole canker code, which has preference over unknown/uncoded canker.
- The damage must meet the severity rating for its particular damage code. Examples: an insect defoliator is coded only when it is causing > 20 percent defoliation; a Hypoxylon canker on a branch is not coded because its severity rating is "any occurrence on the bole."
- If the pest/damage does not satisfy the coding criteria, it is coded to a more general code, such as one of the 900 codes, unknown, uncoded damage.

When two or more pests occur on a tree, record the most significant and important pest. The following applies.

1. Record the agent causing the most severe damage. An agent which will cause death takes precedence over one causing volume loss, which takes precedence over one causing growth or quality loss. For example, a canker low on the main bole takes precedence over decay higher on the stem, but decay low on the main bole takes precedence over a canker high in the crown.
2. Record permanent damage before temporary or seasonal damage. For example, decay or canker takes precedence over insect defoliation, even if defoliation was 100 percent on a hardwood tree.
3. Record bole damage over branch damage.

Death codes are the same as damage codes, when coding the cause of death, choose a code from the list of damage codes. If the tree is dead and the cause can be determined, code the cause of death. If the cause is unknown, and the tree is salvageable, code the damage rather than unknown death, if there is damage. Trees dead at the previous survey should receive a damage code of 900.

		Priority			
<u>Highest priority</u>					<u>Lowest priority</u>
Specific pest	>	General Pest	>		Damage or injury
Death or potential death	>	Volume reduction	>	Growth slowed/quality reduction	

Cull trees (except noncommercial species) must have a damage code other than 000. Seedlings and saplings are considered growing stock, unless a specific damage is observed. Excessive sweep and crook is not considered a specific damage code for seedlings and small saplings (< 3.0" DBH).

A damage code is not recorded to indicate a reason for not qualifying as a better tree grade. Damage codes are given in the appendix section of this manual.

### **Tree Class/Decay Class (TCO, TCC) 2 digits: Item 39**

Tree class/decay class reflects tree suitability for timber products or the extent of decay in the butt section of down-dead trees. Tree class is basically a check for the straightness and soundness of the sawlog portion on a sawtimber tree or the potential sawlog portion on a poletimber tree or sapling. Not considered in determining tree class are: tree vigor, predicted death, and plot site index. The extent of decay in the **butt section** of down-dead trees determines the decay class. A metal pin is useful in assessing the amount of decay, but be sure to minimize damage to the tree. If the pin penetrates to the center of the log the tree is in decay class 44 or 45. Record decay class in the tree class field.

Use one of the following codes for tree/decay class of live standing, standing-dead, and down-dead trees.

#### 20--Growing Stock

Any live tree of commercial species that is sawtimber size and has at least one merchantable 12-foot sawlog or two merchantable 8-foot sawlogs meeting minimum log-grade requirements. At least one-third of the gross board-foot volume of the sawlog portion must be merchantable material. (Sawlog portion is the length between the one-foot stump and the 9.0" top diameter of outside bark, DOB, for hardwoods, or the 7.0" top DOB for softwoods.) A merchantable sawlog must be at least 50 percent sound at any point.

Any poletimber-size tree that has the potential to meet the above specifications. Assume that pole-size trees will eventually attain sawlog size at DBH. In evaluating 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 potential sawlog height for poletimber trees, apply the two-inch rule as a guide. The two-inch rule assumes that a tree's diameter increases uniformly along its bole. For example, a hardwood poletimber tree with an 8.0" DBH needs 3" of diameter growth to become sawtimber size. If diameter growth is uniform, then the DBH minus two inches (eight minus two), or six inches, identifies the potential sawlog top. This method works for both hardwoods and softwoods.

Consider a seedling or sapling as growing stock unless a specific damage is observed. A seedling or small sapling (< 3.0" DBH) may not be culled on the basis of excessive sweep or crook. Assume that seedlings and saplings will eventually attain sawlog size at DBH.

#### 30--Rough Cull, Salvable, and Salvable-down

Any tree of noncommercial species is a rough cull.

Any tree of commercial species that is sawtimber size and has no merchantable sawlog. 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 tree is considered rough cull. The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods, or the 7.0" top DOB for softwoods.

Rough cull pole-size trees do not have the potential to meet the specifications for growing stock because of forks, limb stoppers, or excessive sweep or crook. Assume that all live trees not currently sawlog size will eventually attain sawlog size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

A standing-dead tree that contains at least one 8-foot section that is at least 50 percent sound has a tree/decay class of 30. A down-dead tree that meets these standards is given a tree/decay code of 30.

### 31--Short-log Cull

Any live sawtimber-size tree of commercial species that has at least one 8-foot sawlog, but less than a 12-foot sawlog, meeting minimum log-grade specifications.

Any live sawtimber-size tree of commercial species that has less than one-third of the volume of the sawlog portion in merchantable logs, but has at least one 8-foot or longer sawlog meeting minimum log-grade specifications. A short sawlog must be 50 percent sound at any point. (The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods and the 7.0" top DOB for softwoods.)

**Note:** Pole-size trees never receive a tree class code 31.

### 40--Rotten Cull

Any live tree of commercial species that is sawtimber size and has no merchantable sawlog. Over one-half of the volume in the sawlog portion does not meet minimum log-grade specifications primarily because of rot, missing sections, or deadwood. (The sawlog portion is the length between the one-foot stump and the 9.0" top DOB for hardwoods, or the 7.0" top DOB for softwoods.)

Classify any pole-size tree that does not have the potential to meet the specifications for growing stock because of rot as rotten cull. Assume that all live trees will eventually attain sawlog size at DBH. Predicted death, tree vigor, and plot site index are not considered in determining tree class.

A standing-dead tree without an 8-foot or longer section that is at least 50 percent sound has a tree class of 40.

**Summary:** If any of the requirements for growing stock (tree class 20) are not met, the tree is considered cull. If a short sawlog is present, the tree class is 31. If no sawlog is present, the tree class is either 30 or 40. If a pole-size tree does not have the potential to meet sawlog standards, it is either tree class 30 or 40.

### 41--Solid

The butt section of a down-dead tree with decay class has intact bark and is structurally sound enough that it cannot be penetrated with a pin. Any rotten portions are also intact.

### 42--Solid-punky

Bark may or may not still be attached and the structural integrity of the butt section is sound to somewhat rotten. Branch stubs are still firmly attached. Any rotten portions are partly soft.

### 43--Punky

Decay has progressed substantially in the butt section. Although bark may still be attached, most is sloughing or detached and a pin easily penetrates the wood. Branch stubs pull out and rotten portions are soft and perhaps even squishy if moist.

### 44--Disintegrating

Little structural integrity remains. Bark is detached or absent (for some species it may still be intact). A pin penetrates to the center of the log and branch stubs have rotted. Rotten portions are "doughy" when wet and fluffy when dry.

### 45--Gone

Little to no evidence of the butt section remains.

The following table summarizes valid tree/decay class for the various tree histories.

Tree History	<u>20</u>	<u>30</u>	<u>31</u>	<u>40</u>	<u>41</u>	<u>42</u>	<u>43</u>	<u>44</u>	<u>45</u>
01	yes	yes	yes	yes	no	no	no	no	no
05	no	yes	no	yes	no	no	no	no	no
06	no	yes	no	no	yes	yes	yes	yes	yes
07	yes	yes	yes	yes	no	no	no	no	no
08	yes	yes	yes	yes	no	no	no	no	no
09	yes	yes	yes	yes	no	no	no	no	no
31	yes	yes	yes	yes	no	no	no	no	no
35	no	yes	no	yes	no	no	no	no	no
61	yes	yes	yes	yes	no	no	no	no	no
65	no	yes	no	yes	no	no	no	no	no

### **Crown Ratio (CRO, CRC) 1 digit: Item 40**

Crown ratio is the percentage of total tree height that supports full, live, green, healthy foliage effectively contributing to tree growth. Crown ratio is expressed as a percent of total tree height and is recorded as a one-digit code for all live trees  $\geq 1.0$ " DBH. For trees with uneven length crowns, ocularly transfer branches to fill holes in the upper portions, until an even crown is visualized. For example: A tree might have scattered green branches extending over 60 percent of

its total height, by ocularly transferring branches to produce a full crown, the crown ratio might be 40 percent.

Transfer the original crown ratio from the plot sheet to the data recorder. If the original crown ratio is missing, record an estimate. Use the following codes:

Cod	Crown ratio	Cod	Crown ratio
e		e	
1	1 through 10 percent	6	51 through 60 percent
2	11 through 20 percent	7	61 through 70 percent
3	21 through 30 percent	8	71 through 80 percent
4	31 through 40 percent	9	81 through 100 percent
5	41 through 50 percent		

### Crown Class (CCO, CCC): Item 41

Record a one-digit code to show crown class of all live trees  $\geq 1.0$ " DBH. Crown class is determined by an 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. Transfer the original crown class from the plot sheet to the data recorder. If the original crown class is missing, record an estimate.

Code	Crown Class
1	<b>Open grown</b> Tree receiving full light from above and from all sides throughout all or most of the life of the tree, particularly during early development.
2	<b>Dominant</b> Tree crown extending above the general level of the crown cover and receiving full light from above and partly from the sides. Tree is larger than the average tree in the stand, crown is well developed, but possibly somewhat crowded on the sides.
3	<b>Codominant</b> Tree crown forming part of the general level of the crown cover and receiving full light from above, but comparatively little from the sides. Typically a medium-sized crown, more or less crowded on the sides. (In stagnated stands, includes a small-sized tree crown, crowded on the sides.)
4	<b>Intermediate</b> Tree shorter than those in the two preceding classes, crown is 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. Typically a small crown, considerably crowded on the sides.
5	<b>Overtopped</b> Tree crown entirely below the general level of the crown cover, receiving no direct light either from above or from the sides.
6	<b>Supracanopy</b> Usually a mature or over-mature tree, crown at least 25% taller than the majority of dominant and codominant trees in the stand.

