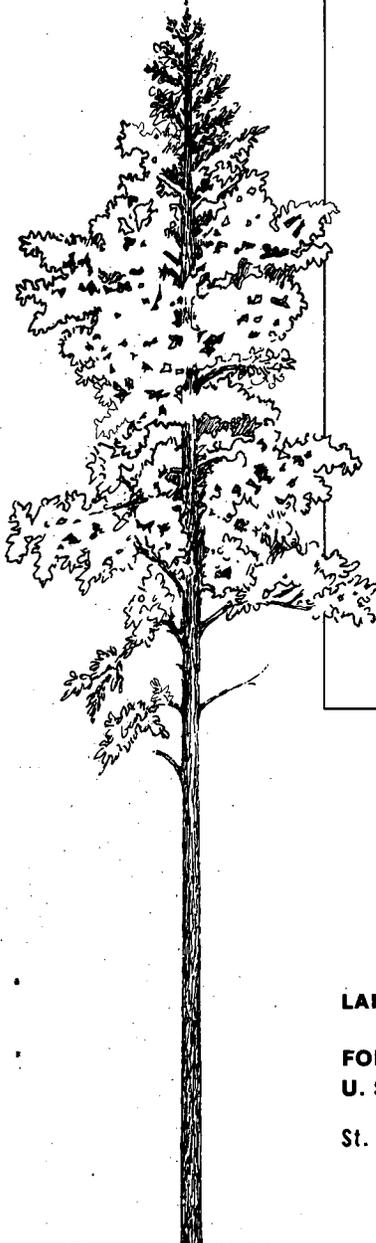


Data File



INSTRUCTIONS FOR
THE SECOND MISSOURI FOREST SURVEY
June 1959

LAKE STATES FOREST EXPERIMENT STATION
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE
St. Paul 1, Minnesota

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	
A. The initial forest survey-----	1
B. Need for a new survey -----	1
C. Cooperation--A key to greater intensity -----	2
D. Purpose and scope of cooperative survey -----	3
E. Reports on the timber situation -----	5
F. Plan for the second Missouri forest survey -----	6
G. Keeping the survey up to date -----	7
II. SAMPLING ON AERIAL PHOTOS	
A. Aerial photography -----	8
B. The forest-nonforest sample -----	9
C. Selection of aerial photos and points for stereoscopic study -----	12
D. Stereoscopic examination -----	14
III. GROUND CHECKING	
A. Selection -----	16
B. Checking in the field -----	19
IV. PLOT SAMPLING	
A. The variable plot tally-----	21
B. Classification of the stand -----	25
C. Supplemental information for each plot -----	26
D. The sample -----	35
V. DETERMINING LOCAL CUT OF TIMBER	
A. Production reports from industry -----	36
B. Stump counts on forest survey plots -----	41
C. Cutting reports from various classes of owners-----	41
D. Wood utilization study -----	41
VI. DETERMINING MILL RESIDUES RESULTING FROM CONSUMPTION OF LOGS AND BOLTS-----	42
VII. FORM CLASS STUDY -----	51
VIII. GENERALIZED TYPE MAPPING -----	52
IX. COMPUTATIONS -----	54

	<u>Page</u>
APPENDIX I--Definitions and Codes -----	56
A. Land classes -----	56
B. Forest type -----	58
C. Stand-size and stocking classes -----	60
D. Regeneration survey -----	62
E. Physiography -----	64
F. Grazing -----	65
G. Land use trend -----	67
H. Stand age -----	68
I. Site quality -----	68
J. Allowable cut -----	72
K. Ownership -----	80
L. Species -----	82
M. D.b.h. -----	83
N. Tree class -----	84
O. Cut or leave -----	87
P. Merchantable height -----	87
Q. Defect class -----	90
R. Log grades -----	92
S. Mortality classification -----	96
T. Tree number -----	96
U. Age -----	96
V. Total height -----	97
W. Sample tree class -----	97
X. Radial growth -----	98
Y. Bark thickness -----	98
Z. Diameter at 17 feet -----	99
AA. Stump diameter -----	99
APPENDIX II.--Survey Design and Accuracy -----	100
APPENDIX III.--Miscellaneous -----	102
A. Factor 5 variable plot radii by d.b.h. -----	102
B. Missouri forest survey tatum guide -----	103

RE-1S
FOREST SURVEY
Missouri

INSTRUCTIONS FOR

THE SECOND MISSOURI FOREST SURVEY

June 1959

I. INTRODUCTION

A. The Initial Forest Survey

The initial inventory of Missouri forest resources was begun in September 1946 and was completed 1 year later. It was designed to obtain statistics for large districts within the State. It employed a triple sampling system using aerial photos (taken mostly between 1935-40). Approximately 196,590 dots were examined on the photos to estimate forest area. Photo-interpreters examined and classified by stand size 26,370 forest points. Field crews examined 2,603 forest plots and 886 nonforest plots. Growth measurements were taken on 2,954 sample trees. From all of these data five local and one State statistical reports were published. A State analytical report was prepared by the Central States Forest Experiment Station and published as "Forest Resources and Industries of Missouri, Research Bulletin 452, by the Agricultural Experiment Station, Columbia, Mo., in 1949.

B. Need for a New Survey

Since that data, many changes have occurred in the condition of the forests, in their protection and management, and in their utilization. A complete reinventory is needed with more up-to-date information on the

local industries as well as upon the possible opportunities for new industries. Furthermore, people in Missouri feel the need for forest statistics by county or small blocks rather than only by State and district.

C. Cooperation--A Key to Greater Intensity

The nationwide forest survey was authorized by the McSweeney-McNary Forest Research Act in 1928. It is designed to provide up-to-date information on forest area, timber volume, growth, mortality, and timber cut needed to plan the management and development of the nation's forest resources. The forest survey is conducted by the U. S. Forest Service through the Forest Experiment Stations. The forest survey organization for the Central and Lake States is at the Lake States Forest Experiment Station in St. Paul. Surveys in Missouri and other Central States are made in close cooperation with the staff of the Central States Forest Experiment Station.

The Forest Service recognizes the need for separate sets of forest statistics for areas small enough to facilitate planning by industries and local governmental units. However, the job of covering all the forests of the nation at this intensity and within a reasonable period is too great for the funds provided. The Forest Service has sought cooperation from State and local groups and, when it is available, assists in the procurement of localized statistics.

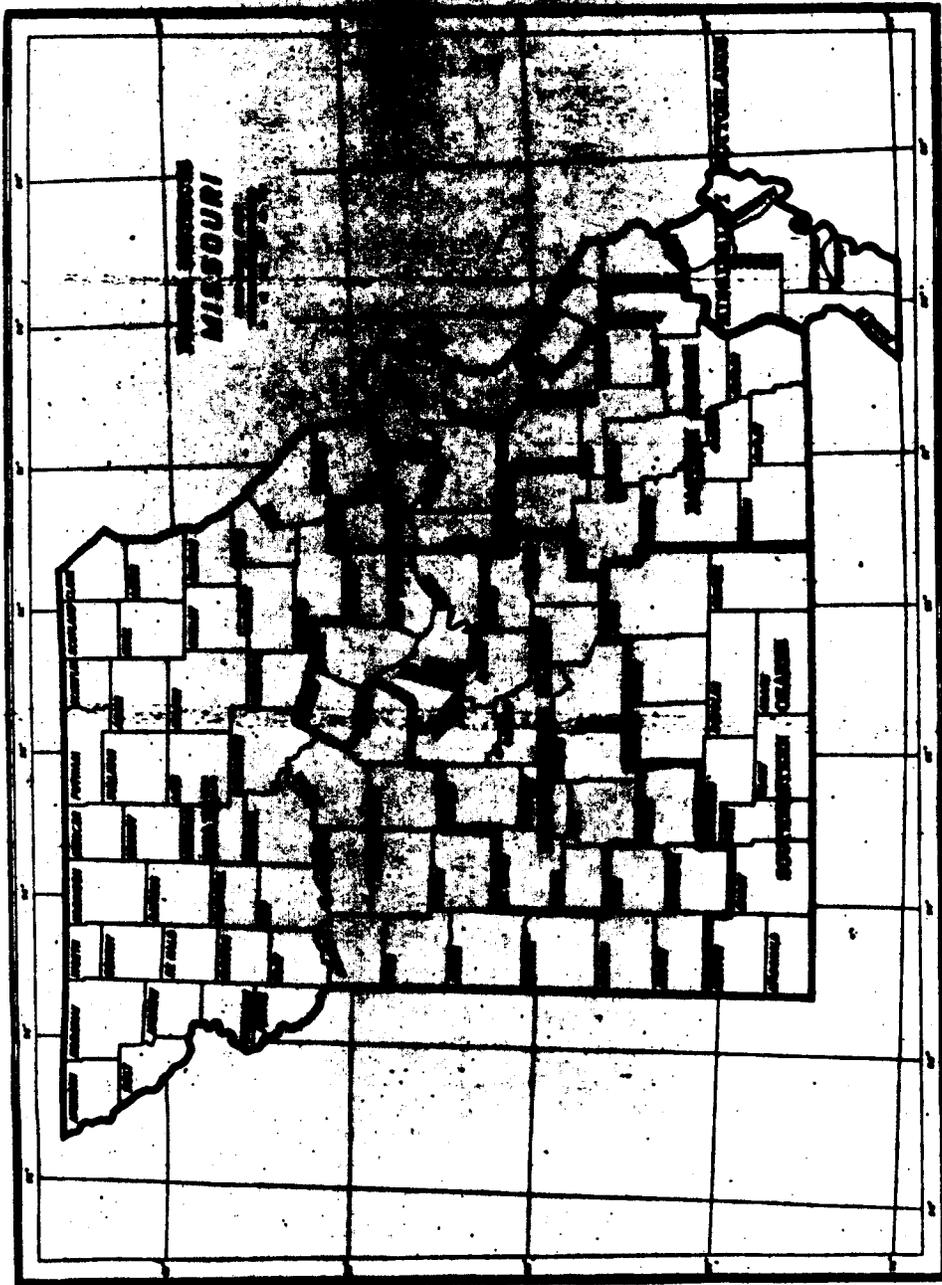
Forestry leaders in Missouri have indicated a desire for forest resource information, especially timber volume, in more detail than was obtained in 1946-47. The Missouri Research Center Advisory

Committee actively supported and advised the forest survey organization in initial planning. The Committee first recommended that the Missouri legislature appropriate \$120,000 over a 3-year period for intensifying the Missouri forest survey. Later it recommended \$80,000 for a 2-year period and a somewhat curtailed program.

Under national survey instructions the statistical accuracy of commercial forest area must be within ± 3 percent per million acres and that of total volume within ± 5 percent per billion cubic feet. If \$80,000 of State funds are added to the survey financing the statistical accuracy of commercial forest area could be held close to 2 percent per million acres and of total volume to approximately 3 percent per billion cubic feet. The sampling error of total volume for most of the individual well-forested counties would then be within 10 percent. This accuracy would permit publication of forest area and timber volume figures, by several breakdowns, for the counties in the Ozarks and Riverborder Districts.

D. Purpose and Scope of Cooperative Survey

The purpose of this survey is to provide such reliable information on the forest resource of the State of Missouri as may be needed to guide industries and public agencies in the wise use of this resource. It is designed to give up-to-date statistics on forest areas and of timber volumes by species, for each of the major forest counties and for blocks of minor forest counties. It will include estimates of timber cut and growth by species and districts. The needs of established industry and the major problems of improving the forest situation will



1927

will be reviewed. Distribution of forest lands and timber volume in the various ownership classes will be determined.

E. Reports on the Timber Situation

Plans are for four district reports and one State report be published. The local reports would cover the following districts:

Eastern Ozarks District
Northwestern Ozarks District
Southwestern Ozarks District
The Riverborder and Mississippi
Bottomlands District

Each of these would follow the general plan of the Timber Resources Report for the Baldwin Block, Lower Peninsula, Michigan, 1956, which includes a brief text, several charts to portray the overall forest situation within the Block, and statistics for the Block and each county. The following tables will be included:

1. Land and forest area by counties.
2. Commercial forest land by ownership and stand size class (for each district and well-forested county).
3. Forest land area by type and stand size class (for each district and well-forested county).
4. Net timber volume on commercial forest land by species and kind of material (for each district and well-forested county).
5. Net timber volume by ownership and kind of material (for each district).
6. Timber cut by species (for each district).
7. Timber cut from growing stock and other material (for each district).
8. Timber cut by ownership groups (for each district).
9. The quantity of plant residue resulting from primary wood-using operations (for each district).

10. Periodic annual net growth on commercial forest land by species and kind of material (for each district).
11. Annual net allowable cut on commercial forest land by species and kind of material (for each district).

The State report will be both descriptive and analytical, somewhat like the Research Bulletin No. 452 "Forest Resources and Industries of Missouri." Much of the local details of the district reports will not be included in the State report, but analysis of some subject matter will be more complete.

A third type of report is desirable--brief, graphic, and popular in style for use by schools and conservationists. This may be prepared and published by a cooperating agency.

F. Plan for the Second Missouri Forest Survey

The second round of the survey got under way in January 1958. Fieldwork began in the Eastern Ozarks and will progress through Prairies, the Riverborder, and the Western Ozarks. Local reports will be prepared and published as rapidly as possible.

The plan calls for use of aerial photos, statistical sampling, and machine computing insofar as possible. Aerial photos will be used to obtain a much larger sample of land use and forest area than could be obtained on the ground with available funds. They will save considerable time in locating sample points in the field and in relocating them for subsequent remeasurement.

A triple sampling procedure will be used. A very large number of dot samples will be taken on aerial photos to determine forest-nonforest proportions. Some of these will be subject to photo-measurements to

determine forest type, density, etc. A somewhat smaller sample will be systematically drawn for checking on the ground. These samples will be the basis for area statistics. At the ground-check points, certain tree measurements will be made as a basis for estimating timber volume and growth. Timber cutting and tree mortality will be studied on these plots. Each plot will be marked to facilitate remeasurements in the future.

In addition to the inventory phases, it will be necessary to collect information on timber use from the forest industry and farmers. Some of this can be accomplished by mail canvass, but small sawmill data and post and fuel information must be obtained by field interviews. Active participation of farm foresters (Missouri Conservation Department) is helping accomplish this work.

The Clark and Mark Twain National Forests cover a net area of 1,359,000 acres in Missouri. An inventory of these forests was begun in 1957. Plans were correlated with the Forest Experiment Stations so that the data collected for the National Forests can be used by the forest survey. It is anticipated that the survey of National Forests will be completed in time to include their statistics in the local reports for the Ozark Districts.

G. Keeping the Survey Up To Date

The forest survey schedule calls for resurveys at 12-year intervals. For Missouri, the surveys may be 1947, 1959, 1971, etc. As the national timber balance is studied from time to time, it may be necessary to arrive at certain figures for some year between these

inventories. This survey is designed as a part of a continuous inventory system which will indicate trends as the forests change and facilitate bookkeeping revisions between periodic surveys. Systematic sampling and permanent plots will provide for accurate measurement of changes in the forests.

II. SAMPLING ON AERIAL PHOTOS

A. Aerial Photography

Panchromatic aerial photos for the entire State of Missouri have been taken at a scale of 1:20,000 during recent years. Examination shows that, with proper scheduling of survey work, no photos more than 5 years old need be used except in Bollinger County. A complete set of contact prints is available in the State Agricultural Stabilization and Conservation Office. Arrangements have been made for Missouri Forest Survey personnel to make the forest-nonforest dot count in that office.

