Sanders County Continuous Forest Inventory Project and Forest Land Management Plan

Norman Bruce Kaufman

The University of Montana

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SANDERS COUNTY CONTINUOUS FOREST INVENTORY PROJECT
AND FOREST LAND MANAGEMENT PLAN

By
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B.S., University of Montana, 1962

Presented in partial fulfillment of the requirements for the degree of
Master of Science
UNIVERSITY OF MONTANA
1977

Approved by:

[Signatures]
W. R. Pierce
Chairman, Board of Examiners

[Signature]
Dean, Graduate School

[Signature]
Date, January 1977
The Sanders County Continuous Forest Inventory Project is a demonstration continuous forest inventory (CFI) study established through cooperation of the U.S. Forest Service, Montana State Forester, U.S. Soil Conservation Service, and the University of Montana. The project was initiated to obtain forest inventory and long-term tree growth information on an area of private and state-owned forest lands in western Sanders County, Montana. Individuals at the cooperating agencies felt that the study area contained some of the better tree growing sites in Montana. The agencies also theorized that management of farm woodlots might contribute materially to the economic stability of this large area of western Montana. The CFI project was designed to provide data for a forest land management plan for the study area. A total of 344 permanent inventory plots were established randomly, throughout the 85,328 acre project area, using a systematic grid method. The measurement interval was set at five years. The plots were established and measured in 1964 and 1965 and remeasured by the author and others in 1969 and 1970. The study compares the data collected from the two measurement periods. A comparison of the volumes of trees growing on the sample plots at the time of the two measurements indicates growth rates that are substantially higher than those found elsewhere in the state. The study shows a substantial potential for increasing farm income from the production and sale of forest products. Results indicate that the study area is producing 48,500 cords of sawtimber annually while only 11,000 cords are being harvested. Evidence is also presented that annual production of forest products could be substantially increased by implementation of forest management practices such as stocking level control and reforestation. The final chapter contains a forest land management plan which describes the resources identified by the CFI project and presents information related to production and marketing of forest products from the area.
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Acknowledgements

I wish to thank all members of my graduate committee for their support and guidance. The committee chairman, Dr. William R. Pierce, has been my advisor throughout most of my academic years. His patience, friendship, and wise counsel have helped me not only during this project, but throughout my career in the forestry profession. Lorin Hearst, a committee member, was primarily responsible for obtaining the financing for the project through the Division of State and Private Forestry, Region One, United States Forest Service. Mr. Hearst has steadfastly maintained his faith in the worth of this project. It is my hope that he will one day realize his dream for the people of Sanders County. My thanks go also to the Office of the Montana State Forester for the transportation that was provided for the field work. My gratitude extends also to Jim Jacoben, Bill Caldwell, and all the other students and graduates who helped to gather the field data for the study. My deepest appreciation is for my wife, Linda O'Neal Kaufman. Her gentle encouragement and frequent sacrifice were my primary motives for attempting and completing this project. She has typed this document through so many drafts and rewrites that it seems as much a part of her as it does of me, as well it should. Finally, my thanks go to the people of Sanders County without whose cooperation there could have been no study.
CHAPTER I

INTRODUCTION

Situation

According to Bolle, Haring, and Gibson (1964), nearly one-fourth of the commercial forest land in the state of Montana is composed of small private ownerships. Most of this 3,771,000 acres is comprised of forest land included in farms and ranches. Although these forest land holdings represent a considerable portion of the state's forest resource, very few have been placed under any form of management. Farm and ranch forest holdings are used primarily for the grazing of livestock. The opportunity to market forest products usually comes in the form of a lump sum stumpage offer from a small logging contractor. Most landowners consider these market opportunities as unexpected income. They seem to possess very little knowledge of the actual value of their tree crop.

The failure of these landowners to integrate their forest assets into the business structure of their farm or ranch is based on various reasons. Some of the more important reasons given by Blair (1962) are:

1) Unlike the annual pattern of investment and return associated with most agricultural products, the time period between planting and harvest of forest crops ranges from 6 to 10 years for Christmas trees and 40 to 120 years for sawtimber.

2) Markets for timber are irregular. The market price offered by mills for sawlogs may fluctuate considerably between the time of the decision to sell and the actual marketing of the product.
3) If the landowner chooses to offer stumpage for sale, he may have difficulty finding a logging contractor available at the time he wants the timber cut.

4) Owners of small properties often have potentially marketable volumes of timber that are too small to attract stumpage buyers.

5) Few landowners are able to obtain an accurate inventory of the timber on their forest property.

6) Tree growth rates in terms of annual periodic increment are usually unknown.