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.

## Tree Cavities/Number Of Seedlings (TCAV) 2 digits: Item 42

### Tree Cavities

At each sample point, examine all live and standing-dead trees,  $\geq 5.0$ " DBH, for cavities that could be used for nesting, resting or storage by birds or mammals. To qualify as a cavity, an entrance hole must be 1.0" or larger in the main stem, fork, or large limb. (A limb must be greater than 8.0" DOB.)

For the largest cavity record a two-digit code. The first digit indicates the size of the cavity. Cavity size is the diameter of the largest ball that could fit through the entrance hole. The second digit indicates the location of the cavity on the tree.

<u>First Digit</u>		<u>Second Digit</u>	
<u>Code</u>	<u>Size of opening</u> (inches)	<u>Code</u>	<u>Location of cavity</u> (feet above ground)
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+

### Number Of Seedlings

Seedlings are tallied on the micro plot by condition number, species and damage class. This item is used to record the number of seedlings of a given species-damage class tallied on the plot. When more than 5 seedlings are on the fixed radius plot, the number of seedlings can be estimated. The accuracy of these estimates should be plus or minus 25%. For example, if you tally 40 seedlings, you should be confident that the true number of seedlings is between 30 and 50. For seedlings record condition number, species, damage, tree history, tree class, and total count. If more than 99 seedlings-record 99.

## Tree Grade (TGRD) 3 digits: Item 43

Grade qualifying sawlog trees (20 and 31 class) on all new subplots (21-24) in Indiana and Illinois.

**First digit** For a hardwood sawtimber tree (tree class 20), grade the sawlog portion of the tree using "Hardwood Tree Grades for Factory Lumber" (USDA Forest Service Research Paper NE-333). The table on a following page contains the specifications for hardwood tree grades. Use the table and the following steps to determine tree grade.

- Measure DBH.
- Establish the location of all defect indicators on the surface of the butt 16-foot log, and then locate the best 12-foot section.

- Within the best 12-foot section, select the third best face of the log. Use this face to determine length of clear cuttings.
- Estimate inside bark diameter (DIB) at the top of the 12-foot section to the nearest inch.
- Estimate scalable defect in the 12-foot section selected previously.
- 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

For a hardwood sawtimber tree that does not qualify as tree grade 3, but has a 12-foot log within the butt 16-foot log and meets specifications for hardwood construction lumber logs (tie and timber) assign a grade 4. For a hardwood sawtimber tree that does not qualify as a tree grade 3 or log grade 4, but has a 12-foot log above the butt log or two 8-foot logs that meets log-grade requirements (therefore a 20 class tree), assign a log grade of 5.

A hardwood construction log grade table (grade 4) and a hardwood lumber log grade table (upper logs or grade 5) are included on the following pages.

For a softwood sawtimber (tree class 20) tree, grade the portion of the log that gives the best grade. Use the grading rules in the Tatum Guides for determining log grade.

For a softwood 31-class tree, grade the log that is present.

Minimum sawlog length for tree grades is 12 feet and for log grades is 8 feet. Sawlog lengths should not extend above large forks, have excessive limbs or other defects, or have a section of the tree bole that does not meet minimum log grade specification. Limitations or "stoppers" for all softwoods and for hardwood grades 1, 2 and 3 include: any limb (live or dead) having a collar diameter exceeding the stem DOB at that point; or any group of 2.0" collar diameter or larger limbs (live or dead), within a 1 foot span, having a combined sum of diameters greater than the stem DOB of that section. Limitations for grade 4 hardwoods include: any limb or group of limbs, within a 1 foot span, with a collar diameter or sum of collar diameters greater than 1/3 of the stem DOB of that section.

**Second and third digit** For hardwoods given a grade 2, 3, 4, or 5, record the limiting quality factor that is keeping the log from moving into a better quality grade. When a grade 5 is given to a hardwood log, the second digit is a 2 or 7 when an 8' log is present. If a 12' upper log is present assign a second digit of 6 or 7. For softwoods, the second and third digits are always "00".

<b>Code</b>	<b>Limiting Factor</b>
00	Not applicable, already a grade 1
10	Diameter
20	Length
30	Clear cuttings
40	Sweep and crook
50	Cull
60	Position in tree
70	Multiple factors
80	Diameter and clear cutting

TABLE OF HARDWOOD TREE GRADES FOR FACTORY LUMBER

Grade factor	Grade 1			Grade 2		Grade 3
Length of grading zone (feet)	Butt 16			Butt 16		Butt 16
Length of grading section <sup>a</sup> (feet)	Best 12			Best 12		Best 12
DBH, minimum (inches) <sup>g</sup>	16 <sup>b</sup>			13		11
Diameter, minimum inside bark at top of grading section (inches)	13 <sup>b</sup>	16	20	11 <sup>c</sup>	12	8
Clear cuttings (on the 3 best faces) <sup>d</sup>						
Length, minimum (feet)	7	5	3	3	3	2
Number on face (maximum)	2			2	3	e
Yield in face length (minimum)	5/6			4/6		3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9			9 <sup>f</sup>		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. In all other hardwoods if you have a 10-foot clear-cutting a minimum DBH of 15.6" can be used.
- c Grade 2 trees can be 10 inches DIB at top of grading section if otherwise meeting surface requirements for small grade 1s. A minimum DBH of 12.6" can be used if minimum length of clear-cutting are 3 feet.
- 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 Fifteen percent crook and sweep or 40 percent 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 grade to 3 unless the cull deduction for rot is greater than 40 %.
- g Use diameter classes, i.e. for grade 1, DBH can be 15.5" and for grade 2, DBH can be 12.5".

**FOREST SERVICE STANDARD SPECIFICATIONS FOR HARDWOOD  
CONSTRUCTION (GRADE 4) LOGS**

Position in tree		Butt & Upper.
Min. diameter, small end		8 inches +.
Min. length, without trim		8 feet +.
Clear cuttings		No requirements.
Sweep allowance, absolute		1/4 d.i.b. of small end for half logs, 1/2 d.i.b. for logs 16 feet long.
Sound surface defects permitted	Single knots	Any number, if no one knot has an average collar diameter over 1/3 of log diameter at point of occurrence.
	Whorled knots	Any number, if sum of collar diameters does not exceed 1/3 of the log diameter at point of occurrence.
	Holes	Any number provided none has a diameter over 1/3 of log diameter at point of occurrence and none extends over 3 inches into included timber.
Unsound defects permitted	Surface	Any number and size if they do not extend into included timber. If they do, they can't exceed size, number, and depth, or limits of sound knots.
	Interior	None allowed; log must be sound internally, but will permit 1 shake not to exceed 1/3 the scaling diameter and a longitudinal split not extending over 5 inches into the contained timber. No center rot.

## FOREST SERVICE STANDARD GRADES FOR HARDWOOD FACTORY LUMBER LOGS

Grading Factors		Log grades							
		F1			F2			F3	
Position in tree		Butts only	Butts & uppers		Butts & uppers			Butts & uppers	
Scaling diameter, inches		13-15	16-19	20+	11+	12+		8+	
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Required clear cuttings of each of 3 best faces	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than 1/4 of end in sound defects	15%			30%			50%	
	For logs with more than 1/4 of end in sound defects	10%			20%			35%	
Maximum scaling deduction		40%			50%			50%	

### Total Tree Height (THGT) 3 digits: Item 74

From leaf fall until leaf flush measure the total height of all live trees with DBH  $\geq$  1.0" (subplot 21 only). Height is measured to the nearest whole foot. For trees up to 30 feet in height, use the 30-foot height pole. Use a clinometer and tape for trees greater than 30 feet. Make a visual estimate of tree height before choosing the scale on the clinometer. Choose a place to stand that gives you a clear view of both the top and base of the tree. The distance from where you stand to the base of the tree should be approximately equal to the total tree height. Try to keep the sun at your back.

### Site Tree Records: Items 51-59

Site index is the height attainable by the average dominant and codominant trees of a 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. Site index is determined in the field using available site index curves appropriate for the area. A site index is needed for each condition, however the same trees may be used for more than one condition if the field crew determines that it is appropriate to do so. This can be done when the two conditions do not have different site indexes. If the same trees are being used for more than one condition they must be entered for each condition.

## Site Tree Data

For all trees measured for site index information record the following items on the site tree record.

- Item 51 Condition number that the site tree is in (CON#)
- Item 52 Tree number (TR#) start numbering at 1
- Item 53 Diameter at breast height (DBH)
- Item 54 Species (SPP)
- Item 55 Total height (HGHT)
- Item 56 Bored age (BAGE)
- Item 57 Total age (TAGE)
- Item 58 Years added to bored age to get total age (YADD)
- Item 59 Site index (from site curves), also recorded on the condition class record (SI)

For remeasurement plots, a new site index is recorded.

### Site Tree Selection

For each condition (or conditions that you decide have the same site index) measure a minimum of two site index trees of the same species. Use tree species that are of the forest type and represent the site from the condition you are sampling. Additional trees of the same or different species can be measured if desired. For example, if the condition is a forest type of aspen, try to use aspen for site index trees. If none are available, use any suitable tree, as long as a site index curve is available for its species.

Generally, site trees should be vigorous in growth and currently growing in 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 that 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 largest trees in the stand. Site trees should be as 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. Be aware of what species have site index curves available. Do not collect site index data on a species unless curves are available. Refer to Site Index book.