A part of the National Forest gross area has been photographed especially for the current management plan survey. These pictures are infrared (modified) at a scale of 1:15,840. Forest cover of National Forest lands has already been mapped. Arrangements have been made for the use of this photography for sampling "other" lands within the National Forest units involved.

Plans call for the purchase of about 9,500 contact prints for use in the field now, and again as the permanent sample points are re-located about 12 years hence. The cost is estimated at \$5,700.

B. The Forest-Nonforest Sample

The first stage in sampling is the determination of forest area. This is primarily a photo classification of a very large number of points scattered over the entire State. A transparent dot grid of points (12 on photography scaling 1:15,840 and 18 on 1:20,000) designed to sample half of the stereoscopic model of two aerial photos is laid over every second print in every flight line. This will provide coverage of half the area of the State. The photo index sheets are used to determine which prints and flight lines to use. Along county lines the photos are sorted to the county which provides most of the sample area. Selection starts with the first photo in the first flight line in a county and includes alternate prints in each flight line thereafter. This continues from county to county, insofar as possible, instead of starting afresh in each county.

The grid must be carefully aligned with the photo fiducial marks to insure exact location of the sample points. Each dot is numbered for reference.

As each photo is placed under the grid the interpreter will scan it with naked eye or reading glass and classify the 1-acre area adjacent to the point as forest, questionable forest, water, urban and industrial, or other nonforest. Any dot which can not definitely be classed as forest or nonforest type is called "questionable forest."

The interpreter will set up a photo-point record LS-70 (Form 1) for each flight line in each county as the job progresses. He will record each photo used giving the photo numbers for the stereo-pair, the classification of each dot and the number of dots in each class.



Templet for 1:15,840 Aerial Photos

Missouri Forest Survey

- | | | | | | | | |
|----|----|----|----|----|---|---|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 18 |
| 12 | 11 | 10 | 9 | 8 | | | |
| 13 | 14 | 15 | 16 | 17 | | | |

Templet for 1:20,000 Aerial Photos

Missouri Forest Survey

On gross National Forest areas the interpreter will dot count only those dots falling on land not administered by the Federal Forest Service. National Forest photos show approximate boundaries of Federal land. Lists of dots falling on National Forest land are available.

Use of the grids as planned will provide for systematic sampling with 1-acre point for each 142 acres of gross area (7,043 points per million acres). Approximately 314,000 points will be used to sample the State (196,590 were used in the first survey). This will provide about 1,200 points for the smallest county. It is estimated that this sample will take about 4 man-days per average county or about 450 man-days for the State. The sampling error (one standard deviation) for forest land will be approximately ± 0.6 percent for the State and ± 6.3 percent for the average county after correction by ground checking. The national standard required for Missouri is $\pm .77$ percent.

C. Selection of Aerial Photos and Points for Stereoscopic Study

The selection of aerial photos to be stereoclassified will be made on the photo-point records. Having arranged these sheets in order by flight lines, the interpreter will toss a coin to determine which of the first two flight lines and which of the first two principal aerial photos listed to begin with. Thereafter, he will use every second photo in every second flight line (even across county boundaries). This is the same as every fourth photo or every second line on every second photo-point record sheet. In all districts except the Prairies he will stereoclassify every forest and questionable dot on every fourth photo. In the Riverborder and Prairie Districts he

will select the first two out of every three forest and questionable dots on every fourth photo to be stereoclassified.

This sampling scheme will distribute groups of stereopoints in a systematic pattern (3.6 x 4.0 mile intervals) across the State.

As the selection is made, check-mark the line to the right of the photo numbers on the photo-point record. If a "forest" or "questionable" point has been entered on this line both aerial photos listed will be purchased for stereoscopic study. If no forest or questionable point has been indicated the photos will not be purchased and no further sampling will be done on the area involved. Points falling on "reserved" land need not be classified. Because of its small area such lands must be mapped or sampled more intensively.

This selection must be delayed until after a number of record sheets have been prepared since knowledge as to which points would be checked might affect the quality of the work.

Every "forest" and "questionable" point chosen for stereoscopic study will be classified and measured as explained in detail below.

D. Stereoscopic Examination

Place the dot grid over the principal aerial photo carefully, using fiducial marks. Look up the grid selected point number on the photo-point record and find it on the aerial photo grid. Make concentrated stereoscopic study of the 1-acre circular plot around the selected dot. If this plot is bisected by a forest cover boundary between

contrasting types, the plot should be moved just enough into the type in which the center falls so it will not sample more than one such type. Only the photo-interpreter may make and reference this move. Contrasting types include changes from forest to nonforest, pine to hardwoods, hardwoods to cedar, nonstocked or restocking to poles or sawtimber, and nonstocked or poorly stocked to well-stocked. Plot location must not be changed unless differences are contrasting. Pin-prick the exact location of each plot center (after change, if any).

As each point is studied under a stereoscope, determine the specific type and measure total height and crown diameter of the tallest main stand trees and crown density of all trees. The main stand is that part of the stand containing the majority of the dominant and codominant trees. Two or three trees will be selected and measured to provide a good average of height and crown diameter. (Changed in May 1959 to "one tree usually will be measured at each point--2 or 3 if necessary.") These may be off the plot if necessary to facilitate measurement. Heights will be measured by parallax wedge or floating dot and recorded to the nearest foot. Crown diameter will be measured by a wedge or floating dot and recorded to the nearest foot. Crown density will be measured by 20 Lossee's triangles on an acre circular plot.

As each "forest" and "questionable" point is classified, record the county, flight, photo, and grid point numbers, the photo-point classification, average tree total height, average crown diameter, crown density, photo type (first digit of photo class) and photo site class on Form LS-72 "Stereoscopic measurements." All information through "photo-point class" will be copied from Form LS-70. As stereoscopic measurements are made they will be entered on the right side of LS-72. Average

height and crown diameter will be entered in columns "photo height" and "crown diameter." Crown density, forest type and photo site (Section IV C-6) will be entered in the following columns.

A total of 151 "forested" and "questionable" dots per average county will be stereoclassified. This will amount to about 25,200 in the State (26,370 used in the first survey). At a rate of 50 classifications per man-day, about 4 days per county or 500 days for the State will be required.

III. GROUND CHECKING

A. Selection

Selection of points to be ground checked should be delayed until after the stereoscopic study of a number of flight lines is completed. This is desirable for avoiding bias. Every eighth forest and questionable point (every third in Mississippi Bottomlands) stereoclassified on Form LS-72 will be marked for ground checking.

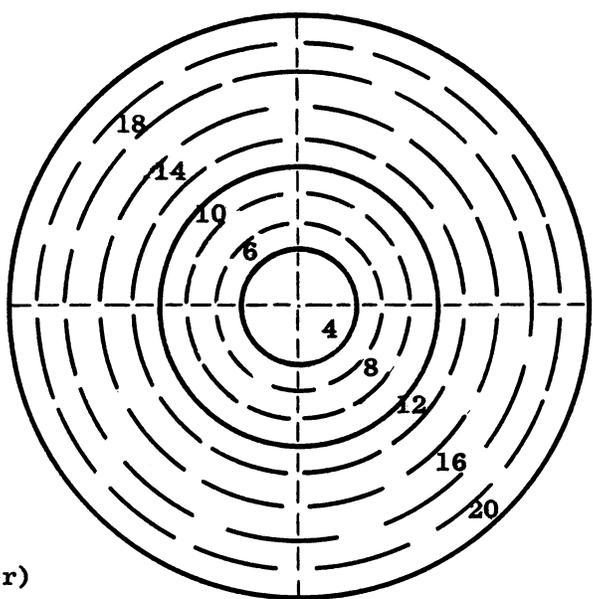
Prepare a Form LS-69 for each point to be ground checked. This consists of copying codes for "county" through "photo class" from Form LS-72. Using Form LS-70 and random numbers, pick and mark one non-forest point on each aerial photo having forest or questionable points to be checked in the field. Set up a Form LS-69 for each of these points indicating on it the county, flight, photo, and point numbers and the point classification.

Bring together the plot record sheets (Form LS-69) for forest (and questionable) points which are to be ground checked and those for nonforest points.

N

PLOT RECORD

Variable Plot - Factor 5 - 3.89'/1" Radius



County #	Position	Plot #
Flight #	Slope	Town
Photo #	Litter depth	Range
Point #	Month	Sect.
Photo point cl.	Duff depth	Subdiv.
Photo height	Humus depth	Date photo
Crown dia.	Humus type	Date cruise
Crown den.	Grazing	Cruiser
Photo class	Use trend	Tallyman
Point BA/A	Stand age	Owner
Ground class	Site	Address
Ground point cl.	Since cut	
Regeneration	Sev. of cut	
Watershed #	Cut recomm.	
Aspect	Ownership	Plot locality (over)

Tree #	Species	DBH	Tree class	Cut or leave	Merchant. ht.			Defect class		Log Grade				Mort. class
					4" top	6" top	8" or 8" top	Total Bd.-ft. vol.	Bd.-ft. vol.	I	II	III	T&T	
01														
02														
03														
04														
05														
06														
07														
08														
09														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														

Tree #	Age	Total height	Sample tree cl.	Radius		Bark thickness	Dia. at 17 ft.	Stump dia.
				10 yr.	20 yr.			

PLOT LOCATION

Starting point: _____



N

Sketch

Course to plot

Direction-	:	:	:
(Azimuth)	:	:	:
Distance--	:	:	:
(Chains)	:	:	:

WITNESS TREES

Tree number	Species	DBH	Azimuth to tree - (degrees)	Distance to tree - (feet)
I-				
II-				
III-				
IV-				
V-				

INDIVIDUAL MEASUREMENTS AND THEIR AVERAGE

	1st	2nd	3rd	4th	5th	Total	Average
Age							
Litter							
Duff							
Humus							

Locate these points carefully and pin-prick the location on the principal aerial photo. Write the plot number on the back of the photo near the pin-prick point.

Spot each ground-checked point on a county road map to facilitate travel planning. Indicate the township, range, section, and subdivision on which each forest plot is located and assign a number for each forest plot on Form LS-69. These plot numbers will begin with 1 in each county.

Before going to the field the aerial photos and plot record sheets should be grouped for convenience and arranged to correspond to the travel plan. A possible starting point for foot travel to each point should also be selected.

B. Checking in the Field

Guided by the county road map and aerial photo, the cruiser will proceed to the proposed starting point. After selection of the best starting point on the ground, he will determine from the photo the direction and distance to the plot. He will record these on the back of Form LS-69. Guided by hand compass he will pace to the approximate location of the plot. There he will study the aerial photos under a field stereoscope and move to the exact point on the ground which is indicated by the pin-prick on the photo. He will correct plot locational data as needed.

As a means of relocating the plot it is imperative that the starting point, course, and plot be adequately and permanently marked. The starting point usually will be visible both on pictures and on the ground. It must be some feature which will be identifiable for a number

of years. On the ground it will be marked by distinctive XX paint marks. The starting point and the direction and distance from it to the plot will be described on the back of Form LS-69. On the ground the course will be indicated by distinctive X marks above d.b.h. on trees at intervals of about 50 feet along the line. Turning points will be marked "T.P."

The plot center will be located exactly on the ground by an aluminum or galvanized steel wire stake. It may be located by intersection of four trees or witnessed by azimuth and distance readings to several trees. In either case the trees will be marked by painted Roman numerals on the side of the trees' base facing toward plot center.

A plot will be taken at each pinprick location which turns out to be commercial forest land. It will serve as a guide for classification of the 1-acre area surrounding the pinprick point. Normally this acre will be circular but if compressed by contrasting types it may be longer in some directions than in others. At nonforest locations no plot will be taken.

The forest type and stand size stocking classification will be recorded on Form LS-69 in space for "ground class." The kind of forest or nonforest area will be coded under "ground point class." IBM codes are provided in the Appendix of this plan.

Estimates indicate there should be about 3,600 forest points and 2,700 nonforest points ground checked in the State. The statistical accuracy of sampling including photo sampling and ground subsampling is indicated in Section II B and Appendix II.

IV. PLOT SAMPLING

A permanent plot will be established on each ground-check point which falls on commercial forest land. It will serve as a guide for classifying the point and as a measure of volume, growth and cutting needed. Repeat measurements of these plots will indicate changes in area and volume and improve estimates of growth and mortality. Data will be recorded in code on the plot record (Form LS-69).

A. The Variable Plot Tally

1. The variable plot.--A variable plot with basal area factor of 5 will be established around the center of the point. The variable plot method of cruising was developed by Dr. Walter Bitterlick and others. It varies from strict angle gauge cruising by using concentric plots with a different size of plot for each 2-inch d.b.h. class. The factor of 5 indicates a basal area of 5 square feet for each tree tallied. It is based on an angle gauge of 73.66 minutes or 2.14 prism diopters. The plot area is twice that of the plot whose basal area factor is 10--thus providing a larger sample at each location.

With the variable plot used, trees whose d.b.h. is 4 inches will be tallied on a circular tract with radius of 15.6 feet, 8-inch trees to a radius of 31.1 feet, 12-inch trees to a radius of 46.7 feet, and 20-inch trees to a radius of 77.9 feet, etc.

A two-man crew generally will be used because of the large amount of data to be gathered at each point. The tallyman will be stationed near the plot center and will operate a Spiegel Relaskop

mounted on a Jake staff. He will advise the cruiser which trees are line trees and will watch to see that no trees are missed.

The distance from the plot center to all line trees will be measured using a tape graduated by d.b.h. plot sizes; 2, 4, 6, etc. inches.

The Relaskop will provide slope readings which can be allowed for by using the slope correction marks on the tape. (A table of plot sizes by d.b.h. and slope is provided in the Appendix III A).

2. Tally of all trees.--The cruiser will measure the d.b.h. of each tree and stump to be tallied starting at the north and progressing in a clockwise direction. As each tree is measured, he will mark the point of measurement with a horizontal paint mark on the side of the tree facing plot center. He will call off species and d.b.h. to closest 0.1 inch. The tallyman will record them on Form IS-69 and spot the approximate location of each tree on the plot diagram. Tree number will be noted on the chart for each tree or stump. As the cruiser considers each tree he will make the following classifications or measurements and call them to the tallyman for recording. Definitions, specifications, and codes are provided in the Appendix.

- a. Tree class.

- b. Cut or leave. This classification need not be made if the stand is not ready for any kind of cutting.

- c. Mortality class for each tree which has died within the last 36 months prior to the tally.

d. Stump diameter of any tree which has been cut within the last 36 months. Stump diameter will be taken outside bark at a point 6 inches above the average ground level. If the tree has been cut lower, estimate the diameter at the 6-inch level. Record to the closest 0.1 inch in the stump column.

3. Tally of special sample trees.--Additional information will be collected on sample trees. All trees 3 inches and larger at breast height on the E $\frac{1}{2}$ of the plot in the Mississippi Bottomlands and on the NE $\frac{1}{4}$ of the plot in the balance of the State are considered "growth sample" trees. The cruiser will make the following classifications or measurements for these trees:

- a. Merchantable height to a 4-inch minimum top diameter inside bark for each tree (including those of sawtimber size).
- b. Merchantable height to a 6-inch flexible top diameter inside bark for each softwood tree of sawtimber size or to an 8-inch top for each hardwood sawtimber tree. Merchantable height measurements up to 40 feet will generally be made with a telescopic fish pole. The cruiser will run the pole up along the stem of the tree until the tallyman indicates the point of merchantability has been reached. The cruiser can then read height on the pole and call it off to the tallyman. If the pole is not long enough the tallyman can estimate the additional length involved. Beyond 40 feet a Relaskop, Abney level, or hypsometer should be used.