There have been many attempts to lessen the effect of the uncertainties faced by private forest landowners. State and Federal forestry and agricultural agencies provide technical assistance to those who display an interest in management of their forest property. Forest products industries have offered technical assistance and marketing agreements to owners of private land. Occasionally, the landowners themselves have joined together in a cooperative attempt to influence marketing and management efforts.

**Problem Statement**

In 1961, a group of private landowners in western Sanders County, organized under the Green Mountain Soil and Water Conservation District, formed a timber marketing cooperative. This group negotiated a contract with the Durable Wood Products Company of Trout Creek, Montana, to provide 25,000 cords of forest material annually in return for specific marketing assurances.

Soon after the contract went into effect, concerned individuals began to express doubts that the area was capable of producing the contracted volumes on a sustained yield basis. No inventory of the forest resource or long-term growth information was available to support or
refute this contention. Cooperative agencies, the U. S. Forest Service, Montana State Forester, U. S. Soil Conservation Service, and the University of Montana, had observed the agreement between landowners and Durable Wood Products with interest because of the beneficial effect such an agreement might have on the economic stability of this large area of Western Montana. These agencies recognized the need for inventory and long-term growth information and agreed to establish a demonstration Continuous Forest Inventory (CFI) project in western Sanders County. The consensus was that the CFI project would provide the necessary inventory and growth information, and also provide the basis for an adequate forest land management plan for the project area.

In 1973, the Forestry Incentive Program was authorized by Congress to provide landowners with Federal financial assistance toward implementation of forestry practices on private lands. Through the Forestry Incentives Program the government will pay from 50 to 75 percent of the cost of forest improvement programs on qualifying ownerships. To qualify, an individual must be a private landowner of a tract of no more than 500 acres (larger tracts may qualify under an exception rule) which is capable of producing timber and has had no commercial harvest in the past five years. Long-term agreements permit cost sharing for tree planting and timber stand improvement over a period of 3 to 10 years, with a maximum payment limitation of $10,000 in any single year. A majority of the private ownerships in western Sanders County are well suited to this new incentives program. The Sanders County Continuous Forest Inventory Project provides evidence of the excellent capacity of the project area to support timber stands. The Forest Land Management Plan in Chapter III is presented in a form to facilitate easy extraction. It can then be used
as a nucleus for individual management plans which are also required of each applicant to qualify for assistance under the Forestry Incentive Program.
CHAPTER II
SANDERS COUNTY CONTINUOUS FOREST INVENTORY

Method

Mr. A.L. Hearst, Jr., Division of State and Private Forestry, Region One, U.S. Forest Service and Dr. William R. Pierce, School of Forestry, University of Montana, collaborated on the design for the Sanders County CFI project. Advice was obtained from Mr. Cal Stott, CFI specialist for the U.S. Forest Service at Milwaukee, Wisconsin. Mr. Stott's recommendations were combined with Dr. Pierce's experience with a CFI project which he developed for the University of Montana's school forest.

The area selected for the project was 85,328 acres of private and state owned land situated from a point about 4 miles east of Thompson Falls, Montana and lying west to the Montana-Idaho border along the Clark Fork River. The project area includes the boundaries of the Green Mountain Soil and Water Conservation District, whose members were involved in the unsuccessful 1961 marketing cooperative described in Chapter I.

The sampling intensity chosen was 344 permanent plots with each plot representing approximately 248 acres of the project area. Davis (1966) considers this intensity as adequate and economical for large tracts of forest land. The plots were located throughout the project area through use of a systematic grid method. A description of the entire plot establishment pattern is contained in Appendix A.

The plots were established and sampled in 1964 and 1965. The data collected was adapted for input to the University of Montana's IBM 1620 computer. The computer programs (Appendix C) for processing the data
were developed by Dr. William R. Pierce of the University of Montana's School of Forestry. The computer output from the original plot measurement was summarized by A. L. Hearst, Jr., Division of State and Private Forestry, Region One, U. S. Forest Service. Mr. Hearst's analysis provided a basic description of the project area and a beginning inventory of the forest resources involved.

The plots were referenced and marked to facilitate remeasurement. The remeasurement interval was set at 5 years. In 1969 and 1970 remeasurement of the Sanders County CFI project plots was accomplished by the author and others. The data collected was similarly applied to the computer programs developed by Dr. Pierce. In 1972, Dr. Pierce completed a computer program designed to summarize the data from remeasurement in the form used by Mr. Hearst in the original evaluation. This program was used by the author to provide the basis for analysis of the two measurements.

Results

The composition of the project area in terms of use at the time of measurement is shown in Table 1.