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. 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 nor high value trees.

Note the locations of the site trees on the subplot diagram.

## Growth Intercept Method

If suitable trees are not available to use with site index curves, the growth intercept method of measuring site index is an alternative. This method has been proposed and tables developed for some tree species that have limbs showing distinct annual whorls (i.e. 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. You should know what species have these tables available and how to use them. If this method is used, record site index, height, age and diameter in the "Notes" section instead of the site tree section.

For red pine:

<u>Height growth during the last 5 years</u>	<u>Site Index (Estimated)</u>
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

### **Minimum Stand Productivity**

In order for a stand to be classified as productive commercial land, there must be at least one tree in the condition that has a site index that meets the following minimum site indices.

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

(Remember, if you can not find a tree of a species in the forest type, use a different species.)

### **Techniques of Site Data Collection**

Carefully measure tree height and age to get a good estimate of site index.

### **Tree Height (HGHT) 3 digits: Item 55**

This measurement is taken to the nearest whole foot. For trees up to 30 feet in height, use the 30-foot height pole. Use a clinometer and tape for trees greater than 30 feet. Make a visual estimate of tree height before choosing the scale on the clinometer. Choose a place to stand that gives you a clear view of both the top and base of the tree. The distance from where you stand to the base of the tree should be approximately equal to the total tree height. Try to keep the sun at your back.

### **Bored Age (BAGE ) 3 digits: Item 56**

### **Total Age (TAGE ) 3 digits: Item 57**

### **Years Added To Bored Age (YADD) 2 digits: Item 58**

These measurements are 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. During the winter, it is best to remove your borer from the tree before taking time to count the core.

Ring porous hardwoods are generally easier to count. Growth rings of many softwoods and diffuse porous hardwoods can be difficult to see. To get an accurate count on these species, it may 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 take it with you. Later, try soaking the core, shaving one side of it clean and holding it up to or under a strong light. Count growth rings more than once and have your partner count them to reach agreement on the tree age.

After counting growth rings to estimate DBH. age, convert to total age by adding years needed from information found on the same page as the site index curve is located for that species.

### **Site Index (SI) 3 digits: Item 59**

Record the site index of each tree as found on the site index curve. Transfer the highest value obtained for site index on site tree record to the condition class records for every condition that the site index applies to.

### **Site Tree Species (SPP) 3 digits: Item 54**

Record a three-digit code for the species of tree bored in determining site index on the site tree record. Also record this information with site index on the condition class records for every condition that the site index applies to.

# Definition Of Terms

The following are definitions of terms used in this handbook.

**Acceptable Trees** Growing-stock trees of commercial species that meet specified standards of size and quality.

**Bureau of Land Management Land** Federal land administered by the Bureau of Land Management.

**Clear Panel** A section of hardwood tree surface one-fourth the circumference of the tree and at least two feet long free of limbs, knots, bumps and other indications of defect which preclude clear cuttings.

**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)

**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).

**Cull** Portions of a tree that are unusable for industrial wood products, because of rot, form, or other defect.

**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 Forest Survey include:

Open Grown Tree receiving full light from above and from all sides throughout all or most of the life of the tree, particularly during early development.

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

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

Intermediate Trees Tree crown 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. Typically a small crown, considerably crowded on the sides.

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

Supracanopy Usually a mature or over-mature tree, with crown at least 25% taller than the majority of dominant and codominant trees in the stand.

**Down-dead** Any dead tree 1.0" DBH or larger that is not free standing to a height of 4.5'. Dead trees that are leaning and supported by another tree are tallied as down-dead.

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

**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.

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

**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.)

**Farmer-Owned Leased** Land owned by farm operators, but leased to forest industry.

**Forest Industry Land** Land owned by companies or individuals operating wood-using plants.

**Forest Land** Land not currently developed for nonforest use and having a stocking value of at least 10.0 of all live forest trees of any size or formerly having a stocking value of at least 10.0. 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 one acre and 120 feet in width. Roadside, streamside, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Also see definitions for land area, commercial forest land, non-commercial forest land, productive-reserved forest land, stocking, unproductive forest land, and water.

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

**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 value of 12.0 on each subplot.)

**Growing-stock Trees** Live trees of commercial species qualifying as acceptable trees. (Note: excludes rough, rotten, and dead trees.)

**Growing-stock Volume** Net volume in cubic feet of growing stock trees five inches DBH and over from a one-foot stump to a minimum four-inch top diameter outside bark of the central stem or to the point where the central stem no longer meets pulpwood specifications.

**Hardwoods** Dicotyledonous trees, usually broadleaved and deciduous.

**Idle Farmland** Includes former croplands, orchards, improved pastures and farm sites not tended within the past two years and presently having a stocking value of less than 10.0 in all live trees.

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

**Indian Land** Tribal lands held in fee or trust by the Federal government but administered for Indian tribal groups and Indian trust allotments.

**Land Area**

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.

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 one acre.

**Limb** The part of the tree above the stump that does not meet the requirement for sawlogs and upper-stem portions, including all live, sound branches to a minimum of four inches DOB.

**Linear Water Feature** Natural water courses that are linear in shape such as streams and rivers. These flowages are treated as a nonforest land use if they are perennial and are at least 30 feet wide. Stream width is measured between mean high-water marks as indicated by the presence of perennial terrestrial vegetation.

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

**Macro plot** A 24.0 ft. fixed radius plot (measured horizontally to the center of the tree at DBH) that samples trees 5.0 inches DBH and larger.

**Maintained Road** Any road, hard topped or other surfaces, that is plowed or graded periodically and capable of use by a large vehicle. Right of ways that are cut or treated to limit herbaceous growth are included in this area.

**Mean High-water Mark** The start of perennial terrestrial vegetation next to aquatic ecosystems.

**Merchantable** Refers to a pulpwood or sawlog section that meets pulpwood or sawlog specifications, respectively.

**Micro plot** A 6.8 ft. fixed radius plot (measured horizontally to the center of the tree at the base) that samples trees less than 5.0 inches DBH.

**Miscellaneous Federal Lands** Federal lands other than National Forest or lands administered by the Bureau of Land Management.

**Miscellaneous Private Lands** Privately owned lands other than forest-industry

**National Forest Land** Federal lands that 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.

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

**Noncommercial Forest Land** Forest land that is classified as either unproductive forest land or productive-reserved forest land (see detailed definitions of these terms).

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

**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, power line clearings of any width, and one-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 one acre in size, to qualify as nonforest land.)

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

**Nonstocked Forest Land** Commercial forest land with a stocking value of less than 10.0 in growing-stock trees but may be greater than 10.0 in all live trees.

**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.

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

**Overstocked Area** Areas where growth of trees is significantly reduced by excessive numbers of trees.

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

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

**Poletimber Trees** Growing-stock trees of commercial species at least five inches in DBH, but smaller than sawtimber size. (see sawtimber trees)

**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.

**Prospectively** As used in this manual it refers to the moment when the tree reaches sawtimber size at DBH it can be considered saw log.

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

**Primitive Roads** Roads that are not maintained and are primarily used by vehicles not intended for highway use (i.e., old logging roads).

**Rotten Trees** Live trees of commercial species that do not contain at least one 12-foot sawlog or two sawlogs eight 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.

**Rough 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 roughness or poor form. Also, all live trees of noncommercial species.

**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.)

**Salvable-dead Trees** A dead growing stock tree containing at least one 8-foot section that is at least 50 percent sound. Salvable dead trees must have been growing stock at the time of death.

**Saplings** Live trees one inch to 4.9 inches in diameter at breast height (DBH).

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

**Sawlog** A log meeting minimum standards of diameter, length and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter outside bark for softwoods of 7 inches (9 inches for hardwoods) or other combinations of size and defect specified by Regional standards.

**Sawlog Portion** That part of the bole of sawtimber trees between the stump and the sawlog top, being nine inches DOB for hardwoods and seven inches DOB for softwoods whenever they are present. (Does not refer to sections meeting minimum log grade specifications.)

**Sawlog Top** The point on the bole of sawtimber trees above which a sawlog cannot be produced. The minimum sawlog top is seven inches DOB for softwoods and nine inches DOB for hardwoods.

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

**Sawtimber Trees** Live trees of commercial species containing at least a 12-foot sawlog or two sawlogs eight feet or longer, and meeting Regional specifications for freedom from defect. Softwoods must be at least nine inches in diameter breast height. Hardwoods must be at least 11.0 inches in diameter.

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

**Seedlings** Live trees less than one inch in diameter at breast height (DBH).

**Site Class** A classification of forest land with inherent capacity to grow crops of industrial wood based on fully stocked natural stands.

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

**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.

**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.

Sawtimber Stands Stands with a stocking value of at least 10.0 in 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.

Poletimber Stands Stands with a stocking value of at least 10.0 in 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.

Sapling-Seedling Stands Stands with a stocking value of at least 10.0 in growing-stock trees of which more than half of the stocking is saplings and/or seedlings.

**Standing-dead Trees** A dead growing stock tree containing no merchantable volume (has no 8' or longer section that is at least 50 percent sound) or any dead cull tree. Standing-dead trees must be at least 1.0" DBH and be free standing to a height of 4.5'.

**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.

**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: see stocking explanation in section 21.5 of Forest Survey Handbook.)

**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.)

**Tree Grades** A classification sawtimber size trees based on external characteristics as indicators of quality or value.