- c. Defect classes for total and for sawtimber volume.
- d. Log grades.
- e. Radial growth--10 and 20 years.
- f. Bark thickness (dropped when form study was completed).
- g. Stump diameter of each sample tree.

Data on age and tree height are needed for preparation of yield tables and site index curves. For yield table construction a good average figure for age of the main stand is needed. If ages of trees within a main stand do not vary much three trees will give a satisfactory average. If they vary greatly, more will be required. A rule-of-thumb has been designed to provide an adequate sample. "Sample until the ages of three trees fall within \pm 20 percent of their average age." Age of a stand averaging 15 years might vary from 12 to 18 years while one of 80 years might range from 64 to 96 years. Confine these measurements to the dominant and codominant trees of the main stand.

Site trees must be dominant or codominant trees of certain species which are representative of the type.

Normally some of the growth sample trees will meet yield and site study requirements. If so, these trees will be indicated on Form LS-69 under "sample tree class" and their total age and total height will be measured. If yield table trees are needed in addition to those found on the sector used for growth sampling, each tree around the balance of the plot may be considered for this purpose and measured if it meets the requirements. If no satisfactory site tree is found on the plot but one is available on a nearby area within the same "ground class," the cruiser may go "off plot" for this measurement.

B. Classifications of the Stand

A number of classifications and supplemental measurements will be made at each point. These are discussed in the order of their appearance on the plot record. Definitions and codes are given in Appendix I.

1. Point basal area per acre.--This will be an estimate for the 1 acre around the point. It will be based upon basal area for the plot (each tree represents 5 square feet of basal area). For sawtimber and poletimber stands it should represent the stocking of trees 5+ inch d.b.h. on the sample acre. For seedling and sapling stands it should represent the stocking of all trees over 1 inch d.b.h. on the sample acre.
2. Ground classification includes two codes: The type, and the size and density of stocking classification for the sample acre as determined on the ground. The cruiser's judgment can be guided by the plot tally.
3. Regeneration.--This can best be determined after the plot tally has been made. The classification should apply to the entire acre.
4. Aspect, position, and slope should be determined for the plot.
5. Watershed number, litter depth, month, duff depth, humus depth, and humus type. (Omitted after September 1958.)
6. Grazing and use trend.--These classifications will be made for the sample acre.
7. Stand age will be the average age of the dominant and codominant trees of the main stand. The average may be calculated on the back of Form LS-69 if desired.

8. The estimate of site quality will be based upon the present or potential merchantable height of pole and sawtimber trees or if no trees are present on aspect, position, and soil features.
9. Severity and time of cutting or burning. (Omitted after September 1958.)
10. The cruiser will consider the need for some cutting in the stand (1 acre) and the possibility of an economic operation. He will then recommend intermediate cutting, delayed cutting or no cutting.

C. Supplemental Information For Each Plot

1. Ownership.--In addition to the classification of ownership, place is provided for recording the name and address of the owner. While not a "must" item, this information will often be needed in order to determine the proper classification.
2. Plot number.--See Section III A., page 19.
3. "Town" through "tallyman." Self explanatory.
4. Diagramming defect indicators.--Studies of defect indicators and defect by log grade were begun early in January 1959. All visible defects (including those resulting in grade defect only) will be diagrammed and classified for the first growing stock tree over 5 inches d.b.h. tallied on each plot. This sample will provide about 900 merchantable trees of pole and sawtimber size.

Each tree will be diagrammed on Form LS-80, "Defect Indicators" to show estimated log or bolt length and d.i.b., log grade, and the location, type and severity (to volume) of each defect. These data will facilitate determination of percent of

defect in each log grade, build toward a better understanding of defect and indicate the comparative volumes of "merchantable" and "local use" logs.

Form LS-80 provides space for showing the location of each defect indicator and its severity on either of four faces and at the proper height above stump. These will be shown by code numbers to facilitate analysis. The codes are listed on the form for convenience. Provision also is made for calculating on the form the percent of defect in the tree and the proportion of net volume in each log grade.

Suggested procedure:

- a. As cruiser approaches the tree, tally on both Plot Record (LS-69) and Defect Indicator Form, the tree number, species, d.b.h., and tree class.
- b. Examine the tree carefully and show the location of each defect indicator by placing a 2-digit code number on the proper face and height on the Defect Indicator Form. Check at bottom of diagram the face to be used for log grading.
- c. Examine the tree for log grades, using the 12-foot rule. Measure or estimate the length and top (small end) d.i.b. for the section in each grade and record graphically by horizontal line and top measurement to the right of the diagram.
- d. Indicate merchantable height to flexible 4-inch top d.i.b. on diagram by horizontal line (cubic feet). Heights to both

cubic foot and sawlog tops will be given for sawtimber trees. Also indicate height to the "local use" log top.

- e. Estimate defect as closely as feasible in each section of the tree and record the percent sound for each section in the summary section of the form.
- f. To determine gross volumes look up the volume of each section by its length and d.i.b. or for portions of these sections, if necessary. A volume table is provided on the back of the form.
- g. Compute net volume for each section and enter on the form. The net sawtimber volume in each grade divided by the total net volume and expressed in percent indicates percent of volume in each grade. Total net volume divided by total gross volume indicate soundness factor for the tree.
- h. Tally information on merchantable height, defect class and log grade (proportion in each grade) from defect indicator form to plot record.

5. Specific Gravity Study.--The Missouri Survey will cooperate with the Forest Products Laboratory and the Southern Forest Experiment Station by collection of increment cores of shortleaf pine. Cores and corresponding plot information will be sent to the Forest Products Laboratory for determining specific gravity.

The sampling and the field reports will be patterned after those used in the Arkansas survey as closely as possible. Our sample will not cover National Forest land but will be heavy enough to

GROSS VOLUME IN BOLTS OF DIFFERENT SIZES

Top d.i.b.:	Length of bolt - feet				Length of bolt - feet			
	2	4	6	8	2	4	6	8
Inches :	Peeled volume - cubic feet				Bd. ft. scale, International 1/4" Rule			
4	.2	.4	.5	.7				
5	.3	.6	.8	1				
6	.4	1	1	2				
7	.6	1	2	2				
8	.7	1	2	3	5	10	10	15
9	1	2	3	4	5	10	15	20
10	1	2	3	5	5	15	20	30
11	1	3	4	6	10	20	25	35
12	2	3	5	7	10	25	35	45
13	2	4	6	8	15	25	40	55
14	2	4	7	9	15	30	50	65
15	3	5	7	10	20	35	55	75
16	3	6	9	12	20	40	65	85
17	3	7	10	13	25	50	70	95
18	4	7	11	15	25	55	80	110
19	4	8	12	16	30	60	95	125
20	4	9	14	18	35	65	100	135
21	5	10	15	20	40	75	115	155
22	5	11	16	22	45	85	130	170
23	6	12	18	24	45	90	140	185
24	6	13	19	26	50	100	155	205
25	7	14	21	28	55	110	165	220
26	7	15	23	30	60	120	180	240
27	8	16	25	33	65	130	195	260
28	9	18	27	35	70	140	210	280
29	9	19	29	38	75	150	230	305
30	10	21	31	41	80	160	245	325
32	11	23	35	46	95	185	280	375
34	13	26	39	52	105	210	320	425
36	14	29	43	58	120	235	355	475
38	16	32	48	64	135	265	400	535
40	18	36	54	72	150	300	445	595

Gross volume in a short section of a tree may be read directly from this table. To use it properly with longer lengths, scale the log in sections measuring or estimating top d.i.b. of each section. If this is not possible, use 1-inch taper for each 8 feet of length. Example: A 20-inch, 16-foot log should scale 290 board feet, International Rule. Using two 8-foot sections with 20 and 21 inches d.i.b. we get 155 + 135 = 290 board feet.

yield the same number of samples per million acres as in Arkansas. There, two factor-of-10 points were taken at each 16th 3 X 3 mile sampling location (2 points per 92,160 acres). We will make increment borings of every pine tree 3.0 inches d.b.h. and larger on one factor-of-5 plot at each 10th point on a 3.6 X 4 mile grid. This yields one 5-factor plot per 92,160 acres or the same intensity of sample. Two increment borings will be made of each pine tree on these plots. About 250 cores should be obtained in Missouri.

Throughout the natural range of shortleaf pine in Missouri every 10th plot will be designated for the specific gravity study. On these plots each pine tree over 3.0 inches d.b.h. will be bored at d.b.h. facing plot center (core position 1) and at 90 degree clockwise from that position (core 2). Cores will be taken squarely into the tree and as nearly to the center as permitted by the length of the borer. Insofar as possible all these measurements will be made with a 10-inch small gauge (hardwood) borer.

Upon removal from the trees, cores will be trimmed with a razor blade. Cuts at right angles to the core will be made to just exclude pith (or to the deepest point reached short of the pith). On the other end it will be trimmed along the outer edge of the last complete growth ring. The core will be measured to the nearest .01 of an inch. It will then be placed in a large straw crimped at both ends. If the core is longer than 8 inches it will be broken in approximately equal parts and placed in separate straws. Each straw will be identified by printing thereon the code for county and core serial number. A single series of core numbers will be used for

each county. Sectional cores also will be labeled A (closest to heart) and B. Cores must be handled carefully to avoid breaking. Cores broken in boring will be acceptable if not badly broken.

As each core is extracted a record must be prepared for each plot (see Form 5) and core. Only the heading and left half of the form need be filled. Diameter of the core is required to .005 inch. A copy of the plot record (Form 2) will be made and stapled to Form 5. It provides the plot and tree information needed for analysis.

These records and the cores will be mailed periodically from field headquarters to the Forest Products Laboratory with letter of transmittal under dual file designation RE-CS FOREST SURVEY, Growth (Specific Gravity) and RP-PL GROWTH-CONVERSION, Quality, Specific Gravity in Forest Survey. Form 5 will be completed by the Laboratory. Then the forms will be forwarded to the Southern Forest and Range Experiment Station for computing. The Missouri Survey will not provide exactly the same information used on specific gravity study cards but does provide most if not all that is essential for this study.

6. Photo-site class study.--A general site classification will be made from aerial photos for each point stereoclassified. It will be based upon position and soil source and be coded as follows on the stereoscopic measurements form. The classification will be checked on the ground as plots are taken and coded by the same figures in the lower margin of Form LS-69. The object is to determine the effectiveness of a photo-site classification.

Upper slope

Primarily a dry site consisting of ridge tops and upper 1/3 of SE, S, SW and W, and Upper 1/3 of NW, N, NE, and E slopes. In prairie areas this will include uplands exposed to afternoon sun and westerly winds.

- | | |
|--|----------|
| Loessal soils ^{1/} | - Code 1 |
| Residual soils--
limestone or shale predominating | - Code 2 |
| Residual soils--other | - Code 3 |

Lower slope

Primarily a moist or shaded site consisting of coves, ravine bottoms and lower 1/3 of SE, S, SW, W, and lower 2/3 of NW, N, NE, and E slopes. In prairie areas this will include sheltered upland.

- | | |
|--|----------|
| Loessal soils | - Code 4 |
| Residual soils--
limestone or shale predominating | - Code 5 |
| Residual soils--other | - Code 6 |

Bottomland

Alluvial soil in strips wide enough to include an acre circular plot.

Glacial soils

On upper slopes exposed to afternoon sun and westerly winds.

- Code 8

On lower and sheltered eastern slopes.

- Code 9

^{1/} Soil source will be determined from soil maps, physiography and soils.

D. The Sample

A permanent forest plot will be taken at each sample point found to be occupied by commercial forest land. As a result of the sampling design, this will provide a grid of plots at about 4.0 X 3.6 mile intervals over the State--some 3,600 plots in all (2,603 plots taken in 1946-47). In some cases more than one plot may be taken near an intersection of this grid but plots cannot fall closer to one another than 1/4 mile. In addition about 2,700 nonforest points will be checked on the ground.

This sample will provide approximately 1 plot for each 1,635 acres of forest land in the Mississippi Bottomlands, 1 plot for each 4,550 acres in the Ozarks and Riverborder, and 1 plot for each 6,800 acres of forest land in the Prairies. For the State the average is 1 plot per 4,200 acres of forest land.

We estimate that 2-man crews in the forest areas will take 3 plots per day and 1-man crews in the Prairie areas will take 2 plots per day. Adjacent nonforest ground checks will be picked up without increasing these estimates. If this averages 1.75 plots per man-day about 9 man-years will be required for plot work.

V. DETERMINING LOCAL CUT OF TIMBER

The following timber cut plan is an attempt to utilize the most promising features of an industry, ownership, and stump count approach for determining timber drain. The periodicity and methods make possible timely and detailed information for appraising the timber cut by species, timber type, size class, forest product, and ownership on a Statewide or county basis. Four sources of data are needed to estimate the amount of timber removed from each of the Forest Survey districts and ownership groups in the State. They are as follows:

Production reports from forest industries.

Stump counts from forest inventory plots.

Cutting records from industrial and public landowners.

Utilization factors based on woods study.

A. Production Reports From Industry

The Station in cooperation with Forest Survey collaborators will make a comprehensive canvass of the heavy primary wood-using canvass in the State. The Station has at its disposal a list of names and addresses of these primary wood-using plants. Prior to the industry canvass the Station will make a point of checking the industry listings through associations and individual members of industry and personnel employed by Federal and State forestry agencies. These revised listings will be used for contacting forest industries.

All pulp, veneer, cooperage, handle, excelsior, and charcoal plants drawing logs and bolts from Missouri will be contacted. In addition, other producers and consumers of raw wood materials will be contacted such as dealers and wholesalers of utility poles and piling, mine operators, and fuelwood and fence post producers.

1. Sawmills.--An estimate of 1958 lumber production for Missouri will be obtained by using the Bureau of the Census estimate. This agency will conduct a mail canvass of a sample of mills drawn from the Census of Manufacturers mailing panel. In addition, the Bureau of the Census will select area segments equivalent in area to 15 counties in Missouri. The Station in cooperation with Farm Foresters employed by the Missouri Conservation Commission will make a field canvass of all sawmills in the selected area segments, using approved Forest Service-Census questionnaires and procedures. Information from individual sawmills will be recorded on the form entitled "Lumber Production and Stocks - Missouri 1958," Bureau of the Budget No. 40-R2914.2. The Station will furnish the Bureau of the Census the completed questionnaires as soon after July 1, 1959 as possible.

2. Pulp, veneer, and cooperage mills.--Production and cross-boundary movement of logs from these mills will be obtained from a 100 percent canvass of all plants in the Central Region. Information from the individual pulp, veneer, and cooperage mills will be obtained by mailing form "Logs, Bolts, and Cordwood Received" to each mill (see Appendix). A second mailing to nonrespondents will follow about a month after the initial contact. Field followup, where necessary, will complete the 100 percent canvass.

3. Handle and excelsior mills.--A 100 percent canvass will be made of the handle and excelsior mills drawing wood from Missouri. Information will be obtained by mailing forms "Logs, Bolts, and Cordwood Received" to each mill. Field followup of the nonrespondents will complete the 100 percent canvass.