### TABLE 1

PROJECT AREA BY LAND USE IN ACRES IN 1965 AND 1970

<table>
<thead>
<tr>
<th>Land use</th>
<th>1965 Acres</th>
<th>1970 Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmland and other nonforest</td>
<td>16,867</td>
<td>18,120</td>
</tr>
<tr>
<td>Forested land</td>
<td>68,461</td>
<td>67,208</td>
</tr>
<tr>
<td>Total project acreage</td>
<td>85,328</td>
<td>85,328</td>
</tr>
</tbody>
</table>
There has been some conversion of forested land to nonforest uses during the period encompassed by the two measurements. For the most part, however, the forested land area has been retained as such by the landowners. There were trees of some description growing on 67,208 acres, or 78.8% of the project area at the last measurement. A further breakdown of the forested acreage is provided in Table 2. This table delineates the acreage of the forested area in board foot per acre volume classes. (All board foot volumes shown throughout this document have been calculated with the use of the Scribner log rule.)

### TABLE 2

<table>
<thead>
<tr>
<th>Volume class</th>
<th>1965 Acres</th>
<th>1970 Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1,000 board feet per acre</td>
<td>13,395</td>
<td>10,664</td>
</tr>
<tr>
<td>1,001 to 3,000 board feet per acre</td>
<td>14,387</td>
<td>11,904</td>
</tr>
<tr>
<td>3,001 to 5,000 board feet per acre</td>
<td>11,906</td>
<td>10,416</td>
</tr>
<tr>
<td>5,001 to 7,500 board feet per acre</td>
<td>7,441</td>
<td>8,928</td>
</tr>
<tr>
<td>7,501 to 10,000 board feet per acre</td>
<td>5,953</td>
<td>5,208</td>
</tr>
<tr>
<td>10,001 to 15,000 board feet per acre</td>
<td>4,713</td>
<td>9,424</td>
</tr>
<tr>
<td>More than 15,000 board feet per acre</td>
<td>1,984</td>
<td>4,216</td>
</tr>
<tr>
<td>Total sawtimber acreage ............</td>
<td>59,779</td>
<td>60,760</td>
</tr>
<tr>
<td>No sawtimber volume ...............</td>
<td>8,682</td>
<td>6,448</td>
</tr>
<tr>
<td>Total forested land ...............</td>
<td>68,461</td>
<td>67,208</td>
</tr>
</tbody>
</table>

While the overall acreage of forested land decreased through the measurement period, the acreage of sawtimber-sized stands increased slightly.

The acreage containing sawtimber stands of more than 5,000 board feet per acre increased substantially. Sawtimber stands of over 5,000 board feet per acre were contained on 20,091 acres, or 23.5% of...
the project area at the time of the first measurement. Five years later, these large volume stands comprised 32.5% of the project area, or 27,776 acres.

The composition of the sawtimber stands is identified by species and total board foot volumes in Table 3.

### TABLE 3

**BOARD FOOT VOLUMES BY SPECIES FOR SAWTIMBER STANDS WITH THE DIFFERENCES BETWEEN MEASUREMENTS REPRESENTING FIVE YEAR GROWTH**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas fir</td>
<td>79,748,326</td>
<td>110,125,390</td>
<td>30,377,064*</td>
</tr>
<tr>
<td>Western larch</td>
<td>60,503,327</td>
<td>69,633,964</td>
<td>9,130,637</td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>59,482,341</td>
<td>75,679,062</td>
<td>16,196,721</td>
</tr>
<tr>
<td>Lodgepole pine</td>
<td>40,412,140</td>
<td>57,746,527</td>
<td>17,334,387</td>
</tr>
<tr>
<td>Western white pine</td>
<td>9,375,506</td>
<td>14,814,503</td>
<td>5,438,997</td>
</tr>
<tr>
<td>True firs</td>
<td>8,189,817</td>
<td>15,879,068</td>
<td>7,689,251</td>
</tr>
<tr>
<td>Hardwoods</td>
<td>7,191,304</td>
<td>10,220,130</td>
<td>3,028,826</td>
</tr>
<tr>
<td>Western red cedar</td>
<td>3,824,017</td>
<td>7,587,436</td>
<td>3,763,419</td>
</tr>
<tr>
<td>All other species</td>
<td>3,607,893</td>
<td>4,592,762</td>
<td>984,869</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>272,334,671</strong></td>
<td><strong>366,278,842</strong></td>
<td><strong>93,944,171</strong></td>
</tr>
</tbody>
</table>

*The standard error of the mean is 6.7% at the first level of confidence. Therefore, the sample mean of 4,294 board feet is within ±289 board feet of the true mean 68.3% of the time. Statistical calculations are contained in Appendix B.*

Four tree species comprise the majority of the sawtimber volume: Douglas fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), ponderosa pine (*Pinus ponderosa*), and lodgepole pine (*Pinus contorta*).