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

**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.)

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

**Variable radius plot** A 37.5 BAF prism plot that samples trees 5.0 inches DBH and larger.

## **Water**

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

Forest Survey: The same as the Bureau of the Census, except minimum width of linear water features (streams, rivers, etc.) is 30 feet and the minimum area of lakes, etc. is one acre.

# Appendix

## Biomass Study "Shrubs" (SPP): Item 24

### Illinois and Indiana Shrub Species

Code	Tree History	Common Name	Scientific Name
230	81	Yew	<i>Taxus canadensis</i>
354	80	European alder	<i>Alnus glutinosa</i>
355	81	Cane	<i>Arundinaria gigantea</i>
463	80	Dwarf hackberry	<i>Celtis tenuifolia</i>
490	80	Dogwood	<i>Cornus spp.</i>
592	80	Black alder, mountain holly, winterberry	<i>Ilex verticillata</i>
594	80	Deciduous holly	<i>Ilex decidua</i>
595	80	Hydrangea	<i>Hydrangea arborescens</i>
603	80	Spice-bush	<i>Lindera benzoin</i>
712	81	Virginia creeper	<i>Parthenocissus quinquefolia</i>
748	81	Spirea	<i>Spiraea spp.</i>
768	80	Devil's walking-stick	<i>Aralia spinosa</i>
853	80	Witch hazel	<i>Hamamelis virginiana</i>
854	80	Common ninebark	<i>Physocarpus opulifolius</i>
855	80	Serviceberry, Juneberry	<i>Amelanchier spp.</i>
856	80	Beaked hazelnut	<i>Corylus cornuta</i>
857	80	Prickly ash	<i>Zanthoxylum americanum</i>
859	80	Buckthorn	<i>Rhamnus spp.</i>
862	80	Viburnum	<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>
869	80	Shrubby trefoil	<i>Ptelea trifoliata</i>
870	81	American bladdernut	<i>Staphylea trifolia</i>
873	81	Black huckleberry	<i>Gaylussacia baccata</i>
874	81	Blueberry, Bilberry	<i>Vaccinium spp.</i>
876	81	Honeysuckle	<i>Lonicera spp.</i>
877	81	Coralberry, Snowberry	<i>Symphoricarpos spp.</i>
881	81	Multiflora rose	<i>Rosa multiflora</i>
902	81	Poison ivy	<i>Rhus radicans</i>
907	80	New Jersey tea	<i>Ceanothus americanus</i>
912	80	Buttonbush	<i>Cephalanthus occidentalis</i>
917	80	Wahoo	<i>Euonymus atropurpureus</i>
920	80	Willow	<i>Salix spp.</i>
932	81	Greenbrier	<i>Smilax spp.</i>
933	80	Ginseng	<i>Panax spp.</i>
934	80	Kudzu-vine	<i>Pueraria lobata</i>
982	81	Grape	<i>Vitis spp.</i>
985	80	Highbush cranberry	<i>Viburnum trilobum</i>
997	80	Other species	(Tall, woody perennials)
998	81	Other species	(Other perennials)

Tree History (shrub history) 80 = Tall, woody, perennials, 81 = Other perennials

## Tree Species (SPP): Item 32

### Illinois and Indiana tree species

Code	Common Name	Scientific Name
068	Eastern redcedar	<i>Juniperus virginiana</i>
070	Larch (introduced)	<i>Larix spp.</i>
071	Tamarack	<i>Larix laricina</i>
105	Jack pine	<i>Pinus banksiana</i>
110	Shortleaf pine	<i>Pinus echinata</i>
125	Red pine	<i>Pinus resinosa</i>
129	Eastern white pine	<i>Pinus strobus</i>
130	Scotch pine	<i>Pinus sylvestris</i>
131	Loblolly pine	<i>Pinus taeda</i>
132	Virginia pine	<i>Pinus virginiana</i>
221	Baldcypress	<i>Taxodium distichum</i>
241	Northern white-cedar	<i>Thuja occidentalis</i>
261	Eastern hemlock	<i>Tsuga canadensis</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>
332	Yellow buckeye	<i>Aesculus octandra</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>
379	Gray birch	<i>Betula populifolia</i>
391*	American hornbeam	<i>Carpinus caroliniana</i>
401	Water hickory	<i>Carya aquatica</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 laciniata</i>
407	Shagbark hickory	<i>Carya ovata</i>
408	Black hickory	<i>Carya texana</i>
409	Mockernut hickory	<i>Carya tomentosa</i>
421	American chestnut	<i>Castanea dentata</i>
452	Northern catalpa	<i>Catalpa speciosa</i>
461	Sugarberry	<i>Celtis laevigata</i>
462	Hackberry	<i>Celtis occidentalis</i>
471*	Eastern redbud	<i>Cercis canadensis</i>
481	Yellowwood	<i>Cladrastis kentuckea</i>
491	Flowering dogwood	<i>Cornus florida</i>
500*	Hawthorn	<i>Crataegus spp.</i>
521	Common persimmon	<i>Diospyros virginiana</i>
531	American beech	<i>Fagus grandifolia</i>
541	White ash	<i>Fraxinus americana</i>

<b>Code</b>	<b>Common Name</b>	<b>Scientific Name</b>
543	Black ash	<i>Fraxinus nigra</i>
544	Green ash	<i>Fraxinus pennsylvanica</i>
545	Pumpkin ash	<i>Fraxinus profunda</i>
546	Blue ash	<i>Fraxinus quadrangulata</i>
551	Water locust	<i>Gleditsia triacanthos</i>
552	Honey locust	<i>Gleditsia aquatica</i>
571	Kentucky coffeetree	<i>Gymnocladus dioicus</i>
601	Butternut	<i>Juglans cinerea</i>
602	Black walnut	<i>Juglans nigra</i>
611	Sweetgum	<i>Liquidambar styraciflua</i>
621	Yellow-poplar	<i>Liriodendron tulipifera</i>
641*	Osage orange	<i>Maclura pomifera</i>
651	Cucumbertree	<i>Magnolia acuminata</i>
660*	Apple	<i>Malus spp.</i>
681	White mulberry	<i>Morus alba</i>
682	Red mulberry	<i>Morus rubra</i>
691	Water tupelo	<i>Nyssa aquatica</i>
693	Black tupelo (blackgum)	<i>Nyssa sylvatica</i>
701*	Eastern hophornbeam (ironwood)	<i>Ostrya virginiana</i>
731	American sycamore	<i>Platanus occidentalis</i>
741	Balsam poplar	<i>Populus balsamifera</i>
742	Eastern cottonwood	<i>Populus deltoides</i>
743	Bigtooth aspen	<i>Populus grandidentata</i>
744	Swamp cottonwood	<i>Populus heterophylla</i>
746	Quaking aspen	<i>Populus tremuloides</i>
752	White poplar	<i>Populus alba</i>
762	Black cherry	<i>Prunus serotina</i>
763*	Chokecherry	<i>Prunus virginiana</i>
766*	Wild plum	<i>Prunus spp.</i>
767*	Pawpaw	<i>Asimina triloba</i>
802	White oak	<i>Quercus alba</i>
804	Swamp white oak	<i>Quercus bicolor</i>
806	Scarlet oak	<i>Quercus coccinea</i>
809	Northern pin oak	<i>Quercus ellipsoidalis</i>
812	Southern red oak	<i>Quercus falcata</i>
813	Cherrybark oak	<i>Quercus pagoda</i>
817	Shingle oak	<i>Quercus imbricaria</i>
822	Overcup oak	<i>Quercus lyrata</i>
823	Bur oak	<i>Quercus macrocarpa</i>
824	Blackjack oak	<i>Quercus marilandica</i>
825	Swamp chestnut oak	<i>Quercus michauxii</i>
826	Chinkapin oak	<i>Quercus muehlenbergii</i>
830	Pin oak	<i>Quercus palustris</i>
831	Willow oak	<i>Quercus phellos</i>
832	Chestnut oak	<i>Quercus prinus</i>
833	Northern red oak	<i>Quercus rubra</i>
834	Shumard oak	<i>Quercus shumardii</i>
835	Post oak	<i>Quercus stellata</i>
837	Black oak	<i>Quercus velutina</i>
901	Black locust	<i>Robinia pseudoacacia</i>

<b>Code</b>	<b>Common Name</b>	<b>Scientific Name</b>
921*	Peachleaf willow	<i>Salix amygdaloides</i>
922	Black willow	<i>Salix nigra</i>
931	Sassafras	<i>Sassafras albidum</i>
951	American basswood	<i>Tilia americana</i>
952	White basswood	<i>Tilia heterophylla</i>
971	Winged elm	<i>Ulmus alata</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.