4. Charcoal plants.--A 100 percent canvass of charcoal plants was made in 1957 for production in 1956. The volume of wood used was recorded separately by species for (a) round, split, and cull logs and (b) slabs, edgings, and other plant residue.

Questionnaires will be mailed to all plants and field followup will be made on a sample of about 25 percent of the nonrespondents. Timber product volume used for charcoal will be related to 1956 round, split, and cull log volume used for charcoal. Knowing the 1956 total volume of round, split, and cull logs for the State, an estimate of the 1958 timber cut for charcoal can be made. The "Logs, Bolts, and Cordwood Received" form will be used.

5. Round and split mine material.--Mine timbers produced in Missouri are mostly used outside the State, Illinois and Kentucky being big users. It is planned to mail questionnaires to all mines in the surrounding states that might use mine timbers cut in Missouri. A sample will be taken of nonrespondent mines from each state. The "Report on Mine Timbers Receipts" form will be used.

6. Poles and piling.--Production estimates for piling and utility poles will be obtained through contacts with each individual dealer and wholesaler handling local poles and piling. A current listing of individuals or companies who handle these items is being compiled. It appears that approximately 15 dealers and wholesalers handle most of the poles and piling produced in Missouri. Information will be obtained by mailing forms "Logs, Bolts, and Cordwood Received." Field followups, where necessary, will complete the 100 percent canvass.

7. Fuelwood and fence posts

Production of fuelwood and fence posts will be estimated from a sampling procedure based on the Revised Master Sample of Agriculture. The State will be divided into 5 districts and 4 counties will be selected in each district with probability proportional to size. Within each of the 20 counties a sample of 9 area segments will be selected at random and the cut of fuelwood, fence posts, and miscellaneous products in that segment will be obtained. It is estimated that about 1,300 respondents from a universe of about 560,000 will be canvassed using form "Production of Fuelwood, Fence Posts, and Miscellaneous Farm Timbers." Cutting on public land or on land of large industrial owners occurring in the sample segments will be excluded in this canvass. However, fuelwood and fence post cuts on public lands and large industrial holdings will be obtained by contacting these agencies or owners using the same form. From information on hand, it appears that there are 5 public agencies and 10 larger industrial owners.

8. Forecast of contacts required

Type of contact	Number of contacts by states							Total
	Illinois	Indiana	Iowa	Kentucky	Missouri	Ohio	Other ^{1/} states	
Pulp mills	8	-	3	-	1	5	13	30
Veneer plants	8	22	2	9	3	17	7	68
Cooperage plants	28	13	3	91	90	31	43	299
Excelsior	-	-	-	-	1	-	-	1
Handle plants	1	-	-	-	28	-	2	31
Charcoal plants	-	-	-	-	32	-	-	32
Mines	120	-	15	30	40	-	-	205
Pole & piling dealers	-	-	-	-	15	-	-	15
Fuelwood & fence post producers	-	-	-	-	1,800	-	-	1,800
Total	165	35	23	130	2,010	53	65	2,481

^{1/} Other than Central States.

9. Sampling accuracy.--It is estimated that in 1958 the timber cut by product in Missouri was approximately the same as in 1952 when the estimated distribution of cut was as shown below. Estimated errors for estimates of cut by product and total are also shown.

Timber product	Estimated volume of timber cut (M cu. ft.)	Estimated error of timber cut (Percent)
Lumber logs	31,916	13.9
Veneer logs	1,806	19.5
Cooperage	9,486	19.5
Pulpwood	584	13.6
Poles and piling	30	-
Fuelwood and posts	33,119	26.5
Other products	6,563	27.5
Total	83,504	12.25^{1/}

^{1/} This includes error of converting factors from production estimates to timber cut estimates and is within the allowable error for estimates of timber cut needed for Forest Survey purposes. This weighted error of estimate for total cut is, of course, less than errors of estimates for various component parts as indicated in the tabulation.

B. Stump Counts on Forest Survey Plots

Cutting information on each sample plot will be obtained at the same time tree measurements are made. Stumps of all trees cut during the 3-year period preceding inventory will be tallied as a basis for prorating some of the industry drain by counties, timber types, size class, etc. Size of stumps will be converted to d.b.h. by table giving stump and d.b.h. relationships. D.b.h. will be recorded by species and later converted to standing timber volumes.

C. Cutting Reports From Various Classes of Owners

As part of the Missouri timber cut plan the Station plans to contact all large private timberland owners and public landowners for cutting reports. These reports will show separately the quantity of rough forest products harvested from these lands in 1958. There will be less than nine contacts required to obtain the necessary information. The information will be obtained by mailing form "Report on Logging Operations, Missouri." Such reports will make possible timber cut computations for the large private and public ownerships.

D. Wood Utilization Study

All forest products data collected through industry surveys must be converted into terms of live merchantable timber. A set of conversion factors are needed to make such computations. These factors take into account logging residue, distressed wood and logs and bolts inadvertently left in the woods or lost in transit, overutilization, etc. A set of utilization factors for Missouri based on 1946 wood studies is available; however, these factors should be checked to determine if they still apply to current utilization practices.

Basic data for calculating such utilization factors will be obtained by measuring felled trees at going logging operations. The major products to be studied are lumber logs, veneer and cooperage logs, handle bolts and pulpwood. Five hundred sample felled trees will be measured to determine product volume and logging residue per standard unit of measure for each of the above forest products. It is planned that about 30 logging operations will be visited. In addition to the woods studies, 10 companies handling piling, poles, round posts, hewn ties, and other piece products will be visited. The kinds of material making up fuelwood and fence posts will be obtained during the course of a separate survey in 20 sample counties. For further information concerning wood utilization study, see "Plan for Checking the Forest Products Utilization Factors Now Available for Use in Missouri," March 12, 1959.

VI. DETERMINING MILL RESIDUES RESULTING FROM CONSUMPTION OF LOGS AND BOLTS

This survey will be made to estimate the quantity of coarse and fine mill residue resulting from the primary manufacture of logs and bolts. Survey findings will also show the disposition of plant residue such as slabs, veneer cores, trimming, sawdust, etc.

The study will be made in conjunction with the canvass of sawmills and other primary wood-using plants in Missouri. Information will be obtained through personal contact at sawmills and mailing form "Percentage Disposition of Plant Residue" to the other industries. The estimate of the total volume of plant residue will be made by applying conversion factors which were developed in special mill studies to data on log and bolt consumption.

INSTRUCTIONS--Please fill out and return one copy promptly in the enclosed envelope which requires no postage. Keep the second copy for your files. The information will be used in statistical reports on lumber production. Individual operations of reporting firms will be held confidential. A separate report should be filled out for each mill. If records are not available, please give your best estimates.

Name of operator _____ Firm name _____ Federal Social Security Identification No. _____
P. O. address _____ :Enter number as reported in item 10 on your
:latest employers quarterly tax return under
Sawmill location _____ :Federal Insurance Contribution Act, Form 941
(County) (MCD or Township) (State) _____ :This number should have nine digits.

Was this sawmill operated by you during all of 1958?

If "NO" check and complete A, B, or C below:

Yes

No

A. Operated by you during part of year.

1. Purchased by you on (date) _____ from _____
(Name and address of former operator or owner)

2. New sawmill (new equipment) started by you on (date) _____

3. Disposed of by you on (date) _____ to _____
(Name and address of buyer or lessee)

4. Went out of business (no new business or lessee) on (date) _____

B. Sawmill not operated at all during the year (but still owned by you).

C. Went out of business or sold prior to January 1, 1958.

ROUGH LUMBER, TIES, TIMBERS, ETC., SAWED DURING 1958--Report in thousands of board feet (lumber tally) all rough lumber, ties, timbers, etc. produced by this mill whether sawed for own use, sawed on contract for others, custom sawed, or sawed for sale. Do not include lumber or other products sawed on a contract basis for you or purchased from other mills. Do not include materials which are sawed one-fourth inch or less in thickness. Do not include products sawed from bolts less than six feet in length or from slabs, edgings, etc.

Kind of wood	Quantity sawed (M ft. bd. measure)	Kind of wood	Quantity sawed (M ft. bd. measure)
Hardwoods:		Softwoods:	
Ash		Cedar, eastern red	
Birch		Cypress, bald	
Cottonwood		Pine, shortleaf	
Elm		Pine, other	
Gum, black		Softwoods, other	
Gum, sweet			
Hickory, shagbark			
Hickory, other			
Maple, hard			
Maple, soft			
Oak, white			
Oaks, post			
Oak, black			
Oak, scarlet			
Oak, northern red			
Oaks, other red			
Sycamore			
Yellow poplar			
Walnut		Total softwoods:	
Hardwoods, other			
Total hardwoods:		Total all woods:	

GROSS STOCK OF LUMBER (ROUGH FINISHED, GREEN OR DRY) ON HAND--Report in thousands of board feet all stocks on hand, whether sold or unsold. Write "None" in each box if there were no stocks on hand.

Date	Softwoods (M bd. ft.)		Hardwoods (M bd. ft.)	Total (M bd. ft.)
	Southern yellow pine	Other softwoods		
Stocks on hand January 1, 1958				
Stocks on hand December 31, 1958				

This report covers only the part of the year in which you operated the sawmill from _____ to _____

(Date prepared)

(Signature and title of person furnishing information)

Name of person who can answer questions which may arise regarding this report. Telephone Number City and State

Remarks:

- 1/ All residues from this plant which go to another plant for use in manufacture of any fiber product, such as pulp, hardboard, roofing felt, etc.
- 2/ All residues used as fuel by any industrial plant, including the plant at which the residues were produced.
- 3/ Include residues used as domestic fuel whether sold or given away.
- 4/ Livestock bedding, mulch, small dimension and specialty items, etc.
- 5/ Include all residues burned as waste, etc.
- 6/ Residues suitable for chipping such as slabs, edgings and veneer cores.
- 7/ Residues not suitable for chipping such as sawdust and shavings.

Character of Residues	Total residues	For 1/ fiber products	For 2/ Industrial	For 3/ Domestic	For 4/ other use	Unused residues	From softwoods:		From hardwoods:			
							Coarse 5/	Fine 7/	Coarse 6/	Fine 7/		
							Percent	Percent	Percent	Percent	Percent	Percent
							100	100			100	100

Instructions: For plant or plants for which production is reported on the other side of this form, consider separately any of the following residues derived: coarse softwood, fine softwood, coarse hardwood, and fine hardwood residues. Enter your best estimate of the percentage of each that is used for various purposes indicated, or is not used. Entries on each line across the page should total to 100 percent in the "Total Residues" column.

PERCENTAGE DISPOSITION OF PLANT RESIDUES

INSTRUCTIONS

General.—This survey is designed to obtain by personal contact the quantity of fuelwood, fence posts, and miscellaneous farm timbers produced by the respondent within the sample segments. Include production by respondent for own use and for sale to others. Production by respondents classed as contractors should likewise be included. To avoid duplication in reporting, exclude the production of respondents hired at an hourly wage or at a price per unit produced. Show production of fuelwood in standard rough cords (128 cubic feet) and production of fence posts and miscellaneous timbers in number of pieces. Include as miscellaneous timbers, round or split material used in construction of barns, outbuildings, corrals, stock shelters, fences, hop and bean poles, etc.

Items 1, 2, and 3 are self-explanatory.

Item 4a. List production from sound live trees over 5 inches in diameter at breast height. Include production from growing stock material left following logging for other products. Show production by principal species. If this is impossible, a breakdown by softwoods and hardwoods should be obtained.

Item 4b. Includes cull trees from stump to a minimum 4.0-inch top i.b. and limbs to a 4.0-inch d.i.b. of all cull and noncull hardwoods. Cull trees are trees that never will be suitable for sawlog material because of decay, poor form, or other defect.

Item 4c. Includes standing and down trees.

Item 4d. Includes (1) upper stems of softwoods and hardwoods and limbs of hardwoods under 4.0-inches d.i.b., (2) all limbs of softwoods, and (3) trees less than 5.0-inches d.b.h. Production from these sources represents over-utilization.

Item 4e. Material from fence rows, orchards, shade trees, or trees from forested areas of less than one acre or less than 120 feet wide and noncommercial forest land.

1. Name _____ P. O. address _____
 2. Ownership: Farm Nonfarm
 3. Location: _____ County _____ P.S.U. No. _____
 4. Quantity produced from each kind of timber

Kind of timber	Fuelwood	Posts	Misc. timbers
	(cords)	(pieces)	(pieces)

a. Growing stock (over 5 in. d.b.h.)			
b. Cull trees and limbs over 4 inches d.l.b.			
c. Dead trees			
d. Upper stems and limbs under 4 inches d.l.b. and trees under 5 inches d.b.h.			
e. Trees from noncommercial and nonforest land			
f. Total (4a to 4e)			
5. Proportion of products in (4a) cut from:			
a. Sawtimber trees	%	%	%
b. Polelimber trees	%	%	%
6. Dimension of average piece from growing stock:			
Length	ft.	ft.	ft.
Top d.l.b.	in.	in.	in.
Butt d.l.b.	in.	in.	in.
7. Sawmill residue used	xxxxxx	xxxxxx	xxxxxx

(Date) _____ (Recorder) _____

See reverse side for instructions.

REPORT ON LOGGING OPERATIONS, MISSOURI

Area _____ Year _____

Name _____ Total acreage owned _____
 Business address _____ Timbered area _____
 Class of owner _____ Cultivated area _____
 Open pasture land _____

A. ROUGH FOREST PRODUCTS USUALLY MEASURED IN BOARD FEET

Species	Lumber	Veneer	Cooperage	Pulpwood	Cabin	Mine
	: logs	: logs	: logs	: logs	: logs	: timbers
	Thousand board feet					
Softwoods						
Cedar, red						
Cypress, bald						
Pine, shortleaf						
Hardwoods						
Ash						
Birch						
Cottonwood						
Elm						
Gum						
Hickory						
Maple						
Oak, white						
Oak, post						
Oaks, red						
Sycamore						
Yellow poplar						
Walnut						
Hardwoods, other						
All species						

B. ROUGH FOREST PRODUCTS USUALLY MEASURED IN CORDS

Species	Box	Handle	Veneer	Cooperage	Pulp-	Fuel-	Charcoal	Excel-
	: bolts	: bolts	: bolts	: bolts	: wood	: wood	: wood	: sior
	Standard cords (unpeeled)							
Softwoods								
Cedar, red								
Cypress, bald								
Pine, shortleaf								
Hardwoods								
Ash								
Birch								
Cottonwood								
Elm								
Gum								
Hickory								
Maple								
Oak, white								
Oak, post								
Oaks, red								
Sycamore								
Yellow poplar								
Walnut								
Hardwoods, other								
Mill residue								
All species								

(Over)

C. ROUGH FOREST PRODUCTS USUALLY MEASURED IN PIECES

Species	Posts	Poles	Piling	:R,R.Tie: Hewn :		:Christmas
				bolts	tie	
				Pieces		
Softwoods						
Cedar, red						
Cypress, bald						
Pine, shortleaf						
Hardwoods						
Ash						
Birch						
Cottonwood						
Elm						
Gum						
Hickory						
Maple						
Oak, white						
Oak, post						
Oaks, red						
Sycamore						
Yellow poplar						
Walnut						
Hardwoods, other						
Mill residue						
All species						

INSTRUCTIONS FOR FILLING OUT FORM

Recording the forest products data:

The information being collected on this form is to determine the total quantities of various forest products harvested from the above described lands during the past year. Therefore, be sure to:

1. Record all cutting that was effected on the above lands by owner and others.
2. Record only the products cut from the above described lands. Do not include products cut from other private lands, state lands, county lands, national forests, etc.