The five-year growth rate for sawtimber stands represents an annual growth rate of 18,788,834 board feet. The average annual growth per acre for the 60,760 acres of sawtimber land was 309 board feet.

A total of 49 plots, representing 12,152 acres of the project...
area, had growth rates of over 3,000 board feet for the five year period. Average annual growth rates for these sawtimber stands was more than twice the average for all sawtimber stands. The plots exhibiting the highest growth rates appear to be well distributed throughout the project area. Of the 49 plots, 25 occur in the west half of the project area; while 24 occur in the east half.

The cubic foot volume of all trees of less than sawtimber size was calculated for trees between 4.6 inches d.b.h. and 9.5 inches d.b.h. Table 4 summarizes the cubic foot volume identified at the two measurements.

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<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lodgepole pine</td>
<td>11,879,244</td>
<td>12,358,980</td>
<td>479,736</td>
</tr>
<tr>
<td>Douglas fir</td>
<td>6,367,721</td>
<td>7,251,718</td>
<td>883,997</td>
</tr>
<tr>
<td>Western larch</td>
<td>5,373,145</td>
<td>5,548,454</td>
<td>175,309</td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>3,226,644</td>
<td>2,723,114</td>
<td>-503,530</td>
</tr>
<tr>
<td>Hardwoods</td>
<td>1,151,037</td>
<td>1,503,921</td>
<td>352,884</td>
</tr>
<tr>
<td>True firs</td>
<td>956,256</td>
<td>1,752,021</td>
<td>795,765</td>
</tr>
<tr>
<td>Western white pine</td>
<td>863,700</td>
<td>906,713</td>
<td>43,013</td>
</tr>
<tr>
<td>Western red cedar</td>
<td>731,416</td>
<td>985,006</td>
<td>253,590</td>
</tr>
<tr>
<td>All other species</td>
<td>822,874</td>
<td>587,636</td>
<td>-235,238</td>
</tr>
<tr>
<td>Total</td>
<td>31,372,037</td>
<td>33,617,563</td>
<td>2,245,526</td>
</tr>
</tbody>
</table>

The same four species that constitute a majority of the sawtimber volume also comprise most of the cubic foot volume. Lodgepole pine, which ranked fourth in sawtimber volume, is the predominant species in terms of cubic foot volume.

Two examples of a decrease in cubic foot volume occur in Table 4.
A decrease in cubic foot volume between the two measurements can occur as a result of harvesting, land clearing, and growth of trees less than 9.5 inches d.b.h. into the sawtimber class.

The total five year increase in cubic foot volume for the 4.5 to 9.6 inches d.b.h. class results in an annual increase of 449,105 cubic feet, or 6.7 cubic feet for each of the 67,208 acres of forested land.

A slight improvement in stocking levels occurred between the two measurements. Stands that demonstrated between 50 and 120 square feet of basal area per acre were considered adequately stocked with trees. Stands with less than 50 square feet of basal area per acre were considered inadequately stocked. Those stands with more than 120 square feet of basal area per acre were considered overstocked with trees. Table 5 compares the acreage of each stocking class found at each of the two measurements.

<table>
<thead>
<tr>
<th>Stocking Class</th>
<th>1965 Acres</th>
<th>1970 Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequately stocked</td>
<td>28,773</td>
<td>28,037</td>
</tr>
<tr>
<td>Adequately stocked</td>
<td>26,541</td>
<td>28,024</td>
</tr>
<tr>
<td>Overstocked</td>
<td>15,627</td>
<td>14,880</td>
</tr>
</tbody>
</table>

The stocking levels indicate that almost 40% of the forested land is below desired levels of stocking. An overstocked condition is indicated on 21% of the forested land within the project area.

Timber cutting occurred during the period between measurements.
A total of 21 plots, representing 5,208 acres, had received some form of harvest activity. Table 6 summarizes the cubic foot volume of trees removed during the five year period.