## Damage Or Cause Of Death (DAM): Item 38

### Illinois and Indiana damage codes and coding criteria

CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
000	<b>Healthy</b>	<b>All species</b>	<b>&lt;20% crown affected. No volume/degrade loss</b>
100	<b>Insect defoliators</b>	<b>All species</b>	<b>&gt;20% foliage affected</b>
104	Sawflies	All species	>20% foliage affected
106	Spider Mites	All species	Any occurrence on foliage
109	Orange Striped Oakworm	Hardwoods	Any occurrence on foliage
110	Forest Tent Caterpillar	Hardwoods	Any occurrence on foliage
111	Yellownecked Caterpillar	Hardwoods	Any occurrence on foliage
113	<b>Gypsy Moth</b>	<b>Hardwoods</b>	<b>Any occurrence on foliage</b>
114	Fall Webworm	Hardwoods	Any occurrence on foliage
115	Walnut Caterpillar	Black Walnut	Any occurrence on foliage
119	Looper complex	Hardwoods	Any occurrence on foliage
130	<b>Shoot and Branch Insects</b>	<b>All species</b>	<b>Any occurrence on leader &gt;20% shoots/branches affected</b>
132	Tip Moths (Nantucket)	Conifers	Any occurrence on shoots/branches
135	Pine Needle Scale	Conifers	Any occurrence on shoots/branches
136	Oyster Shell Scale	Hardwoods	Any occurrence on shoots/branches
137	Walnut Shoot Moth	Black Walnut	Any occurrence on shoots/branches
138	Pine Shoot Beetle	<i>Pinus</i>	Any occurrence on shoots/branches
140	<b>Branch Gall Insects</b>	<b>All species</b>	<b>&gt;20% branches affected</b>
141	Ash Flower Gall Mite	<i>Fraxinus</i>	Any occurrence on branches
142	Gouty/Horned Oak Gall	<i>Quercus</i>	Any occurrence on branches
150	<b>Bole Borers</b>	<b>All species</b>	<b>Any occurrence on bole</b>
151	Two Lined Chestnut Borer	<i>Quercus</i>	Any occurrence on bole
154	Sugar Maple Borer	Sugar Maple	Any occurrence on bole
155	Zimmerman Pine Moth ( <i>Dioryctria</i> )	<i>Pinus</i>	Any occurrence on bole
159	Oak Borer	<i>Quercus</i>	Any occurrence on bole
170	<b>Bark Beetles</b>	<b>Conifers</b>	<b>&gt;20% crown dead/dying</b>
171	<i>Ips spp.</i>	Conifers	>20% crown dead/dying
190	<b>Root/Root Collar Insects</b>	<b>Conifers</b>	<b>Entire crown off color dead tree</b>
191	Root Collar Weevil	<i>Pinus</i>	Entire crown off color dead tree
200	<b>Foliage Diseases</b>	<b>All species</b>	<b>&gt;20% foliage affected</b>
201	Needlecasts	Conifers	>20% foliage affected
202	Anthrachnose	Sycamore, Oak, Ash, Black Walnut, Sugar Maple	>20% foliage affected
205	Dogwood Anthracnose	Flowering Dogwood	Any occurrence on foliage
206	Powdery Mildew	Flowering Dogwood	Any occurrence on foliage
207	Oak "Tatters"	<i>Quercus</i>	Any occurrence on foliage
210	<b>Shoot Blights</b>	<b>All Species</b>	<b>Any occurrence on leader &gt;20% shoots affected</b>
214	<i>Diplodia</i> Tip Blight	Conifers/ <i>Pinus</i>	Any occurrence on leader >20% shoots affected
217	Top Dieback Black Walnut	Black Walnut	Any occurrence on leader/shoots
218	<i>Botryosphaeria</i> Canker	<i>Quercus</i>	Any occurrence on leader/shoots

CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
220	<b>Mistletoe</b>	<b>Hardwoods</b>	<b>Any occurrence on leader/shoots</b>
231	Black Knot	Black Cherry	Any occurrence on leader/shoots
235	Cedar-Apple Rust	E. Red Cedar	>20% shoots galled
240	<b>Bole Rust</b>	<b>Pines</b>	<b>Any occurrence on bole</b>
241	White Pine Blister Rust	White Pine, <i>Ribes</i>	Any occurrence on bole
244	Pine-Pine Gall Rust	<i>Pinus</i>	Any occurrence on bole
250	<b>Bole Cankers</b>	<b>Hardwoods</b>	<b>Any occurrence on bole</b>
251	<i>Eutypella</i> Canker	Maple	Any occurrence on bole
252	<i>Hypoxylon</i> Canker	Oaks	Any occurrence on bole
253	<i>Cytospora</i> Canker	Spruce	Any occurrence on bole
254	<i>Nectria</i> Canker	<b>Hardwoods</b>	<b>Any occurrence on bole</b>
256	Chestnut Blight	Chestnuts	Any occurrence on bole/branches
257	<b>Butternut Canker</b>	<b>Butternut</b>	<b>Any occurrence on tree</b>
260	<b>Stem Decay (heartrot)</b>	<b>All species</b>	<b>Any occurrence on bole</b>
264	<i>Pereniporia fraxinophila</i>	Ashes	Any occurrence on bole
265	<i>Ganoderma applanatum</i>	Hardwoods	Any occurrence on bole
266	<i>Fomes rimssus</i>	Black Locust	Any occurrence on bole
271	<b>Ash Yellows</b>	<b>Ashes</b>	<b>Any occurrence</b>
273	American Beech Bark Disease	American Beech	Any occurrence
274	Oak Decline/Mortality	Oaks	Any occurrence
275	Elm Yellows	Elms	Any occurrence
276	Hickory Decline	Hickories	Any occurrence
281	<b>Dutch Elm Disease</b>	<b>Elms</b>	<b>Any occurrence</b>
282	<b>Oak Wilt</b>	<b>Oaks</b>	<b>Any occurrence</b>
291	<i>Annosus</i> Root Rot	Conifers	Any occurrence
292	<i>Armillaria</i> Root Rot	All species	>20% crown dieback rhizomorphs/fan in root collar
300	<b>Weather</b>	<b>All species</b>	<b>&gt;20% crown affected; Any damage to leader; Any damage to bole cambium</b>
302	Wind	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
303	Lightning	All species	>20% crown affected; Any damage to leader; any damage to bole cambium
304	Frost Crack	Hardwoods	>20% crown affected; Any damage to leader; Any damage to bole cambium
306	Winter drying	Conifers	>20% crown affected; Any damage to leader; Any damage to bole cambium
307	Flooding	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
308	Drought	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
309	Ice/Snow	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
311	Sunscald	Hardwoods	>20% crown affected; Any damage to leader; Any damage to bole cambium

CODE	DAMAGE OR DEATH	HOSTS	SEVERITY
400	<b>Animal Damage</b>	<b>All species</b>	<b>&gt;20% crown affected; Any damage to leader; Any damage to bole cambium</b>
401	Browse	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
402	Deer	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
403	Rabbit	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
404	Beaver	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
405	Squirrel	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
408	Sapsucker	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
409	Cattle/Domestic	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
410	Mice	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
500	<b>Fire</b>	<b>All species</b>	<b>&gt;20% crown affected; Any damage to leader; Any damage to bole cambium</b>
710	Missing, Broken, or Dead Top	All species	Bole top
760	Vine Damage	All species	>20% of crown covered
800	<b>Logging/TSI/Other human</b>	<b>All species</b>	<b>&gt;20% crown affected; Any damage to leader; Any damage to bole cambium</b>
810	Mechanical Damage	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
811	Imbedded Objects -- wires, nails	All species	Any occurrence
820	Soil Compaction	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
830	Vehicle Damage	All species	>20% crown affected; Any damage to leader; Any damage to bole cambium
860	<b>Chemical</b>	<b>All species</b>	<b>&gt;20% crown affected</b>
861	Pesticide/Herbicide	All species	>20% crown affected
862	Air Pollution	All species	>20% crown affected
900	<b>Unknown/uncoded Dead</b>	<b>All species</b>	<b>Use on dead trees only</b>
901	<b>Unknown/uncoded Defoliation</b>	<b>All species</b>	<b>&gt;20% foliage affected</b>
902	<b>Unknown/uncoded Discoloration</b>	<b>All species</b>	<b>&gt;20% foliage affected</b>
903	<b>Unknown/uncoded Decline/Dieback</b>	<b>All species</b>	<b>&gt;20% crown affected</b>
904	<b>Unknown/uncoded Breakage</b>	<b>All species</b>	<b>&gt;20% crown affected. Any occurrence on bole</b>
905	<b>Unknown/uncoded Abnormal Growth or Form in Crown</b>	<b>All species</b>	<b>&gt;20% crown affected</b>
906	<b>Unknown/uncoded Canker</b>	<b>All species</b>	<b>Any occurrence on bole</b>
907	<b>Unknown/uncoded Crack</b>	<b>All species</b>	<b>Any open crack on bole</b>
908	<b>Unknown/uncoded Abnormal Growth or Form on the Bole</b>	<b>All species</b>	<b>Any occurrence on the butt log or any abnormal growth for that species causing a volume loss</b>