Upper left-hand corner of form:

Name: Enter name of owner, renter or leasee "farming" the land.

Business address: Enter address where logging data can be obtained for future reports.

Class of owners: Enter class of ownership, such as:

- (a) Farmer
- (b) Small owner other than farmer (resort owner, etc.)
- (c) Industrial land being held or managed primarily for forest products.
- (d) Public (U. S. Forest Service, State, County, etc.)

Upper right-hand corner of form:

Total acreage owned: Enter total acreage of property owned in study area by owner.

Timbered area: Enter acres of timbered area. In case of farmer, include wooded pasture land with other timbered area.

Cultivated area: Enter acres of land under cultivation.

Open pasture land: Enter acres of open pasture land.

VII. FORM CLASS STUDY

A study of form class in the Ozark and Riverborder Districts is necessary in order to provide good species factors for use with a composite volume table. This is set up as a special job primarily so that the information will be available for computing data from the first unit without undue delay. A 1-month study for a 2-man crew has been designed. Forty points have been laid out on a state highway map at 31-mile intervals in each direction. At each point a string of variable size plots will be taken near the road and form class of each sawtimber-size tree on these plots will be measured with aid of a light extension ladder. One-half crew-day (including travel time) will be spent at each point. Eight hundred trees will be measured at a cost of about \$1.50 each.

The crew will drive to that location on a mapped highway nearest to the desired point. It will select the nearest pole or sawtimber stand (not close to dwellings) at this location or along the route of travel. In case of an indisposed owner, take the next suitable stand. A course of travel through this stand and across the topography will be selected. The first variable size plot (factor of 5) will be taken two chains within the stand and others at two-chain intervals thereafter. Transition zones will be sampled but no plot will straddle two contrasting map types. The course may turn or another course in a nearby stand may be taken, if necessary to get in a half day's measurements at a location.

Merchantable sawlog height and 17.3 feet above ground level will be measured by a telescopic pole for each sawtimber-size tree of tree class 1, 2, 3, or 4 on the plot. The d.b.h. or 17.3 foot points may be

raised or lowered somewhat to prevent measurement at a deformity. Each plot will be classified as to type, size and density and one or more site trees will be measured for age and total height in each stand. If done, the other point should be adjusted accordingly. Omit entirely the measurement of any tree which is not suitable for form class study. D.b.h. and d.o.b. at 17.3 feet will be measured by diameter tape to the closest 0.1 inch. Bark thickness will be measured at d.b.h. and at 17.3 feet with a Swedish Bark Gauge to the closest 0.05 inch (average of 2 measurements). The measurements will be recorded by species on Survey Form No. 7. Form class (the ratio of d.i.b. at 17.3 feet to d.o.b. at breast height) will be computed to 2 decimal places.

The ladder will be held during ascent and descent. A safety belt must be used by the person taking measurements at 17.3 feet.

VIII. GENERALIZED TYPE MAPPING

Some revision is necessary of the "General Forest Types, Missouri, 1947," which was published in Research Bulletin No. 452. The type boundaries on this map will be copied carefully onto several recent official Missouri highway maps. These will be cut into sections for ease of handling. Each crew leader will be provided with a section covering the area he is working. He will check type boundaries as he travels through the area and make any necessary revisions on the sections. Later they will be used to compile a general forest type map for 1959.

The following types will be shown in Missouri if they predominate on 36 square miles having 10 percent or more in forest land or form stringers (as along river bottoms) one-half mile wide:

Loblolly-shortleaf pine
Oak pine
Oak-hickory
Oak-gum-cypress
Elm-ash-cottonwood
Maple-beech-birch
Aspen-birch
Unproductive forest land

Areas of reserved land 40 acres or larger will be shown by cross-hatching and name in addition to type of forest cover.

IX. COMPUTATIONS

The field data will be coded for machine computing on the plot record sheet from which one set of cards will be key punched. The information to be shown on the card is indicated by column numbers on the following sheet. Cards will be reproduced as necessary for computing purposes.

This section will be expanded after the computing plan has been worked out in detail and tested.

GUIDE FOR PUNCHING IBM CARD FROM FORM LS-69

<u>Item</u>	<u>Column No.</u>	<u>Item</u>	<u>Column No.</u>
County #	1-3	Sev. of cut	-
Flight #	4,5	Cut recomm.	35
Photo #	6-8	Ownership	36
Point #	9,10	Plot #	37-39
Photo point cl.	11	Tree #	40,41
Photo height	12,13	Species	42,43
Crown dia.	14,15	D.b.h.	44-46
Crown den.	16,17	Tree class	47
Photo class	18,19	Cut or leave	48
Point BA/A	20-22	Merchant. ht.	
Ground class	23,24	4" top	49,50
		6" or 8" top	51,52
Ground point cl.	25	Defect class	
Regeneration	26	Total vol.	53,54
		Bd. ft. vol.	55,56
Watershed #	-	Log grade I	57
Aspect	27	" " II	58
		" " III	59
		" " T&T	60
Position	28	Mort. class	61
Slope	29	Age	62,63
Litter depth	-	Total height	64,65
Month	-	Sample tree cl.	66
Duff depth	-	Radius	
Humus depth	-	10 yr.	67-69
		20 yr.	70-72
Humus type	-	Bark thickness	73-75
Grazing	30	Dia. at 17 ft.	-
Use trend	31	Stump dia.	76-78
Stand age	32,33	District	79
Site	34	State	80
Since cut	-		

APPENDIX I

Definitions and Codes

A. Land Classes

Land area

Dry land and land temporarily or partially covered with water, including streams less than 1/8 mile in width and ponds less than 40 acres in area. County figures are from "areas of the United States, 1950 Bureau of Census."

Forest land.--Rural lands are: (a) Areas at least 10 percent stocked with forest tree species and capable of producing timber or other wood products, or of exerting an influence on the climate or on the water regime. (b) Land from which the trees described in (a) have been removed to less than 10 percent stocking and which has not been developed for other use. (c) Afforested areas.

Explanation: Does not include orchard land. Includes unimproved, open grazing lands if at least 10 percent stocked with trees (merchantable, cull, and noncommercial).

The minimum size area that will qualify as forest land is 1 acre. Wooded strips must be at least 120 feet wide to qualify as forest land. Conversely, clearings, streams, treeless strips, and unimproved roads less than 1 acre in extent or less than 120 feet in width within forest areas will be classified as forest land.

G. Land Use Trend

Changes in land use can largely be judged in the aggregate by comparison of statistics from two surveys. However, the causes of such changes are difficult to determine without more specific data. The following was developed to indicate specific trends.

<u>Code</u>	<u>Trend</u>
0	No change since last survey.
1	Grazing use--nonforest land or forest land less than 25 percent stocked with commercial tree species, used for grazing now and likely to be maintained for grazing. Fencing not necessary but a maintained fence is indicative of grazing use. Heavy grazing is considered necessary to maintain grazing on lands over 10 percent stocked with forest trees. (Used in E. Ozarks and Mississippi Bottomlands)
1	Improved pastureland over 10 percent stocked with commercial tree species and likely to be maintained for grazing. (Used in other districts.)
2	Changing to nonforest for grazing. (Clearing for grazing was used in E. Ozarks and Mississippi Bottomlands.)
3	Changing to nonforest--clearing land for cultivation.
4	" " " --by urbanization.
5	" " " --by mining.
6	" " " --by other.
7	Changing to forest (land with less than 10 percent forest which had been developed for other use and is now reverting).

H. Stand Age

The average age of the main stand will be recorded to the closest year up to 99. If over 99 years, the age will be shown as 99. Age will include the time required to grow to breast height where the increment boring is taken. Code nonstocked areas as 0; leave blank if age cannot be given.

I. Site Quality

Each acre plot on forest land will be classified as to the forest site for the type involved. The average number of logs produced by mature dominant trees will be the primary basis of site determinations on the ground. (View with caution culls and old stand remnants which may be poor indicators of true site quality.)

Mature dominant trees quite often will not be present for making the site class determination. In small sawtimber stands or poletimber stands, judgment of the log site class should be based on the number of logs capable of being produced by a dominant tree on the site, rather than being based on the number of actual logs in a dominant tree at the present time. Dominant trees on adjacent acres of comparable site may be used when no sawtimber or poletimber trees are present on the sample acre.

When sawtimber or poletimber trees are present on the sample acre or adjacent area of comparable site, use the following table to indicate site class:

Site class	16' log lengths ^{1/} mature trees			Generalized site conditions
	Hardwoods	Pine	Cedar	
0 ^{2/}	½ or less	½ or less	½ or less	Usually found on ridge tops, poorly drained uplands, and dry south slopes. Soil is thin and rock outcroppings are frequent.
1	1 - 1½	1 - 2½	1	Usually found on south and west slopes, upper parts of ridges, and on dry flats.
2	2 - 2½	3 - 3½	1½	Usually found on north and west slopes and moist flats and bottoms.
3	3 - 3½	4 - 4½	2	Usually found in coves and bottomlands.
4	4+	5+	2½+	

^{1/} Including local use logs.

^{2/} Site 0 is considered unproductive and noncommercial.

When neither sawtimber nor poletimber are available on the sample acre or adjacent acres of comparable site, site class will be estimated from soil and moisture conditions, topography, exposure and appearance of existing vegetation. Use the following as a guide to indicate site class from values for aspect, position, and soil.

Site Rating Factors for Missouri

Aspect	Classification	Value	Topographic position	Classification	Value	Soil depth - A horizon	Classification	Value
	(1)	(2)	(3)	(4)	(5)	(6)		(6)
N through NE or bottomland		4	Better ^{1/} bottoms	6	Very deep 12" +	5		
E or NW		3	Lower slope or rolling to level	5	Deep 8-12"	4		
SE or W		2	Poorer bottoms	4	Moderate 3-8"	3		
S through SW		1	Upper slope	3	Shallow 1-3"	2		
			Better ^{1/} ridges	2	Very shallow 0-1"	1		
			Poorer ridges	1				

^{1/} Meaning more fertile for forest growth than "poorer" areas.

- Steps:
1. Rate physical features of the site using above table.
 2. Total the values of columns 2, 4, and 6. This total will be the point rating.
 3. Compare point rating with the point range below and read indicated site.

Point range	:	3-5	:	6-8	:	9-11	:	12-13	:	14-15
Indicated site	:	0+	:	1	:	2	:	3	:	4

In addition, age and total height of at least one sample dominant or co-dominant tree will be measured on or near the plot for site determination. These measurements will be used in a supplemental office study to determine site indexes for the various species. The site indexes may be later compared to the log site classes. When possible, use the following species as indicators of site class for the corresponding type:

Forest type	Indicator species
Pine or oak-pine	Shortleaf pine
Oak types	Black oak White oak Post oak
Maple-beech	Hard maple
Cedar or cedar-hardwood	Eastern redcedar
Bottomland types	American elm Cottonwood Black gum

Age will be determined by increment boring at breast height and then corrected for age at stump by adding 5 years to the age at d.b.h. This will apply for all species.

J. Allowable Cut

Allowable cut is the amount of merchantable timber that may be cut annually during the current decade while (a) progressively effecting a reasonably even distribution of age classes during the optimum rotation selected for each type, and (b) progressively building up to a desirable level of good growing stock to meet the future needs for desired products. The cut should be at a level which can be sustained in subsequent decades.

The allowable cut will be computed by two methods: (a) formula, and (b) field recommendations. These will then be studied from various angles and an allowable cut estimate evolved.

The Lake States Forest Survey Handbook provides a general guide for this work. Operability will not be used in Missouri where all timber is considered operable. Field recommendations will follow silvicultural marking guides developed in Missouri insofar as possible. They will be used in conjunction with tree grades to provide an estimate of a silviculturally desirable cut. However, no cutting will be recommended unless the stand is capable of yielding at least 3 cords or 500 board-feet of sawtimber per acre.

Each acre sample will be coded on Form 2 as:

<u>Code</u>	<u>Item</u>
0	No cut recommended.
1	Urgent cut; 1st decade; to free crop trees, prevent loss of growth, or salvage volume about to be lost.
2	Delayed cut--can wait for 2nd decade.

Each tree on the sample plot will be tallied as "cut" or "leave":

<u>Code</u>	<u>Item</u>
0	Leave
1	Cut

Management guides for shortleaf pine and pine-oak stands
Missouri National Forest, 1958^{3/}

<u>Type</u>	<u>Stand Condition</u>	<u>Cutting Prescription</u>
(1) Pine	Pine stands over 70-80 years old with more than 70 sq. ft. of basal area per acre.	Reduce basal area to 40-50 sq. ft. for regeneration cut. On subsequent cuttings if reproduction is established leave 3-4 seed trees and cut the remaining stand.
(2) Pine	Pine sawtimber (45-70 years old) and pole stands (20-45 years of age) supporting more than 70 sq. ft. of basal area per acre.	Remove all hardwoods and reduce basal area of pine crop trees to 70 sq. ft. per acre. Deaden inferior hardwoods with recommended TSI practices.
(3) Pine	Pine pole and sawtimber stands with less than 70 sq. ft. of growing stock per acre.	Remove all merchantable hardwoods and thin dense pine groups to 70 sq. ft. per acre. Remove inferior hardwoods with standard TSI practices.
(4) Pine	Seedling and sapling stands.	Treat with recommended TSI practices.
(5) Pine-Oak	Stands overstocked with inferior hardwoods but understocked with pine. (Pine seed trees present in the overstory stand.)	Remove all inferior hardwoods that are interfering with the growth of pine crop trees and provide openings for regeneration to pine. Thin dense pine groups to 70 sq. ft. of basal area.
(6) Pine-Oak	Stands with an understory of pine reproduction of 150 or more trees per acre. (Seed trees present or absent.)	Eliminate hardwoods especially in openings created for regeneration purposes. Remove overstory hardwoods, and treat the residual hardwood stand with the standard TSI practices.

^{3/} Fieldmen should refer to the complete management guides.

Management Guides - Northern Hardwood Type^{4/}

<u>Stand condition</u>	<u>Stand description before cutting</u>	<u>Recommended treatment</u>
1. Fully regulated.	All elements of structure stocked in excess of recommendations.	Harvest mature timber. Reduce stocking of timber (10"+) to 70 square feet of basal area per acre, poles to 15 square feet, and saplings to 10 square feet.
2. Overstocked with sawtimber but understocked with smaller timber.	Stand is parklike and free of "underbrush." Abundant small reproduction may be present. Commonly found in virgin stands.	Reduce dominant sawtimber portion of stand to 70 square feet of basal area per acre. Remove poles that will not produce high-quality timber in the future.
3. Understocked with sawtimber but overstocked with smaller timber.	Most commonly found in second-growth stands. Stand has even-aged appearance.	Reduce stand to 85 square feet of basal area in poles and sawtimber together. Remove cull and defective overstory trees. Cut only poor growing stock in overstory. After defective overstory trees have been removed, reduce stand to desired stocking by cutting in pole-sized portion of stand. If no sawtimber is present, reduce poles to 75 to 85 square feet of basal area per acre.
4. Understocked throughout entire structure.	Open, brushy stands. Grass, sod, or raspberries and other brush species predominant in under-story.	No cutting recommended.