### TABLE 6

CUBIC FOOT VOLUME BY DIAMETER CLASS OF TREES CUT DURING THE FIVE YEAR PERIOD BETWEEN MEASUREMENTS

<table>
<thead>
<tr>
<th>Diameter Class</th>
<th>Cubic foot volume cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6 to 9.5 inches d.b.h.</td>
<td>477,425</td>
</tr>
<tr>
<td>9.6 inches d.b.h. and larger</td>
<td>4,707,586</td>
</tr>
</tbody>
</table>

The conversion of volume expressions, in units of Scribner board feet, cubic feet and cords, is a function of variables involving size and shape of the products measured. The Institute of Forest Products (1975) at the University of Washington has developed rule-of-thumb factors to facilitate fair estimates for volume expression in units other than those used in measurement. These factors are: 86 cubic feet is equal to 1 cord of unpeeled wood; 1 cord is equal to 500 Scribner board feet; and 1 cubic foot of solid wood is equal to 6 Scribner board feet.

Using the rule-of-thumb conversion factor, the cubic foot volume of sawtimber-sized trees cut, during the period between measurements, represents an annual cut of approximately 11,000 cords. An additional 1,000 cords of material was cut annually from the smaller diameter class.

### Conclusions

The project area is capable of sustained yield production of the 25,000 cords of sawlog material originally contracted between the Soil and Water Conservation District and the Durable Wood Products Company. The annual cut during the period between measurements was
approximately 11,000 cords. The average volume per acre increased during the same period from 4,556 board feet to 6,028 board feet. Using the rule-of-thumb conversion factor of 1 cord equals 500 board feet, the annual volume increment for the sawtimber stands, 18,788,834 board feet, indicates an additional 37,500 cords could be cut annually before a reduction in growing stock would occur.

The annual yield could be increased substantially if more of the owners within the project area practiced known forest management techniques on their forested properties. An understocked condition exists on 40% of the project area. Insufficient trees are growing on this portion of the area to take advantage of the high production potential indicated by the study. An additional 20% of the project area is overstocked with trees. These stands should be thinned to provide optimum growth to the remaining trees. Planting trees on unused land, and cultural practices such as thinning and weeding of existing stands, would place forest products on a similar footing with row crops and livestock production in the agricultural economics of the project area.

Plans call for future remeasurement of the established sample at five year intervals. These remeasurements will continue to monitor the development of the forest resource. Changes in land use will be noted. The Sanders County Continuous Forest Inventory Project will also provide landowners and agency foresters with a measurement of the success of the forest management recommendations outlined in the following chapter.
CHAPTER III
A FOREST LAND MANAGEMENT PLAN

General Purpose

The purpose of the management plan is to provide information and flexible guidelines to encourage management of the forested lands within the project area. The information presented is intended to describe the physical and geographic properties of the project area. Data on the availability of factors of production, such as transportation and labor, are included because they affect the marketing of forest products. Forest management practices are recommended and described with the purpose of increasing the amount and diversity of forest products available for marketing. The result of management activities is expected to be an increase in income to property owners through the orderly sale of forest products.

The degree of acceptance or rejection of management recommendations is the prerogative of the individual landowner. However, certain primary objectives for the project area can be stated:

1. To increase stocking on 40% of the project area.
2. To decrease stocking on 20% of the project area.
3. To improve age class distribution.
4. To improve the health and vigor of the stands through the removal of overmature, diseased, and insect-infested timber.
5. To coordinate the production of forest products with other land uses.
Project Area Description

The project area is located in Sanders County, Montana. The east boundary is situated some 4 miles east of the city of Thompson Falls, Montana. The project area includes state and privately-owned lands within the Clark Fork River Drainage from the east boundary to the Montana-Idaho border, a distance of approximately 50 miles. The Cabinet Mountain Range borders the northeast of the project area; while the Bitterroot Mountain Range borders the southwest. The topography of the unit is predominantly level valley bottom with few slopes above 30%. On some of the foothills and side drainages slopes up to 60% are found.

Large portions of the area were burned in major forest fires which occurred in 1889 and 1910. These fires account for the fact that a majority of the stand age classes fall between 30 and 70 years. Remnants of the original forests which were visible during the study indicate that large areas of the west half of the project area contained a climax forest type of hemlock and cedar.

Climatic conditions vary somewhat across the length of the project area. The U. S. Weather Bureau (1960) lists mean annual temperature ranges from 47.7°F at Thompson Falls to 44.0°F at Heron near the west boundary of the study area. Precipitation is considerably higher in the west half of the valley. Mean annual precipitation is 20 inches at Thompson Falls, 30 inches at Trout Creek near the center of the project area, and 35 inches at the town of Heron near the western boundary.