## Forest Type (FTS): Item 62

### Central States Forest Types (Illinois and Indiana)

Code	Forest type
03	<b>White pine</b> Forests in which white pine comprises a plurality of the stocking. Includes other pines: Jack and Red.
32	<b>Shortleaf pine</b> Forests in which shortleaf pine comprises a plurality of the stocking.
33	<b>Virginia pine</b> Forests in which Virginia pine comprises a plurality of the stocking.
35	<b>Eastern redcedar</b> Forests in which eastern redcedar comprises a plurality of the stocking.
42	<b>Eastern redcedar-hardwood</b> Forests in which hardwoods comprise 50 percent of the stocking and eastern redcedar comprises at least 25 percent.
44	<b>Shortleaf pine-oak</b> Forests in which oaks/hardwoods comprise 50 percent of the stocking and shortleaf pine comprises at least 25 percent.
49	<b>Other pine-oak</b> Forests in which oaks/hardwoods comprise 50 percent of the stocking and pines at least 25 percent.
51	<b>Post-blackjack</b> Forests in which oaks/hardwoods comprise a plurality of the stocking and post oak and blackjack oak predominate.
52	<b>Chestnut-black-scarlet oak</b> Forests in which oaks/hardwoods comprise a plurality of the stocking and chestnut oak, black oak, and scarlet oak predominate.
53	<b>White oak-red oak-hickory</b> Forests in which oaks/hickories comprise a plurality of the stocking and white oaks, red oaks, and hickories predominate.
54	<b>White oak</b> Forests in which oaks/hardwoods comprise a plurality of the stocking and <i>Quercus alba</i> (white oak) predominates.
57	<b>Sassafras-persimmon</b> Forests in which sassafras and persimmon comprise 50 percent of the stocking.
59	<b>Bur oak</b> Forests in which oaks/hardwoods comprise a plurality of the stocking and bur oak predominates.
60	<b>Oak-gum-cypress</b> Forests in which bottomland hardwoods comprise a plurality of the stocking and baldcypress, sweetgum, and swamp tupelo predominate.
61	<b>Swamp chestnut oak-cherrybark oak</b> Forests in which bottomland hardwoods comprise a plurality of the stocking and wet site oaks such as swamp chestnut, pin, cherrybark and overcup predominate.
71	<b>Elm-ash-soft maple</b> Forests in which lowland hardwoods comprise a plurality of the stocking and elm, ash and red maple predominate.
73	<b>Cottonwood</b> Forests in which cottonwood comprises 50 percent of the stocking.
74	<b>Willow</b> Forests in which willow comprises 50 percent of the stocking.
81	<b>Maple-basswood</b> Forests in which upland hardwoods comprise a plurality of the stocking and sugar maple, black maple, basswood, yellow birch, beech and butternut predominate.
82	<b>Cherry-ash-yellow poplar</b> Forests in which upland hardwoods comprise a plurality of the stocking and black cherry, black walnut, white ash and yellow-poplar predominate.
90	<b>Aspen-birch</b> Forests in which quaking aspen, bigtooth aspen, balsam poplar or paper birch comprise a plurality of the stocking.

## County (CTY): Item 72

### **Illinois (State code 17 County Codes by Unit**

#### **UNIT 1 - SOUTHERN**

003 Alexander  
055 Franklin  
059 Gallatin  
065 Hamilton  
069 Hardin  
077 Jackson  
087 Johnson  
127 Massac  
145 Perry  
151 Pope  
153 Pulaski  
157 Randolph  
165 Saline  
181 Union  
193 White

#### **UNIT 2 - CLAYPAN**

005 Bond  
013 Calhoun  
023 Clark  
025 Clay  
027 Clinton  
033 Crawford  
035 Cumberland  
047 Edwards  
049 Effingham  
051 Fayette  
061 Greene  
079 Jasper  
081 Jefferson  
083 Jersey  
101 Lawrence  
117 Macoupin  
119 Madison  
121 Marion  
133 Monroe  
135 Montgomery  
159 Richland  
163 St. Clair  
173 Shelby  
185 Wabash  
189 Washington  
191 Wayne

#### **UNIT 3 - PRAIRIE**

001 Adams  
007 Boone  
009 Brown  
011 Bureau  
015 Carroll  
017 Cass

#### **UNIT 3 - PRAIRIE, continued**

029 Coles  
031 Cook  
037 De Kalb  
039 Dewitt  
041 Douglas  
043 Dupage  
045 Edgar  
053 Ford  
057 Fulton  
063 Grundy  
067 Hancock  
071 Henderson  
073 Henry  
075 Iroquois  
085 Jo Daviess  
089 Kane  
091 Kankakee  
093 Kendall  
095 Knox  
097 Lake  
099 La Salle  
103 Lee  
105 Livingston  
107 Logan  
115 Macon  
123 Marshall  
125 Mason  
109 McDonough  
111 McHenry  
113 McLean  
129 Menard  
131 Mercer  
137 Morgan  
139 Moultrie  
141 Ogle  
143 Peoria  
147 Piatt  
149 Pike  
155 Putnam  
161 Rock Island  
167 Sangamon  
169 Schuyler  
171 Scott  
175 Stark  
177 Stephenson  
179 Tazewell  
183 Vermillion  
187 Warren  
195 Whiteside  
197 Will  
201 Winnebago

019 Champaign  
021 Christian

203 Woodford

## Indiana (State code 18) County Codes by Unit

### UNIT 1 - LOWER WABASH

021 Clay  
 027 Daviess  
 051 Gibson  
 055 Greene  
 083 Knox  
 101 Martin  
 121 Parke  
 125 Pike  
 129 Posey  
 133 Putnam  
 153 Sullivan  
 163 Vanderburg  
 165 Vermillion  
 167 Vigo

### UNIT 2 - KNOBS

013 Brown  
 019 Clark  
 025 Crawford  
 037 Dubois  
 043 Floyd  
 061 Harrison  
 071 Jackson  
 093 Lawrence  
 105 Monroe  
 109 Morgan  
 117 Orange  
 119 Owen  
 123 Perry  
 143 Scott  
 147 Spencer  
 173 Warrick  
 175 Washington

### UNIT 3 - UPLAND FLATS

029 Dearborn  
 041 Fayette  
 047 Franklin  
 079 Jennings  
 115 Ohio  
 137 Ripley  
 155 Switzerland  
 161 Union

### UNIT 4 - UPLAND FLATS

001 Adams  
 003 Allen  
 005 Bartholomew

### UNIT 4 - NORTHERN, continued

007 Benton  
 009 Blackford  
 011 Boone  
 015 Carroll  
 017 Cass  
 023 Clinton  
 031 Decatur  
 033 De Kalb  
 035 Delaware  
 039 Elkhart  
 045 Fountain  
 049 Fulton  
 053 Grant  
 057 Hamilton  
 059 Hancock  
 063 Hendricks  
 065 Henry  
 067 Howard  
 069 Huntington  
 073 Jasper  
 075 Jay  
 081 Johnson  
 085 Kosciusko  
 087 La Grange  
 089 Lake  
 091 La Porte  
 095 Madison  
 097 Marion  
 099 Marshall  
 103 Miami  
 107 Montgomery  
 111 Newton  
 113 Noble  
 127 Porter  
 131 Pulaski  
 135 Randolph  
 139 Rush  
 141 St. Joseph  
 145 Shelby  
 149 Starke  
 151 Steuben  
 157 Tippecanoe  
 159 Tipton  
 169 Wabash  
 171 Warren  
 177 Wayne  
 179 Wells  
 181 White  
 183 Whitley

## National Forest-Ranger District (NFRD): Item 73

### Illinois National Forest-Ranger District Codes

- 908 Shawnee National Forest
  - 01 East
  - 02 West

### Indiana National Forest-Ranger District Codes

- 911 Hoosier National Forest
  - 02 Brownstown
  - 03 Tell City

## Data Recorder

### Hot keys

Key	Action
F1	Menu down
F2	Menu up
F3	Main menu
F4	Select first or last data item
Del	Clear number
No	
↑ ↓ ← →	Move up, down, left, right
*	(Husky Paw key) Override errors
PgUp	Previous tree
PgDn	Next tree
A	Add a duplicate tree or biomass
D	Slope corrections (When in tree data screen this will tell you if the tree is within the limiting distance after you've entered the DBH.)
F	First tree
L	Last tree
H	Cursor home
S	Scrolling screen (press S again for exit)
X	Edit current menu

### Screens

#### Startup

```
                Welcome to the
North Central Forest Exp. Station's
                FIA
    Field Data Entry Environment

Hit any key to continue.
```

#### Identification

```
Enter the name of your machine:
PBUNYON

Is this correct? (Y/N)
```

### Shrub setup

```
Are you going to be collecting shrub
data? [Not needed in winter] (Y/N)
```

### Main menu

```
      Main Menu   FIAField v3.00 Pascal
1. Enter/Edit data  6. Print a plot
2. Delete a plot   7. Slope
corrections
3. Transmit a plot 8. Reset Keyboard
4. Receive a plot  9. Battery Level
5. Exit from prog  0. Reconfigure
                   S. DOS Shell
      Choice (0-9,S):
```

### Plot selection

```
=>00000000 NEW PLOT  Enter/Edit
10010012
10100123
20030004
20070258
```

### Plot data

```
ST   17  UNIT  1   CNTY  1   PLT#  12
OLD# 16  SK    2   CRUZ  29  TALY  30
WTYP  1   WARE 33  WDIS  35  RTYP  2
RDIS 25  NFRD  0   ODAT  785  CDAT  795
```

### GPS location

```
      Plot Lat-Long Coordinates
N: 00°00.000'
W: 000°00.000'
GPS:  0
```

### Condition records

```
CONDITION CLASSES
CON# 1  GLUC  2  REAS  3  ASP   4
POS  5  SLP   6  SHP   7  LEN   8
PHYS 9  SORI 10  SHIS 11  CFTS 12
SAGE 13 SI   14  SISP 15  AREA 16
OWN  17 POST 18  TCWD 19

# CONDITIONS ENTERED IS 2 YOU'RE ON # 1
```

### Tree records (remeasured plots)

```
TREE DATA PT# 1
TR#  1  DIST  2  DBHC  3  SPP   4
DAM  5  TCC   6  THIS  7  CRC   8
CCC  9  AZM  10  CON# 11  TCAV 12
TGRD 13 THGT 14  DBHO 15  TCO  16
CRO  17 CCO   18

# TREES ENTERED IS 1 YOU'RE ON TREE 1
```

### Tree records (new plots)

```
TREE DATA PT# 21
TR#  1  DIST  2  DBHC  3  SPP   4
DAM  5  TCC   6  THIS  7  CRC   8
CCC  9  AZM  10  CON# 11  TCAV 12
TGRD 13 THGT 14

# TREES ENTERED IS 1 YOU'RE ON TREE 1
```

### Subplot records

```
SUB PLOTS PT# 1          On 1 of 1
COND 1  %ARE 100 COV  3  LAZM  4
RAZM 5  CAZM  6  CDIS  7
```

### Plot menu

```
***PLOT MENU***
1. Plot data      2. Condition classes
3. Sub plot data  4. Site index data
5. Save plot and go to main
6. Edit the plot  7. Plot Map
8. Reset Keyboard 9. Power Level
F2. Doing Shrubs -> Yes
                Select from menu >>>
```

### Biomass records

```
BIOMASS DATA PT# 21
SNUM 2   SPP  3   SHIS  4   COV   5
DIAC 6   FREQ  7   BROW  8

# SHRUBS ENTERED IS 1 YOU'RE ON # 1
```

### Site tree records

```
SITE INDEX DATA
TR#  2   CDBH  3   SPP   4   HGHT  5
BAGE 6   TAGE  7   ADYR  8   SI    9
CON# 10

# TREES ENTERED IS 1 YOU'RE ON TREE # 1
```

## Global Positioning System (GPS) instructions

Exact geographic coordinates will need to be obtained for each field plot. The coordinates will aid in the analysis of the plot data and locating the plot for the next survey. The Precision Lightweight GPS Receiver (PLGR's - pronounced "Plugger"), manufactured by Rockwell International, will be used for this task. Instructions for use can be found in the accompanying "Operations and Maintenance Manual", however, it contains much extraneous information that we do not have to be concerned with. Below is a synopsis for the day to day use of the "Plugger" unit.