^{4/} Refer to complete "Marking Guides" for northern hardwoods, by Carl Arbogast, Lake States Forest Experiment Station Paper No. 56.

Management Guides - Bottomland Hardwood Type^{5/}

<u>Stand class</u>	<u>Nature of stand and products</u>	<u>Cutting objectives</u>
1. <u>Sawtimber</u>		
a. 50 percent or more of the volume in trees 23 inches d.b.h. and larger.		
Adequate supporting stand.	Large trees--mostly residual old growth; overstory often seriously obstructing promising second growth. Factory logs of many sizes but mostly of medium to poor quality.	Harvest, salvage, stand improvement, release.
Same as above, but inadequate supporting stand.	Sawtimber overstory usually in very poor condition from same causes that damaged or eliminated understory. Products largely factory logs of good size but medium to poor quality; also considerable tie-and-timber logs. Species composition often poor.	Harvest, salvage, stand improvement.
b. Less than 50 percent of the volume in trees 23 inches d.b.h. and larger. Supporting stand will be present.	If undamaged, fair chance of sustained yield after first cut. Factory logs medium to poor in size and quality and often only a small majority of total. Tie-and-timber log volume large, sometimes good deal of bolt stock and pulpwood.	Stand improvement, release, occasional salvage.
2. <u>Heavy pole stand</u>		
More than 175 trees per acre 5 to 11 inches d.b.h.	Stands are mainly even-aged. Excellent chance of early formal management if not seriously damaged. Products almost entirely pulpwood and chemical wood, rarely piling or low-grade local-use sawlogs.	Thinning and stand improvement; occasional salvage.

^{5/} Refer to complete report on "Management of Bottomland Hardwoods" by John A. Putnam, Southern Forest Experiment Station, Occasional Paper 116, March 1951.

<u>Stand class</u>	<u>Nature of stand and products</u>	<u>Cutting objectives</u>	
<p>3. <u>Light pole stand</u> Less than 175 trees per acre 5 to 11 inches d.b.h.</p>	<p>One of commonest conditions. Products mainly low-grade cordwood and posts, occas- ionally traces of low-grade, local-use sawlogs.</p>	<p>Mainly stand improvement and release; occas- ional salvage.</p>	
<p>With supporting stand of saplings.</p>	<p>Same as above.</p>	<p>Stand improvement, occasional salvage.</p>	
<p>Without supporting stand of saplings.</p>	<p>4. <u>Saplings and seedlings</u> At least 250 trees per acre.</p>	<p>Low-grade cordwood, traces of sawtimber, largely low- grade, local-use logs. Total too light for commer- cial operation.</p>	<p>Release and stand improvement.</p>
<p>5. <u>Nonstocked</u> All potentially productive conditions.</p>	<p>No produce, except perhaps a little low-grade, local- use material.</p>	<p>Elimination of undesirable seed source and clear- ing as site preparation.</p>	

Management Guides - Eastern Redcedar^{6/}

<u>Site class</u>	<u>Size class</u>	<u>Stand condition</u>	<u>Prescription</u>
1	Sawlogs and poles	80 years or older. BA over 40 sq. ft., well-stocked.	Regeneration cut. Leave seed trees and harvest all other merchantable trees. TSI residual hardwoods.
1	Sawlogs and poles	60 to 80 years old. BA over 40 sq. ft., well-stocked.	Regeneration cut. Leave 30 sq. ft. of crop trees. TSI residual hardwoods.
1 & 2	Sawlogs and poles	30 to 60 years old. BA over 40 sq. ft., well-stocked.	Intermediate cut. Leave 40 to 50 sq. ft. of crop trees. TSI residual hardwoods.
1 & 2	Sawlogs and poles	60 to 80 years old. BA less than 40 sq. ft., poorly stocked. Reproduction present.	Harvest cut. Leave 10 to 20 sq. ft. of seed trees. TSI residual hardwoods.
1 & 2	Sawlogs and poles	30 to 60 years old. BA less than 40 sq. ft., poorly stocked.	Intermediate cut. Leave all growers and ciphers. TSI residual hardwoods.
0	Sawlogs and poles	All aged. BA less than 40 sq. ft., poorly stocked to open.	Clear cut all merchantable trees. TSI residual hardwoods overtopping cedar reproduction only.
0 & 1	Seedling and sapling	Less than 30 years old. 300 or more stems per acre, medium stocked.	Harvest mature timber and clean to a 6' x 6' spacing of crop trees.

^{6/} Refer to complete guides "Eastern redcedar and hardwood-eastern redcedar timber types" by Sluzalis and Schirck, 1958.

(Management Guides - Con't.)

Hardwood - Redcedar

<u>Site class</u>	<u>Size class</u>	<u>Stand condition</u>	<u>Prescription</u>
2+	Sawlogs	80 to 90 years old. BA of 10+ sq. ft. of redcedar, well-stocked.	Regeneration cut. Equal consideration of all species. TSI residual stand.
2+	Sawlogs and poles	40 to 80 years old. BA of 10+ sq. ft. of redcedar, well-stocked.	Intermediate cut. Equal consideration of all species. TSI residual stand.

Post Oak - Blackjack Oak

0 & 1	All	Any age. Any BA. Any stocking.	Convert to redcedar by seeding or planting. Remove hardwoods by most practical method, either sales or TSI.
-------	-----	--------------------------------------	---

Temporary Management Guides (Other)

As a general guide intermediate cuts in hardwood sawtimber stands for which specific basal area levels are missing should reduce the basal area (of trees 1" + d.b.h.) to 70 square feet; of poletimber stands to 60 square feet; and of large sapling stands to 50 square feet. The stands may be cut to lower levels if necessary to salvage trees, thin clumps or otherwise improve the stand.

Temporary Management Guide^{5/} for Oak Stands in Missouri.

Improvement and salvage cuttings are especially needed in the merchantable stands because of the decadent residual trees and poor form and quality of many of the second growth trees. Cutting should guide upon the condition, species, position and space occupied, site and cutting cycle.

The general aims are to remove defective and poorly formed trees and build up a growing stock of better species suitable to the site and well spaced.

The cutting cycle in the better stands will be based on the ability of the residual stand to at least replace the volume cut during the period of 10 or not to exceed 15 years, while in poor quality stands the cutting cycle may be increased.

Species to favor will vary with site quality.

	<u>BEST</u>	<u>INTERMEDIATE</u>	<u>POOREST</u>
Site I	(The best) Walnut Basswood Yellow poplar Black cherry Shumard red oak White oak Bur oak Northern red oak Shagbark hickory Cottonwood Sycamore Pine	Pin oak Sugar maple Hackberry Chinquapin oak Red gum Bitternut hickory Mulberry	Plane tree Slippery elm White elm Buckeye
Site II	White oak Northern red oak Southern red oak Black oak Scarlet oak Walnut	Black gum Ash Mockernut hickory Pine	Sugar maple Elm Post oak
Site III	Pine White oak Black oak Scarlet oak Northern red oak Southern red oak	Hickories Black gum	Winged elm Black jack oak Chinquapin oak
Site IV	Pine Black oak Scarlet oak	Post oak White oak	Black jack oak Hickory

K. Ownership

The ownership of each permanent point which is on commercial forest land will be looked up in the county courthouse unless it can be ascertained in the field. The following classification will be used:

<u>Code</u>	<u>Item</u>
0	National forest and related lands. Federal lands which have been designated by Executive Order or Statute as national forests or purchase units and other lands under the administration of the Forest Service.
1	Bureau of Land Management.
2	Indian. Indian tribal lands held in fee by the Federal Government, but administered for Indian tribal groups and Indian trust allotments.
3	Other Federal.
4	State. Lands owned by states or leased by the state for more than 50 years.
5	County.
6	Municipal and school.
7	Forest industry. Lands owned by companies or individuals operating wood-using plants. Indicate pulp companies by P., lumber producers by L., and other wood-using plants by O.

Code Item

- 8 **Farmer-owned lands.** Lands owned by operators of farms. A farm operator is a person who operates a farm by performing the labor or directly supervising it. A farm is a place of 3 or more acres with an annual value of agricultural products (exclusive of home-garden products) amounting to \$150 or more. Lands leased from nonfarm owners are excluded. When an owner qualifies as both farmer and forest industry the ownership should be classed the latter if of significant commercial importance (intermittently operated farm sawmills would not meet this criterion).
- 9 **Miscellaneous private lands.** Privately owned lands other than forest industry or farmer-owned lands.

In addition to the above classification, show size of forest land for all privately owned lands.

a -	0 -	99	acres
b -	100 -	499	"
c -	500 -	4,999	"
d -	5,000 -	49,999	"
e -	50,000+		acres

The alphabetical codes will not be put on punch cards. They will be analyzed by hand methods.

L. Species

Code Item
Softwoods

- 01 - Shortleaf pine
- 07 Bald cypress
- 08 Eastern redcedar
- 09 Other softwoods

Hard Hardwoods

- 10 White oak
- 11 Swamp chestnut oak
- 12 Swamp white oak
- 13 Bur oak
- 14 Post oak
- 15 Overcup oak
- 16 Chinquapin oak
- 17 Nuttal oak
- 20 N. red oak
- 21 Swamp red (cherry bark) oak
- 22 Black oak
- 23 Scarlet oak
- 24 Black jack oak
- 25 Pin oak
- 26 Willow oak
- 27 Water oak
- 28 Shingle oak
- 29 Shumard oak
- 30 River birch
- 31 White birch
- 32 Black birch
- 33 Sugar maple
- 34 Beech
- 35 Rock elm
- 36 White ash
- 37 Red ash
- 38 Green ash
- 39 Blue ash
- 40 Shagbark hickory
- 41 Mockernut hickory
- 42 Shellbark hickory
- 43 Pignut hickory
- 44 Water hickory
- 45 Pecan
- 46 Bitternut hickory
- 47 False Pignut hickory
- 48 Southern red oak
- 49 Black hickory
- 50 Black walnut
- 51 Honey locust
- 52 Black locust
- 53 Red mulberry
- 54 Persimmon
- 55 Osage orange
- 56 Dogwood
- 57 Yellow-wood
- 58 Pumpkin ash
- 59 Other hard hardwoods

Code Item
Soft Hardwoods

- 60 Silver maple
- 61 Red maple
- 62 Boxelder
- 63 Black cherry
- 64 Hackberry and sugarberry
- 65 American elm
- 66 Slippery elm
- 67 Winged elm
- 68 Chinese elm
- 69 Black ash
- 70 Cottonwood
- 71 Aspen
- 72 Willow
- 73 Basswood
- 74 Butternut
- 80 Sycamore
- 82 Kentucky coffee tree
- 83 Catalpa
- 84 Yellow poplar
- 85 Sweet gum
- 86 Black gum
- 87 Buckeye
- 88 Magnolia
- 89 Other soft hardwoods

Noncommercial

- 90 Sassafras
- 91 Holly
- 92 Alder
- 93 Blue beech (musclewood)
- 94 Ironwood
- 95 Chinquapin
- 96 Choke cherry
- 97 Red bud
- 98 Service berry
- 99 Other noncommercial
- Sandbar willow
- Hawthorne
- Paw Paw
- Plum

M. D.b.h.

Diameter breast height normally will be measured with a diameter tape carefully and tautly stretched in a horizontal plane around the tree trunk at $4\frac{1}{2}$ feet above average ground level. Previous to measurement all moss or bark likely to break off during measurement or check measurement should be removed by hand. On slopes, d.b.h. will be measured $4\frac{1}{2}$ feet above the ground on the uphill side of the tree. On leaning trees d.b.h. will be taken at right angles to the lean $4\frac{1}{2}$ feet along the upper side. In case of irregularities at d.b.h. (swellings, bumps, depressions, branches, etc.) diameter will be measured immediately above the irregularity at the place where it ceases to affect the normal stem form. If the stem forks immediately above d.b.h., measure diameter below the swell at the place where the fork ceases to affect the normal shape. When the stem forks below d.b.h. consider the tree as two trees and measure diameter at a point $3\frac{1}{2}$ feet above the likely cutting point above the fork. Indicate the point of measurement on side of the tree facing plot center with a (usually horizontal) paint line.

Code d.b.h. to nearest 0.1 inch; 15.8 inches will be coded 158. If the tree has been cut, leave this space blank and enter stump diameter at the bottom of Form LS-69.

N. Tree Class

Code Status and condition

0 Poor saplings and poles.--Nongrowing stock; saplings unlikely to produce merchantable poles and poletimber unlikely to produce merchantable sawtimber. Trees for which poletimber volume should be figured but sawtimber growth is not desired. Should be removed in harvest or intermediate cuts when possible.

1 Crop tree.--A growing stock tree which meets the following specifications:

Risk and vigor--likely to survive 20 years, vigorous.

Position and crown--dominant and codominant trees with crowns more than one-third filled with good foliage. (Lake States Tree Classes 1, 2, and 3 with a or b crowns.) This classification may include pine and redcedar potential crop trees in the understory though overtopped by hardwoods.

Species--most desirable species for the site.

Form and soundness--good form and less than 10 percent defect. Capable of good growth in diameter and capable of reaching the average merchantable height for the site.

Log grade--butt log of grade 2 or better potential.

Location--not closer to a better crop tree than 1.8 times the d.b.h. (expressed in feet) of that tree. (1.8 x 10" tree = 18 ft. growing space required for a better 10" crop tree.)

Code

Status and condition

2

Good storage tree.--A growing stock tree which does not meet all the specifications for crop tree but does meet the following:

Risk--likely to survive 10 years.

Position and crown--codominant and intermediate trees.

(Lake States Tree Classes 1, 2, or 3, and 4a and b, and 5a.) Generally better than competing trees though it may provide shelter or be a trainer for a better tree.

Form and soundness--no bad forks or excessive limbiness.

Not over 10 percent rotten or 20 percent total defect. Tree may be capable of good growth only in diameter.

Location--may be closer than 1.8 times the d.b.h. (expressed in feet) of a crop tree if it is not over-topping a potential crop tree. These are slower growing trees, relatively sound but of low quality or less desirable species for the site. They are suitable for "leave" trees.

Tally all good saplings of commercial species here.

- | <u>Code</u> | <u>Status and condition</u> |
|-------------|--|
| 3 | <p><u>Poor storage tree.</u>--A growing stock tree which does not meet all the specifications for a good storage tree but which does meet the following:</p> <p>Risk--likely to survive 10 years.</p> <p>Position and crown--same as for a good storage tree.</p> <p>Soundness--not over 30 percent defective.</p> <p>Location--may be overtopping a potential crop tree.</p> <p>These trees are poor growers, low quality, defective, of an undesired species for the site or competing with a better tree. They would usually be marked "cut" in harvest or intermediate cuts, but may be left if desired.</p> |
| 4 | <p><u>Undesirable tree.</u>--A growing stock tree which does not meet the specifications for codes 1, 2, or 3. The trees in this class should normally be marked for harvest or intermediate cutting (unless needed for seed, shade, or as trainers). Includes Lake States Tree Class 0, 4c, 5b and c, and 6a, b and c.</p> |
| 5 | <p><u>Sound cull.</u>--Nongrowing stock. Fifty percent or more of the gross volume defective and less than half of the defect due to rot.</p> |
| 6 | <p><u>Rotten cull.</u>--Nongrowing stock. Fifty percent or more of the gross volume defective and more than half of the defect due to rot.</p> |
| 7 | <p><u>Noncommercial species.</u>--Nongrowing stock.</p> |

Code Status and condition

8 Dead trees.--In this round of the survey tally all trees which have died in the last 3 years. In the next round, tally all trees which died between surveys. Add X after Code 8 if tree is salvable.