A complete soils study of the project area has not been done. Carlson and Nimlos (1960) identified and studied five soils within the project area. These soils were the Cabinet, Tenibac, Selle, Waits, and Tarkio series. The authors concluded that the well-developed Brown Podzolic
soils of the Cabinet and Tenibac series were associated with the best tree growth. Intermediate site indexes were found on the Selle series. The lowest site indexes were associated with the Tarkio and Waits series. The Sanders County Continuous Forest Inventory Project provides for future assimilation of soils study data. A soils study should be completed as soon as possible. A soils type map of the project area might provide an excellent guide to the extent and location of the highest quality tree growing sites.

Carlson and Nimlos took age and height measurements of 645 trees within the project area, and compared these to existing site curves. They found approximate mean site indexes of 75 for western larch, 115 for ponderosa pine, and 95 for lodgepole pine. These site indexes were compared to averages found in other areas of western Montana; 58 for western larch, 80 for ponderosa pine, and 64 for lodgepole pine. Data from the Sanders County Continuous Forest Inventory Project was applied to the same site curves. Approximate mean site indexes found were as follows: western larch, 72; ponderosa pine, 105; and lodgepole pine, 98. The project area appears to contain some of the best tree growing sites in western Montana.

Most properties within the project area were originally government grants made to the Northern Pacific Railway during construction of the railroad. The railroad made the land available to settlers in an attempt to foster trade along its route. Ownership within the project area are extremely diverse, both as to size and current primary use. The average size of farms and ranches in Sanders County is 830 acres (Montana Department of Agriculture and U.S.D.A., 1968). Some of the ownerships are smaller than 100 acres. The State of Montana and
the Pack River Lumber Company are two of the largest landowners in the project area.

Forest Description

The largest landholdings are primarily timber land. The typical ownership is a combination of crop land or pasture and timber land.

The major timber types and acreages identified in the study area are as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas fir</td>
<td>17,608</td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>13,640</td>
</tr>
<tr>
<td>Lodgepole pine</td>
<td>11,656</td>
</tr>
<tr>
<td>Western larch</td>
<td>9,424</td>
</tr>
<tr>
<td>True firs</td>
<td>2,728</td>
</tr>
<tr>
<td>Western white pine</td>
<td>2,232</td>
</tr>
<tr>
<td>Aspen</td>
<td>1,240</td>
</tr>
<tr>
<td>Cottonwood</td>
<td>496</td>
</tr>
<tr>
<td>Hemlock</td>
<td>496</td>
</tr>
<tr>
<td>Cedar</td>
<td>496</td>
</tr>
<tr>
<td>Engelmann spruce</td>
<td>248</td>
</tr>
<tr>
<td>All other species</td>
<td>496</td>
</tr>
</tbody>
</table>

Although occurrence of the most numerous timber types can be found throughout the project area, Douglas fir and western larch types are predominant in the west half of the area. The ponderosa pine type is predominant on the drier sites of the east half of the project area.

The average age of dominant trees indicates 65% of the timber stands to be in average age classes from 30 to 70 years. A total of 3,472 acres contain stands of overmature timber. Of 1,240 acres clear-
cut during the remeasurement period, 496 acres had evidence of reproduction at the last measurement.

Protection of the project area from wildfire through cooperation with state and federal forestry agencies appears to be satisfactory. The study did not identify any mortality from forest fires during the remeasurement period.

The primary cause of mortality is from insect and disease activity. The major disease problem is blister rust disease (*Cronartium ribicola*) in western white pine. Other pathogens found in localized infestations include dwarf mistletoe (*Arceuthobium campylopodum f. laris*) in larch, and white pocket rot (*Fomes pini*) in larch, Douglas-fir, and lodgepole pine. The Indian paint fungus (*Echinodontium tinctorium*) is causing a high degree of cull in mature and overmature grand fir and hemlock.

Extensive defoliation of western larch occurred during the study period from an infestation of the larch casebearer (*Coleophora laricella*). The extent of this insect infestation appeared to be decreasing at the last measurement. Endemic populations of bark beetles were noted throughout the project area. Particularly common were the mountain pine beetle (*Dendroctonus ponderosae*) and pine engraver (*Ips pini*) in all species of pine. Evidence of isolated populations of the Douglas-fir bark beetle (*Dendroctonus pseudotsugae*) were also noted throughout the project area.

**Economic and Social Situation**

Any planned increase in forest management activity and timber harvesting must consider the availability of labor, markets, and transportation facilities. Although the statistics listed are available only for the county as a whole, they should compare closely to the project area. The U.S. Department of Commerce (1970) reports that Sanders County
had a total population of 7,093 at the last census. The population of
the county decreased 1.5% between 1950 and 1960, but later increased 3%
between 1960 and 1970. Thompson Falls, the largest population center
within the project area, had a population of 1,356 in 1970. Three small
towns with populations under 500 are also located within the project
area. These are the communities of Trout Creek, Noxon, and Heron. The
Unemployment Compensation Commission of Montana (1962) indicates that
chronic unemployment has plagued Sanders County. The commission reports
that the unemployed have averaged 8% of the estimated labor force of 2,600
people over the reporting period prior to 1962. Unskilled labor should
be plentiful to meet the needs of an expanding forest products industry.