### Setup Instructions

Setting up the "Plugger", with the correct parameters needs only be done once. However, the unit should be checked each day for correct settings.

After turning the unit on, press the "Menu" button (key 3). The main menu will be displayed:

←move→	↓	select
STATUS		SETUP
INIT		TEST
HELP	<more>	↓ P

One of the menu items will be flashing, move to the "SETUP" menu by pressing the arrow-right or arrow-left button (keys 4 or 6) and select the item by pressing the page-down button (key 5). The first page of the SETUP menu will be displayed:

	Explanation
SETUP MODE: <b>STBY</b>	<b>Stand By</b> power saving mode
No tracking, low power.	
SV - TYPE: <b>all-Y</b> ↓ P	Track only Y-code signals

The items in bold in the above menu page are the options that can be set. Move to each item by pressing one of arrow keys (keys 4 or 6), the item will begin to flash when it is active. When you have moved to the desired item, press the page-down button (key 5) until the correct option is displayed. The above mode should be set to **STBY** (Stand By) just for setting up the unit and would not be used in normal field operations.

To proceed to the next menu page, press an arrow key until the ↓ appears next to the "P". Press the page-down button (key 5) again to move on to the next page: (Note if any item is flashing, continue to press an arrow key (keys 4 or 6) until nothing is flashing and the page-up/down symbols appear next to the "↓" in the lower right corner - nothing on the screen should be flashing when you desire to move to the next menu page.). The next page is **VERY IMPORTANT**, set the units according to the display below:

	Explanation
SETUP UNITS	Latitude / Longitude displayed in Degrees and minutes. Use <b>English</b> units (miles, feet, mph)
<b>L/L-dm. English</b>	Elevation above <b>Mean Sea Level in feet.</b>
ELev : <b>feet MSL</b>	Azimuths in <b>Degrees from Magnetic north</b>
ANGL : <b>Deg Mag</b> ↓ P	

Move on to the next page when the page appears as above.

The next page is:

SETUP MAGVAR	Explanation
TYPE : <b>Calc</b> deg	Magnetic Variation is
WMM 1995	<b>Calculated</b> by the system in degrees
↑ P	

Set the page as shown above. Next, page-down to the next menu page.

SETUP	Explanation
ELHold : <b>automatic</b>	Auto- calculates when to hold elevation constant
TIME : <b>Zulu</b>	Time display in "Zulu" time
ERR : <b>+/- ft</b> ↑ P	Error displayed as plus or minus in feet

Set the page as shown above. Next, page-down to the next menu page.

SETUP DTM : <b>NAR</b>	Explanation
No Amer-83/GRS80	Datum set to the North American 1983
AUTOMATIC OFF	using the GRS spheroid
TIMER : <b>20 min</b> ↑ P	The unit will automatically turn off in 20 minutes

The above page is **VERY IMPORTANT**, please make sure the Datum is set to "**NAR**".

Set the page as shown above. Next, page-down to the next menu page.

SETUP I/O	Explanation
SERIAL : <b>Standard</b>	Input/out parameters for the serial port.
HAVEQUICK : <b>Off</b>	However, we will not use it.
1PPS : <b>Off</b> ↑ P	

This page should already be as shown, if not please make the appropriate changes and continue on to the next page.

SETUP AUTOMARK	Explanation
MODE : <b>off</b> WP000	This option would automatically take a point at a
##-##-## ####Z	specified time or interval in time. However, it
REPEAT 0000 ↑ P	should be set to off.

Make sure that the MODE is set to **off**, that is the only thing to worry about on this page. This is the last page in the setup menu. Paging to the next page will bring you back to the first page of the setup menu. If not, press page-down key (5) until the first page does appear. Press menu to display the main menu.

## Operations in the Field

### Acquiring a Daily Almanac

The first time the PLGR is turned on each day, known as a "Cold Start", the PLGR starts searching for SVs (Satellite Vehicles). The first information the PLGR receives from each satellite (health, ephemeris, etc.) is picked up from the CA-code signal. The PLGR looks for the best geometry among the SVs in view and locks on to them. Your receiver will not instantly obtain a precise and accurate position fix. You should be prepared to **allow 15 to 20 minutes** for the receiver to obtain the daily almanac (at the start of the day) before it will collect accurate position data. The longer the PLGR has been in storage the more time it will take to determine a precise position. During this time the receiver must be set to CONTINUOUS (CONT) mode. Begin by turning the PLGR on:

<u>Action</u>	<u>KEY #</u>
Turn the PLGR on	Key 1

Upon turning the unit on, the battery status will be displayed. A warning will be given if it is low on power. **Always** carry a spare battery pack with you! After the start up test is performed by the unit, the POSITION page will be displayed:

```

FIX          OLD
N 44° 59.089'
W 93° 11.092'
Elh +00941 ft  ↑  P
  
```

The receiver mode can be viewed in the upper left corner of the first position to be displayed. When the unit is first turned on it will be in the quick "FIX" mode (if it is using only battery power).

The receiver will need to be in to the **CONT** mode, begin by going to the main menu:

<u>Action</u>	<u>KEY #</u>	<u>Screen</u>	
Display Main Menu Page	Key 3	←move→	↑↓ select
		STATUS	<b>SETUP</b>
		INIT	TEST
		HELP	<more> ↑↓ P

Move to the "SETUP" menu item by pressing one of the arrow buttons (keys 4 or 6), it will be active when it is flashing, then select the SETUP menu by pressing the down key (key 5). The first page of the SETUP menu will be displayed:

<u>Action</u>	<u>KEY #</u>	<u>Screen</u>	<u>Menu Explanation</u>
Display Setup Menu	Keys 6,5	SETUP MODE: FIX Quick POS fix,	Obtains a quick fix of position, then goes to stand-by mode,

then STBY and eventually turns off  
 SV-Type: all Y Track only Y-code signals  
 ↓ P

Change the Mode to the Continuous Mode:

<u>Action</u>	<u>KEY #</u>	<u>Screen</u>	<u>Menu Explanation</u>
Change Mode to <b>(CONT)</b> inuous	Keys 6,2	SETUP MODE: <b>CONT</b> Continuous POS and VEL update SV-Type: all Y ↓ P	Calculates its position and velocity continuously Tracks only Y-code signals

The items in **bold** in the above menu page are the options that can be set. Move to each item by pressing one of arrow keys (keys 4 or 6), the item will begin to flash when it is active. When you have moved to the desired item, press the page-down button (key 5) until the correct option is displayed. The above mode should be set to **CONT** (Continuos), this is just for the "cold start" up of the unit and should not be used for acquiring the position of the plot center.

When you have changed the receiver to the CONT mode, press the "POS" button (key 8). Check the error in the upper right hand corner of the position screen, it will probably be very high for a few minutes. After about 5 minutes the error should have dropped somewhat. Also check the almanac age by pressing the page-up button (key 2) - while the position screen is displayed. When it states that the age is 1 day, the receiver is ready to collect the plot coordinates. This may take some time so be patient. The unit will turn itself off if left untouched for 10 minutes, so while you are waiting for it to acquire the almanac, it would be wise to press the "POS" key every 5 minutes or so to prevent this. When the almanac has been obtained, you may switch the unit off and proceed to the plot center or, if you are already at the plot center, proceed with the next section - Collecting the Plot Center Coordinate. If the above was done correctly, the Almanac Age should be one day.

### Collecting the Plot Center Coordinate

When you have found or established the pin at plot center, stand over the pin holding the receiver - preferably facing south. If you have not acquired the almanac for the day do so by completing the above section. If the almanac has been acquired (that is the almanac age is one day, - check this by pressing the "POS" button (key 8) and then the page-down button (key 5) twice) proceed...

change the operating mode to **AVG**, to do this:

Press the "Menu" button (key 3). The main menu will be displayed:

```

←move→      ↓ select
STATUS      SETUP
INIT        TEST
HELP        <more> ↓ P

```

One of the menu items will be flashing, move to the "SETUP" menu by pressing one of the arrow keys (keys 4 or 6) and select the item by the page-down button (key 5). Next the first page of the SETUP menu will be displayed:

	<u>Menu Explanation</u>
SETUP MODE: <b>AVG</b>	The <b>AVERAGING</b> mode continuously records a new position and averages with previous positions. <b>DO NOT MOVE</b> the PLGR.
Static POS fix, better accuracy	
SV - TYPE: all Y ↑ P	Track only Y-code signals

The items in **bold** in the above menu page are the options that can be set. Move to the mode item by pressing the right-arrow button (key 6), the item will begin to flash when it is active. When you have moved to the "MODE" item, press the page-down button (key 5) until the **AVG** option is displayed. The averaging mode will continually record a position and average them together, it is therefore very important that you **DO NOT MOVE** the PLGR unit while it is averaging. After the AVG mode is displayed, press the "POS" button (key 8). "AVG" will now be displayed in the upper left corner of the screen. After approximately 15 seconds (or several minutes) the unit will display the number of positions it has averaged together and continually update the resulting "average" coordinate. Allow the unit to collect at least 180 points (this will take about 3 minutes). After which the coordinates for the plot center may be entered into the HUSKY and recorded onto the plot sheet. The coordinates are in degrees and decimal minutes for the latitude and longitude, enter and record the full number to the 3rd decimal place of the minutes, **DO NOT ROUND!** After you have entered and recorded the coordinates the PLGR unit may be turned off by pressing the off button twice.