9 Stump.--Trees cut by man. Cut within the last 3 years. Tally all stumps with diameter outside bark of 5.0 inches or more. Tally stump diameter on variable plot in d.b.h. column.

O. Cut or Leave

Each tree tallied on the plot will be recorded as "cut" or "leave" after considering the cutting recommendation for the stand, the tree class and silvicultural requirements. Leave trees will be coded "0" and cut trees "1".

P. Merchantable Height

Timber volumes will be estimated using composite volume tables and measurements of d.b.h. and merchantable height from sample trees. The tables are made for use with merchantable height measurements to flexible tops with a minimum 4 inches for total volume, 6 inches for sawtimber volume of softwood trees and 8 inches for sawtimber volume of hardwood trees.

Merchantable height is the distance from stump (generally about 6 inches above average ground level) to that point where the stem or main fork reaches the minimum diameter inside bark, or becomes unmerchantable for other reasons (fork, excessive limbiness, rot, etc.).

The defect factor will be adjusted to deduct for intervening cull sections as well as defect in merchantable sections. To be classed as merchantable, a section must be at least 8 feet long.

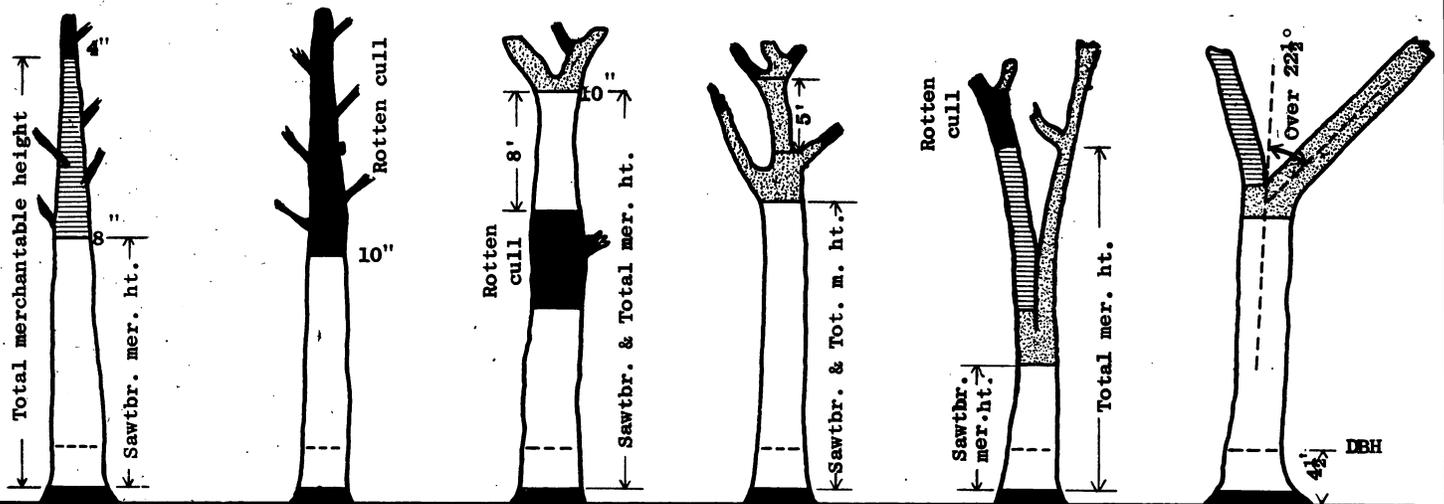
Net volume will be determined for the sawlog portion of the tree in board feet, International 1/4-inch Rule; and for all merchantable material in the main stem of the tree in cubic feet or cords. The net volume of hardwood limbs will be computed by use of conversion factors. Division of the sawtimber-size tree into component parts is illustrated for hardwoods by the following chart.

Material must be sufficiently straight and sound to make merchantable pulpwood now or merchantable sawlogs now or prospectively; thus, sawlogs must be of grade 3 or tie and timber quality or potential, and pulpwood must be relatively straight (a straight line through the center of each end will not fall outside the periphery of the stick inside bark) at least 50 percent sound and with knots or whorls of knots (within a 6-inch distance) not exceeding one-third of the stem diameter at the point of occurrence. Local use material is not included.

In the sawtimber-size tree that section of the bole between stump or butt-off and the uppermost usable sawlog or tie and timber log is called the sawlog portion or lower stem. The upper stem is that portion (at least 8 feet long) of the main stem of a sawtimber tree from the merchantable top of the lower stem to a point where it is limited by branches, deformity, rot, or a minimum top diameter of 4 inches, d.i.b. The upper stem or any portion of it should not depart more than one-fourth of a 90-degree arc ($22\frac{1}{2}$ degrees) from the general course of the lower stem (short abrupt

MERCHANTABILITY IN HARDWOOD SAWTIMBER TREES

Sawlog section
 Upper stem
 Limbs
 Waste



A

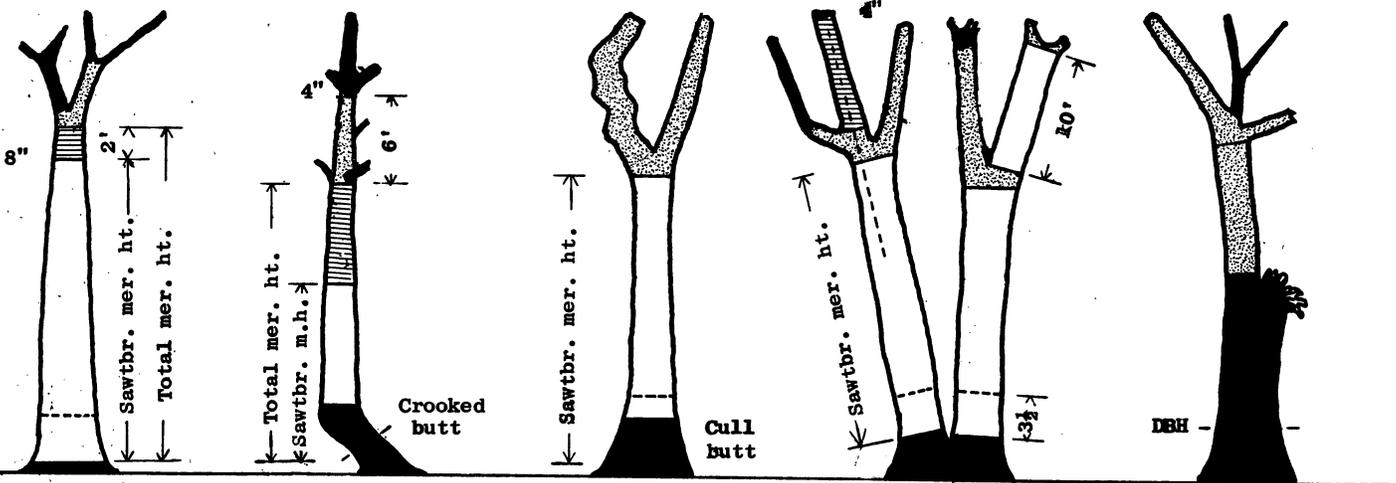
B

C

D

E

F



G

H

I

J

K

Explanation:

- A. Illustrates relationship of total and sawtimber merchantable heights where diameter is the limiting factor.
- B. Total and sawtimber merchantable height may be the same when tree is alive but top is rotten cull section.
- C. Merchantable sections must be at least 8 feet long.
- D. A five foot section is too short to class upper stem. Sound cull sections are included in limbwood.
- E. Upper stem is the largest (in diameter) branch following general course of the lower stem. Utilization here is limited by rotten cull.
- F. A branch departing more than 1/4 of a 90° arc from general course of the lower stem is disqualified.
- G. Merchantable height will be measured from stump level to the upper limiting points (not for sawtimber and upper stem sections separately).
- H. Percent of defect will be increased to correct to net volume when a butt-off is necessary. One or more limbs whose diameter at the limb collar exceeds 1/3 of the diameter of the stem at that point will limit merchantability. DBH is measured at right angles to the stem.
- I. Merchantability here is limited by crook in the main stem. DBH is measured immediately above the butt swell.
- J. Trees forking below DBH are handled as two trees. Only merchantability in the main stem following the general course of the lower stem is considered. May have sawlog above fork. DBH is measured 3-1/2 feet above cut off point (usually above 4-1/2 feet above fork).
- K. No merchantable height will be measured for a cull tree.

LAKE STATES FOREST EXPERIMENT STATION, MAY 1959

crooks excepted). When branches appear, it is always the largest, more or less vertical one following the general course of the lower stem. The base diameter of any section above a fork must be at least one-half of the diameter of the stem immediately below the fork. The upper stem stops when it is no longer the largest branch of the fork following the general course of the lower stem or becomes less than 4 inches, d.i.b. Where a tree separates into two or more branches each more or less vertical, only one (the largest in diameter) may be considered the upper stem.

Other portions of the tree include stump, rotten cull sections, limbs and twigs. Limbs includes sound cull sections and branches to a minimum of 4 inches d.i.b. No restriction is made to quality or length of individual pieces except that limbwood be live and sound.

Merchantability in softwood sawtimber trees is the same except for use of a 6-inch minimum top (instead of 8-inch) for the sawlog section. Merchantability in poletimber-size trees is similar except for the absence of the sawlog section.

Measure both sawtimber and total merchantable height for each merchantable sawtimber tree and total merchantable height for each merchantable poletimber tree. Record to the nearest full even (2) foot interval.

Q. Defect Class

Each "growth sample" tree over 5 inches d.b.h. will be carefully examined for signs of defect. Two estimates will be made for each sawtimber tree and one for each pole-size tree. One will be the defect insofar as total cubic foot volume is concerned. The several types of

defect will be allowed for as done in scaling pulpwood. The other estimate will be the defect in board foot volume. It will be made following log scaling rules.

Both defect estimates will be recorded on Form 2 by the following codes.

<u>Code</u>	<u>Item</u>
98	Any tree with 0 to 5 percent defect
92	Any tree with 6 to 10 percent defect
85	Any tree with 11 to 20 percent defect
75	Any tree with 21 to 30 percent defect
65	Any tree with 31 to 40 percent defect
55	Any tree with 41 to 50 percent defect
40	Any tree with 51 to 69 percent defect
20	Any tree with 70 to 100 percent defect

A great deal of judgement is needed in estimating defect. Each tree suspected of being hollow should be "sound tested." Stumps should be examined and sawmills visited to see logs opened up in order to develop good judgement. The following average soundness guide prepared by the National Forest Administration may be used as a start in judging defect in the individual tree.

(Inches)	<u>Species</u>							
	<u>Pine</u>	<u>Scarlet oak</u>	<u>Black oak</u>	<u>Post oak</u>	<u>Red oak</u>	<u>White oak</u>	<u>Hickory</u>	<u>Black gum</u>
	<u>Percent sound</u>							
12	100	90	90	85	95	90	90	90
14	100	90	90	85	90	90	85	85
16	100	80	85	80	80	85	80	80
18	100	75	80	80	75	80	75	75
20	100	65	75	60	70	75	75	75
22	100	65	70	60	70	75	70	70

In all districts of Missouri except the Eastern Ozarks and the Mississippi Bottomlands a study of defect indicators and defect in each log grade will be conducted on "growth sample" trees over 5 inches d.b.h. See instructions under Section R., Log Grades, which follows.

R. Log Grades

Log grading will be done for sawtimber-size trees using (1) specifications for logs of southern pines, (2) hardwood log grades for standard lumber (developed by Forest Products Laboratory), and (3) specifications for tie and timber logs.

Instead of grading each log in the tree in the lengths to which it should be cut, the "12-foot rule" will be used. Under this plan, the tree is divided into 16-foot sections insofar as possible and the best 12 feet in each section is graded.

Having graded the logs, the proportion in each grade (of the merchantable sawtimber volume in the tree) must be determined. This can be done with dispatch and accuracy by consulting the following table.

Distribution of Volume in the Tree

Tree size :		Bolt number									
Bolts :	Logs :	1	2	3	4	5	6	7	8	9	10
(8')	(16')	:	:	:	:	:	:	:	:	:	:
<u>Percent of tree volume</u>											
2	1	56	44								
3	1½	41	33	26							
4	2	33	28	22	17						
5	2½	27	23	19	17	14					
6	3	24	21	18	15	12	10				
7	3½	22	19	17	14	12	9	7			
-	4	20	18	15	13	11	9	8	6		
-	5	18	15	13	12	10	9	8	6	5	3

EXAMPLE: A 1-log tree has 56 percent of tree volume in the butt bolt, 44 percent in the 2nd.

The proportion (to the nearest 0.1) will be entered under each log grade on Form 2.

Specifications for Logs of Southern Pines

Grade	D.i.b.	Length	Surface requirements
1	10" - 16"	8' plus	Surface clear (not considering adventitious knots and branches).
	16" plus	8' plus	Not more than three 2- to 4-inch knots and any number of smaller knots.
2	8" - 9"	8' plus	Surface clear.
	10" - 13"	8' plus	Any number of small knots. (Less than 2 inches in diameter).
	14" plus	8' plus	Not more than six 2- to 4-inch knots and any number of smaller knots.
3	6" - 7"	8' plus	Any number of small knots not exceeding 1 inch in diameter.
	8" - 13"	8' plus	With not more than six 2- to 4-inch knots.
	14" plus	8' plus	More than six 2- to 4-inch knots. Any log with one or more knots 5 inches and larger.

Knotty or crooked merchantable logs 8-inch d.i.b. or over that do not fall in either No. 1 or No. 2 grade: length 10 feet or over.

Hardwood Log Grades for Standard Lumber

Grade factors	Log grade 1		Log grade 2	Log grade 3
	Butts only	Butts and uppers	Butts and uppers	Butts and uppers
Diameter (min.)	13-15"	16-19":20+	11"	8"+
Length (min.)	10'+	10'+	8-11': 12'+	8'+
Clear cuttings (on the 3 best faces)				
Length (min.)	7'	5':3'	3'	2'
Number on face (max.)	2	2	2 : 3	Unlimited
Yield in face length (min.)	5/6	5/6	4/6	3/6
Sweep and crook deduction (max.)	15%	15%	30%	50%
Cull deduction, including sweep (max.)	40%	40%	50%	50%
Sound end defects, area (max.)	See instructions			

Exceptions.--In ash and basswood 12" d.i.b. for grade 1 butts.

Grade 2, 10" d.i.b. must be grade 1 surface quality.

Grade 2, 11" d.i.b. limited to two cuttings.

Grade 2, 8' and 9' lengths limited to 12" d.i.b.; 3/4 yield in not more than 2 3'+ cuttings.

Sweep and crook allowance reduced 1/3 in logs with more than 1/4 diameter in sound end defects.

Sixty percent cull deduction permitted in grade 2 if otherwise of grade 1 quality.

Sixty percent cull deduction permitted in grade 3 if otherwise of grade 2 quality.