Agricultural statistics reported by the Montana Department of
Agriculture and U. S. D. A. (1974) also indicate that an upsurge in farm
woodlot activity would be a welcome addition to the area's economy.
Sanders County reported total cash receipts per farm of $14,682, com-
pared to an average of $20,470 per farm for the 10 western Montana coun-
ties. These receipts were a total of income from livestock and livestock
products, crops, and government payments. The average total income from
all farm crops harvested in Sanders County in 1973 was $35.86 per acre.
Using as a base the 1969 price offered by Durable Wood Products, Inc. of
Trout Creek of $55.00 per cord for woodlot logs delivered to the mill,
the annual cut indicated by the study, of 48,500 cords would represent a
value of $2,667,500.¹ This amount would total $39.69 per acre for each

¹Prices paid for logs are subject to a highly variable market for
wood products. The January, 1977, price was obtained by personal communi-
cation with Jeff Gunshall, Forester, Louisiana Pacific Corporation, Trout
Creek Branch (successor of Durable Wood Products, Inc.). January, 1977,
prices paid for logs delivered to the mill were; $135 per Mbf for white
pine, $125 per Mbf for logs of other species 10 inches or larger top dia-
meter, and $115 per Mbf for logs of other species 10 inches and smaller
top diameter. These rates are slightly higher than the 1969 base.
of the 67,208 forested acres in the project area.

The existing markets for forest products appear to be sufficient to handle the increase in raw material recommended by this study. A listing appears below of timber processors located within or adjacent to the project area:

<table>
<thead>
<tr>
<th>Mill and Location</th>
<th>Approximate Annual Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diehl Lumber Co., Inc.</td>
<td>45 MMbf</td>
</tr>
<tr>
<td>Plains, Montana</td>
<td></td>
</tr>
<tr>
<td>Flodin Lumber Co., Inc.</td>
<td>20 MMbf</td>
</tr>
<tr>
<td>Plains, Montana</td>
<td></td>
</tr>
<tr>
<td>Flodin Lumber Co., Inc.</td>
<td>5 MMbf</td>
</tr>
<tr>
<td>Thompson Falls, Montana</td>
<td></td>
</tr>
<tr>
<td>Thompson Falls Lumber Co.</td>
<td>35 MMbf</td>
</tr>
<tr>
<td>Thompson Falls, Montana</td>
<td></td>
</tr>
<tr>
<td>National Log Construction Co.</td>
<td>624,000 lineal feet</td>
</tr>
<tr>
<td>Thompson Falls, Montana</td>
<td>(lodgepole pine only)</td>
</tr>
<tr>
<td>Louisiana Pacific Corp.</td>
<td>20 MMbf</td>
</tr>
<tr>
<td>Trout Creek, Montana</td>
<td></td>
</tr>
<tr>
<td>Bonner Company</td>
<td>10 MMbf</td>
</tr>
</tbody>
</table>

(Directory of the Forest Products Industry, 1975)

Transportation facilities are also adequate to support marketing efforts. The entire project area is served by a well-developed road system. Montana Highway 200, a surfaced, all-weather road, traverses the entire unit from east to west. The Burlington Northern Railway also bisects the project area along the same route as the highway. Sidetracks are conveniently located throughout the length of the railroad. Some minor construction of spur and skid roads will be required to access some of the timber lands within the project area.

Taxes and Tenure

Sanders County taxes landowners within its boundaries using the ad valorem system common to Montana counties. In addition to the value
of the land itself, the timber value on forested lands is also taxed. In the early 1960's, the State Forester's Office classified forest lands in Sanders County, for tax purposes, from aerial photographs supplemented by ground checking. Private forest lands were classified as to condition class and accessibility. The condition class of the timber stands is based on three variables: (1) timber type, (2) size- seedlings, saplings, poles or sawtimber, and (3) stocking- well, medium, or poor. Accessibility is a function of roads, topography, and distance to the nearest manufacturing point. The combination of condition class and accessibility then sets the value of the timberland to which tax rates apply. At present, no good system exists for changing the classification of forest property when management activities or tree growth warrant a change. Reliance for adjustment rests with the observation of assessors or reports from the landowners. Landowners should report changes to the County Assessor's office, particularly when harvest activities would result in a classification change that would lower the tax.