### What to Do When You Can't Get to Plot Center

If plot center happens to be inaccessible, go to a point from which you know the distance and azimuth to plot center. At this point, obtain the coordinates as you would for the PC explained above. When the unit has averaged over 180 points into its calculation, press the "MARK" button. This screen will appear:

```
MARK POS→WP:###
MARK : saves
NAV:ManOverbrd
ON : cancels
```

The unit will give the coordinate a Way Point (WP) number, make note of this number, then press the "MARK" button to save the way point.

Next press the "WP" button (key 7). The Way Point menu will appear:

```
WP ←move→ ↑ sel
ENTER EDIT COPY
SR-CALC RNG-CALC
DIST CLEAR ROUTE
```

Move to the "RNG-CALC" item with the arrow buttons (keys 4 or 6) and press the page-down button (key 5) when the "RNG-CALC" item flashes. The following screen will appear:

```
CALC from WP000
RNG 0000.0 ft
AZ 360.0(M
EL +00000 ft  ↑  P
```

This is the coordinate calculation screen. Here you will enter the distance (range) and azimuth to the plot center. Move to the way point item with the arrow-right button (key 6), when the "000" flashes next to the "WP", press the page-down button (key 5), the way point number of the coordinate you have just marked should appear. If not, continue pressing the down button until it does. When you have the correct way point number displayed, move to the range (RNG) item with the arrow-right key (key 6) so that the "0000" will flash, then press the page-down button (key 5) and the first digit will begin to flash. If your distance is less than 1000 feet, move on to the next digit by pressing the arrow-right button (key 6). When the appropriate digit flashes select the correct number with the page-down or page-up buttons (keys 2 or 5). Next, move to the (AZ)imuth item and enter the azimuth to the PC in the same way. Move past the (EL)evation item to the (P)age so that the page-up and down arrow (↑ ↓) appears next to the P symbol. Next, press the page-down button (key 5). The calculated coordinates for the PC will now appear on the screen.

## Maintenance

The "Plugger" unit uses 8 AA Alkaline power batteries good for about four hours of operation and will need to be replaced every few days. Power batteries can be accessed by removing the power battery cover at the top of the unit. The "Plugger" unit also has one AA size lithium memory battery that is located at the bottom end of the unit. The memory battery is only replaced as a maintenance action annually and is used to maintain power to the memory for critical information - **NEVER REMOVE THIS BATTERY!** This removes the encryption codes and reduces the accuracy of position coordinates.

Keep the unit clean and dry as you would the HUSKY. Unless you are about to be overrun by the enemy - **NEVER EVER PRESS THE "NUM LOCK" BUTTON AND THE "MARK'BUTTON SIMULTANEOUSLY!** This will clear all the special encryption codes from the unit and it will have to be returned to the Missoula Technology Development Center for recoding - costing you money and the severance of your index and middle fingers! To check that encryption codes are in the unit press the "Menu" key twice. You should see the following menu with "CRPTO" displayed in the lower left of the screen:

```
Data-XFR          SV-SEL
DOP-CALC          ALERTS
SINCGARS          KOI-18
CRPTO           <more> ↑  P
```

From time to time, way points should be cleared out of the memory. This can be done by pressing the WP button and moving down to the "CLEAR" item. Select it and enter the range of way points you wish to clear, then move to and select the "Activate" item to clear them.

## Recommended Site Index Curves for Illinois and Indiana

Species		GTR NC-128		F.Man.	
Code	Common Name	Fig. #	Pg. #	Pg. #	Source
068	Eastern redcedar	58	73	SI 1	Hampf 1965
110	Shortleaf pine	79	94	SI 2	Schumacher and Coile 1960
125	Red pine	95	110	SI 3	Gevorkiantz 1957
129	White pine	103	118	SI 4	Gevorkiantz 1957
131	Loblolly pine	109	124	SI 5	USDA Publication 1929
132	Virginia pine	125	140	SI 6	Kulow, Sowers, and Heesch 1966
313	Boxelder	01	16	SI 7	Use red maple curve
314	Black maple	03	18	SI 8	Use sugar maple curve
316	Red maple	01	16	SI 7	Carmean 1978
317	Silver maple	01	16	SI 7	Use red maple curve
318	Sugar maple	03	18	SI 8	Carmean 1978
371	Yellow birch	06	21	SI 9	Carmean 1978
373	River birch	09	24	SI 10	Use paper birch curve
375	Paper birch	09	24	SI 10	Carmean 1978
379	Gray birch	09	24	SI 10	Use paper birch curve
402	Bitternut hickory	10	25	SI 11	Hampf 1965
403	Pignut hickory	10	25	SI 11	Hampf 1965
404	Pecan	10	25	SI 11	Hampf 1965
405	Shellbark hickory	10	25	SI 11	Hampf 1965
407	Shagbark hickory	10	25	SI 11	Hampf 1965
408	Black hickory	10	25	SI 11	Hampf 1965
409	Mockernut hickory	10	25	SI 11	Hampf 1965
461	Sugarberry	53	68	SI 31	Use American elm curve
462	Hackberry	53	68	SI 31	Use American elm curve
531	Beech	11	26	SI 12	Carmean 1978
541	White ash	13	28	SI 13	Carmean 1978
543	Black ash	14	29	SI 14	Carmean 1978
544	Green ash	15	30a	SI 15	Broadfoot 1969
546	Blue ash	14	29	SI 14	Use black ash curve
601	Butternut	16	31	SI 16	Use black walnut curve
602	Black walnut	16	31	SI 16	Kellogg 1939
611	Sweetgum	21	36	SI 17	Broadfoot and Krinard 1959
621	Yellow-poplar	25	40	SI 18	Schlaegel 1969
691	Water tupelo	26	41	SI 19	Applequist 1959
693	Black tupelo	27	42	SI 20	Applequist 1959
741	Balsam poplar	32	47	SI 22	Use aspen curve
742	Cottonwood	28	43	SI 21	Neebe and Boyce 1959
743	Bigtooth aspen	32	47	SI 22	Carmean 1978
744	Swamp cottonwood	28	43	SI 21	Use cottonwood curve
746	Quaking aspen	32	47	SI 22	Carmean 1978
762	Black cherry	34	49	SI 23	Carmean 1978
802	White oak	41	56	SI 24	Carmean 1972
804	Swamp white oak	41	56	SI 24	Use white oak curve
806	Scarlet oak	42	57	SI 25	Carmean 1972
809	N. pin oak	49	64	SI 28	Use black oak curve
812	S. pin oak	49	64	SI 28	Use black oak curve

813	Cherrybark oak	48	63	SI 27	Use northern red oak curve
817	Shingle oak	49	64	SI 28	Use black oak curve
822	Overcup oak	41	56	SI 24	Use white oak curve
823	Bur oak	41	56	SI 24	Use white oak curve
824	Blackjack oak	49	64	SI 28	Use black oak curve
825	Swamp chestnut oak	41	56	SI 24	Use white oak curve
826	Chinkapin oak	41	56	SI 24	Use white oak curve

<b>Species</b>		<b>GTR NC-128</b>		<b>F.Man.</b>	
<b>Code</b>	<b>Common Name</b>	<b>Fig. #</b>	<b>Pg. #</b>	<b>Pg. #</b>	<b>Source</b>
830	Pin oak	49	64	SI 28	Use black oak curve
831	Willow oak	49	64	SI 28	Use black oak curve
832	Chestnut oak	46	61	SI 26	Carmean 1971
833	N. red oak	48	63	SI 27	Carmean 1978
834	Shunard oak	48	63	SI 27	Use northern red oak curve
835	Post oak	41	56	SI 24	Use white oak curve
837	Black oak	49	61	SI 28	Carmean 1971
901	Black locust	50	65	SI 29	Kellogg 1939
951	American basswood	51	66	SI 30	Carmean 1978
952	White basswood	51	66	SI 30	Use American basswood curve
971	Winged elm	53	68	SI 31	Use American elm curve
972	American elm	53	68	SI 31	Carmean 1978
974	Siberian elm	53	68	SI 31	Use American elm curve
975	Slippery elm	53	68	SI 31	Use American elm curve
977	Rock elm	53	68	SI 31	Use American elm curve

Source: Carmean, W.H., J.T. Hahn, and R.D. Jacobs. 1989. Site index curves for forest tree species in the Eastern United States. North Central Forest Expt. Stn. Gen. Tech. Report NC-128.

## **Additional Information**

### **Tatum Guides**

### **Site Index Curves**

### **IL Forest Resources Districts**

### **IN DNR District Foresters, State Forests, and Recreation Areas**

### **Field plot sheets**