Specifications for Tie and Timber Logs

Position in tree	Butt and upper.
------------------	-----------------

D.i.b., small end, inches	8"+
---------------------------	-----

Length without trim, feet	8'+
---------------------------	-----

Clear cuttings	No requirements. Not graded on cutting basis.
----------------	---

Sweep allowance, maximum	1/4 d.i.b. of small end for half logs and 1/2 d.i.b. for log 16' long.
--------------------------	--

Sound surface defects permitted:	
Single knots	Any number, if none has an average collar diameter in excess of 1/3 of log diameter at point of occurrence. ^{7/}
Whorled knots	Any number provided the sum of the collar diameters does not exceed 1/3 the log diameter at point of occurrence.
Holes	Any number not exceeding knot specifications if they do not extend over 3 inches into the contained tie or timber.

Unsound defects permitted:	
Surface	Any number and size if they do not extend into contained tie or timber. If they extend into contained tie and timber they shall not exceed size, number, and depth of limits of sound knots.
Interior	None permitted except one shake not more than 1/3 the width of contained tie or timber and one split not over 5 inches long.

^{7/} Knot collar is the average of the vertical and horizontal diameters of the limb or knot swelling as measured flush with the surface of the log.

Local use logs that do not meet the minimum specifications of the above grades will not be considered merchantable for Survey purposes.

S. Mortality Classification

The major lethal agent will be indicated for all trees which have died or been cut during the last 3 years. Indicate an important contributing agent by a letter suffix to the number; thus a tree weakened by disease then broken by the wind becomes 2d. Number 2 will be punched on the IBM cards - the d is material for a special study using plot records.

<u>Code</u>	<u>Major Lethal Agent</u>
1	Fire
2	Wind breakage or blowdown
3	Other weather causes
4	Suppression
5	Disease
6	Insects
7	Birds and animals
8	Man (including logging)
9	Unknown

T. Tree Number

Record the individual tree number if it was tallied above. If not tallied above, number in a series beginning with 51.

U. Age

Total age at stump will be recorded for each sample tree that is sound enough. The increment core will be taken about 2 inches below d.b.h. and corrected as described in Appendix I, I. Site.

Record age to closest year up to 99. If over 99 years, record as 99.

V. Total Height

Total height will be measured and recorded to the nearest even foot. Trees over 40 feet tall will be measured with the Relaskop, Abney level, or Lake States height stick. Smaller trees may be measured (or estimated) using the telescoping fish pole.

W. Sample Tree Class

Four classes of sample trees are recognized:

1. Growth sample trees will include:

- a. All 3-inch and larger merchantable trees on the east half of the plot in the Mississippi Bottomland District, or
- b. All 3-inch and larger merchantable trees on the NE quarter of the plot throughout the rest of the state.

The following data will be collected for growth sample trees in addition to that which is tallied for all trees:

Merchantable height
Defect class
Log grade
Radial growth
Bark thickness
Stump diameter

This will provide a representative sample of all merchantable trees regardless of their condition.

2. Yield table sample trees.--These trees must belong to the main stand. They will be bored for total age and measured for total height. The aim is to measure three trees which are within \pm 20 percent of the average age of the main stand.

3. Site sample trees.--One site sample tree is desired. This tree must be of a proper species to represent the type, a dominant or codominant tree throughout life and sound enough for determination of total age. It may be taken from a similar area off the plot if necessary.
4. Volume table tree.--A tree used for form class and other volume table measurements.

For convenience in sorting, certain sample trees will be indicated by code.

<u>Code</u>	<u>Item</u>
1	Yield sample tree
2	Site sample tree
3	Yield and site sample tree
4	Growth sample tree merchantable
5	Growth sample tree rotten cull
6	Growth sample tree sound cull

X. Radial Growth

Radial growth measurements will be made on each growth sample tree. An increment boring will be taken within 3 inches below d.b.h. on the side of the tree facing the plot center. The core should be along the radius to the pith. Starting from the cambium the growth rings will be counted and the 10th and 20th marked. Distance from the cambium to each mark will be measured to the closest 1/20th inch and recorded on Form 2. A distance of 1.35 inches will be recorded 135.

Y. Bark Thickness

Bark thickness will be measured on each growth sample tree within 3 inches below d.b.h. using a bark gauge. The reading will be taken to the nearest 1/20th inch and recorded as in the case of radial growth.

2. Diameter at 17 feet

Not to be used. A special form class study (Section VII) was made.

AA. Stump diameter

This parameter is measured to determine the relationship between diameter at the stump and at breast height or size of a tree which has been cut. Diameter of each growth sample tree over 5-inch d.b.h. and each cut tree over 5-inch stump diameter will be measured outside bark at a point 6 inches above the average ground level. In cases where stump diameters are abnormal, bark has sloughed off or tree was cut below a 6-inch height, the normal diameter will be estimated. Record to the closest 0.1 inch.

APPENDIX II

Statistical Accuracy

The design for the inventory of Missouri is covered briefly in Section I-F of these instructions. It is discussed in more detail in other sections. The numbers of dots, stereoscopic points, ground-checked locations and permanent plots are summarized in the table on the following page. The distribution of these samples by districts also is indicated.

It is estimated that the numbers of samples proposed will provide area and total volume information with the following error (one standard deviation):

Error of areas in Missouri + 0.6
percent (+ 2.3 percent per \overline{MMA} .)

Error of volume in Missouri + 1.2
percent (+ 2.4 percent per \overline{MM}
cubic feet.)

The Sample (anticipating cooperation)

Districts	Gross land		Land area		1947 Forest area		Total forest area		Stere. forest dots		Volume plots		Non-forest ground-check points	
	acres	acres	acres	acres	acres	acres	acres	acres	Number	Number	Number	Number	Number	Number
	M	M	M	M	M	M	M	M	Proportion	Proportion	Proportion	Proportion	Proportion	Proportion
E. Ozarks	6,174	6,174	4,488	4,488	73	43,500	31,300	1/4	7,825	1/8	978	360		
SW Ozarks	5,533	5,531	3,130	3,130	57	39,000	21,900	1/4	5,475	1/8	684	130		
NW Ozarks	5,117	5,059	2,603	2,603	51	36,000	18,200	1/4	4,550	1/8	569	110		
S. Prairie	6,553	6,537	884	46,100	14	46,100	6,500	1/6	1,083	1/8	135	580		
N. Prairie	13,075	13,020	1,612	92,100	12	92,100	11,000	1/6	1,833	1/8	229	1,050		
Riverborder	5,937	5,852	2,089	41,800	36	41,800	15,100	1/4	3,775	1/8	472	330		
Mississippi Bottomlands	2,202	2,160	381	15,500	18	15,500	2,800	1/4	700	1/3	233	120		
Total	44,591	44,333	15,187	314,000	34	314,000	106,800	-	25,241	-	3,593	2,680		

APPENDIX III

Miscellaneous

Factor 5 Variable Plot Radii by D.b.h. and Percent of Slope

D.b.h. class	Percent slope class						
	0	10	20	30	40	50	60
	(A)	(B)	(C)	(D)	(E)	(F)	
	<u>Feet</u>						
2	7.78	7.82	7.95	8.15	8.41	8.71	9.04
4	15.56	15.65	15.90	16.31	16.83	17.43	18.09
6	23.33	23.46	23.85	24.45	25.23	26.13	27.12
8	31.11	31.29	31.80	32.60	33.64	34.85	36.17
10	38.89	39.11	39.75	40.76	42.05	43.56	45.21
12	46.67	46.94	47.71	48.91	50.47	52.27	54.26
14	54.45	54.76	55.66	57.07	58.88	60.99	63.30
16	62.22	62.57	63.60	65.21	67.28	69.69	72.33
18	70.00	70.40	71.55	73.37	75.70	78.41	81.38
20	77.88	78.32	79.61	81.62	84.22	87.23	90.54
22	85.56	86.05	87.46	89.67	92.52	85.83	99.47
24	93.34	93.87	95.41	97.83	100.93	104.55	108.51
26	101.11	101.69	103.36	105.97	109.34	113.25	117.54
28	108.89	109.51	111.31	114.13	117.75	121.97	126.59
30	116.67	117.34	119.26	122.28	126.16	130.68	135.63
32	124.45	125.16	127.21	130.43	134.58	139.39	144.68
34	132.23	132.98	135.17	138.59	142.99	148.11	153.72
36	140.00	140.80	143.11	146.73	151.39	156.81	162.75
38	147.78	148.62	151.06	154.89	159.80	165.53	171.80
40	155.56	156.45	159.01	163.04	168.22	174.24	180.84
42	163.34	164.27	166.97	171.19	176.63	182.95	189.89
44	171.12	172.10	174.92	179.35	185.04	191.67	198.93

MISSOURI FOREST SURVEY TATUM GUIDE

Lake States Forest Experiment Station - 1959

POINT CLASS	FOREST TYPE	STAND-SIZE STOCKING CLASS (Minimum # trees on 5 factor plot)
1 Forest	0 Pine	0 Nonstocked 0 trees
2 Questionable	1 Oak-pine	1 Restocking poor 2 trees (half in 0-5 class)
	2 Black-scarlet oak	2 Restocking medium 3 trees (half in 0-5 class)
3 Water	3 White oak	3 Restocking well 6 trees (half in 0-5 class)
4 Urban and industrial	4 Post-blackjack oak	4 Poles poor 4 trees 6" class or 3 larger (half in 5-9)
5 Other nonforest	5 Hardwood-redcedar	5 Poles medium 7 trees 6" class or larger (half in 5-9)
	6 Redcedar	6 Poles well 12 trees 6" class or larger (half in 5-9)
6 Commercial forest	7 Oak-gum-cypress	7 Sawtimber poor 4 - 10" softwoods or 3 trees over 11"
7 Unproductive forest	8 Elm-ash-cottonwood	8 Sawtimber medium 7 sawtimber trees
8 Reserved forest	9 Maple-beech	9 Sawtimber well 12 sawtimber trees

SPECIES

SPECIES	REGENERATION SURVEY	ASPECT
Hardwoods	0 Not restocking naturally, but not recommended for planting.	0 0 degrees
01 Shortleaf pine	1 Restocking 5+ percent naturally to pine	1 45 degrees
07 Bald cypress	2 Restocking 5+ percent naturally to redcedar	2 90 degrees
08 Eastern redcedar	3 Restocked 20+ percent naturally to hardwoods	3 135 degrees
09 Other softwoods	4 Machine planting with pine	4 180 degrees
	5 Hand planting with pine	5 225 degrees
	6 Unfavorable planting chance	6 270 degrees
		7 315 degrees
		8 Indeterminate
Hard Hardwoods		
10 White oak		
11 Swamp chestnut oak		
12 Swamp white oak		
13 Bur oak		
14 Post oak		
15 Overcup oak		
16 Chinquapin oak		
17 Nuttall oak		
20 Northern red oak		
21 Swamp red (cherry bark) oak		
22 Black oak		
23 Scarlet oak		
24 Black jack oak		
25 Pin oak		
26 Willow oak		
27 Water oak		
28 Shingle oak		
29 Shumard oak		
30 River birch		
31 White birch		
32 Black birch		
33 Sugar maple		
34 Beech		
35 Rock elm		
36 White ash		
37 Red ash		
38 Green ash		
39 Blue ash		
40 Shagbark hickory		
41 Mockernut hickory		
42 Shellbark hickory		
43 Pignut hickory		
44 Water hickory		
45 Pecan		
46 Bitternut hickory		
47 False pignut-hickory		
48 Southern red oak		
49 Black hickory		
50 Black walnut		
51 Honey locust		
52 Black locust		
	Soft Hardwoods	
	53 Red mulberry	
	54 Persimmon	
	55 Osage orange	
	56 Dogwood	
	57 Yellowwood	
	58 Pumpkin ash	
	59 Other hard hardwoods	
	GRAZING AND DISTURBANCE	
	0 No grazing - No disturbance	
	1 No grazing - Light disturbance	
	2 No grazing - Heavy disturbance	
	3 Light grazing - No disturbance	
	4 Light grazing - Light disturbance	
	5 Light grazing - Heavy disturbance	
	6 Heavy grazing - No disturbance	
	7 Heavy grazing - Light disturbance	
	8 Heavy grazing - Heavy disturbance	
	OWNERSHIP	
	0 National Forest	
	1 Bureau of Land Management	
	2 Indian	
	3 Other Federal	
	4 State	
	5 County	
	6 Municipal and School Forests	
	7 Forest Industry	
	P Pulp Company	
	L Lumber Company	
	O Other	
	8 Farmer	
	9 Miscellaneous Private	
	POSITION ON SLOPE	
	0 Bottom	
	1 Lower 1/3	
	2 Middle 1/3	
	3 Upper 1/3	
	4 Upland	
	PERCENT ON SLOPE	
	0 0 Percent	
	1 1-3 Percent	
	2 4-9 Percent	
	3 10-19 Percent	
	4 20-29 Percent	
	5 30-39 Percent	
	6 40-59 Percent	
	7 60+ Percent	
	SITE CLASS (based on present or prospective mature trees).	
	# 16' logs to local use top	
	Hardwoods Pine Cedar	
	0 1/2- 1/2- 1/2-	
	1 1-1 1/2 1-2 1/2 1	
	2 2-2 1/2 3-3 1/2 1 1/2	
	3 3-3 1/2 4-4 1/2 2	
	4 4+ 5+ 2 1/2+	
	Classify 7, 8, and 9 further:	
	a. 0-99 acres	
	b. 100-499 acres	
	c. 500-4,999 acres	
	d. 5,000-49,999 acres	
	e. 50,000+ acres	
	USE TREND	
	0 No change	
	1 Improved pasture over 10 percent stocked and likely to be maintained for grazing	
	2 Changing to nonforest for grazing	
	3 Changing to nonforest-clearing for cultivation	
	4 Changing to nonforest-by urbanization	
	5 Changing to nonforest-by mining	
	6 Changing to nonforest-by other	
	7 Changing to forest-less than 10 percent forest which had been developed for other use and is now reverting.	

CUTTING RECOMMENDATIONS (STAND) CUT OR LEAVE TALLY

0 No cut	0 Leave tree
1 Urgent cut - First decade	1 Cut tree
2 Delayed cut	

TREE CLASS

TREE CLASS	DISTRIBUTION OF VOLUME IN THE TREE										SOUNDNESS CLASS	MORTALITY		
	Tree Size		Bolt Number											
	Bolts (8')	Logs (16')	1	2	3	4	5	6	7	8			9	10
0 Poor saplings and poles													98 0-5 %	0 Live tree
1 Crop tree													92 6-10 %	1 Fire
2 Good storage tree													35 11-20 %	2 Windbreakage or blowdown
3 Poor storage tree	2	1	56	44	Percent of Tree Volume								75 21-30 %	3 Other weather causes
4 Harvest tree	3	1 1/2	41	33	26	Example: A 1 log tree has 56% of tree volume in the butt bolt, 44% in the second.						65 31-40 %	4 Suppression	
5 Sound cull	4	2	33	28	22	17	14	12	9	7			55 41-50 %	5 Disease
6 Rotten cull	5	2 1/2	27	23	19	17	14						40 51-69 %	6 Insects
7 Noncommercial species	6	3	24	21	18	15	12	10					20 70-100 %	7 Birds and Animals
8 Dead tree	7	3 1/2	22	19	17	14	12	9	7					8 Man (including logging)
9 Stump	-	4	20	18	15	13	11	9	8	6				9 Unknown
	-	5	18	15	13	12	10	9	8	6	5	3		