Taxes based on the value of timber for marketing are particularly burdensome to landowners who lack the knowledge that their woodlots represent a valuable crop. Those owners who feel the long wait for the timber to reach marketable size is untenable, may be tempted to liquidate the timber and reduce the tax value to that of cut-over land. This temptation ignores the fact that the resource represented by the trees is a growing value and part of the worth of the property. The value of the forest land can be realized in the sale of the property, or become an important part of the estate that is passed on to heirs. Those who inherit these forested properties should consider the developing value before selling the property at a value based on its use for farmland.
or residences. Taxes are a cost of any business and are usually an indication of its worth.

Coordination with Other Uses

Cattle ranching and farming are important industries within the project area. Most of the cleared land within the unit is dedicated to these agricultural industries. Many landowners who desire to utilize their timber lands for livestock grazing will continue to keep the stands in an understocked condition to provide optimum forage. In many cases, it will be possible to increase stocking of forested grazing lands considerably without a corresponding loss of forage.

Landowners who currently plant crops on part of their lands could realize a supplement to their income as a result of management of their woodlots. High potential timber growth rates indicated by the study may prove that income from sales of forest products will exceed income obtainable from clearing the land for agricultural crops.

Opportunities for property owners to realize income from the growing outdoor recreation industry are limited at the present time. The project area is located far from major population centers. There appears to be some opportunity to provide campgrounds on private land with facilities for travel trailers. National Forest campgrounds within the project area do not provide electricity or showers and laundry facilities. Opportunities for recreational developments are probably limited to those properties near major roads and highways. The management and controlled harvest of timber lands would not preclude future recreational development should the demand occur.

The harvesting of Christmas trees is a common practice on forest lands within the project area. This seasonal activity provides certain
forest landowners with a supplemental income. The harvesting of Christmas trees provides an excellent opportunity to thin overstocked stands profitably. Property owners interested in increasing stocking of their forest lands might consider overstocking when planting to provide an inter-rotational income from Christmas trees.

Some property owners near the project area are presently planting trees for exclusive marketing as Christmas trees. These cultured, commercially-grown trees are superior to wild-grown Christmas trees and command a higher price. The University of Idaho Cooperative Extension Service (1975) reports that growers in northern Idaho are receiving returns as high as $200 per acre.

Many species of wildlife inhabit the project area. The existing pattern of forest land interspersed with crop land and pastures provides excellent food and cover for wildlife. Forest management activities within the project area would provide additional varieties of habitat for wildlife.

Management and Silvicultural Recommendations

Individual landowners interested in management of their forest holdings should obtain a specific inventory of their property and develop a detailed management plan. Forest management assistance is available from the State Forester's Office, U. S. Soil Conservation Service, and the U. S. Forest Service. Serious consideration should be given to obtaining a reliable consultant forester's services. A consultant forester can provide the landowner with all services from inventory to contracts for sale of products. A group of property owners could combine their needs to help defray the cost of a consultant.

Opportunities exist for landowners to form a marketing cooper-
ative similar to that one formed in 1961. A marketing cooperative would help achieve the highest prices for farm woodlot products by offering a constant flow of raw material in return for price guarantees. Smaller property owners might consider combining their woodlots into a single larger management unit. Large units have the advantage of providing income at shorter intervals and spreading fixed costs over a larger acreage.

Specific silvicultural prescriptions will be the prerogative of individual land managers, owners, or consultants. However, certain guidelines are indicated by the Sanders County Continuous Forest Inventory Project. These guidelines are necessary if the project area is to provide a sustained yield of forest products. Basic silvicultural guidelines are as follows:

1. A planting program should be initiated immediately to improve stocking levels and reforest non-stocked lands. Stocking levels should be obtained which will permit optimum growth on the maximum number of stems. The proper level is a function of site quality and expected yield, and should be professionally selected for each property.

2. A thinning program should be initiated to reduce stocking on overstocked lands. Attempts should be made to select trees for removal that are marketable. However, the health and vigor of the remaining stand should receive primary consideration.

3. High risk mature and overmature trees, and those showing evidence of insects and disease, should be removed in the first cutting cycle. The cutting cycle, the period of time over which the sequence of annual harvesting covers the entire forest, should
be relatively short. Five years or less is recommended to minimize losses from mortality. A prime consideration in choosing the length of the cutting cycle is that each cycle will remove enough volume to make it economical to log the stand.

4. Consideration should be given to early removal of economically undesirable and disease susceptible species, and conversion made to high value species.

5. Logging contracts should require harvesting practices that provide for protection of healthy understory trees to help fill gaps in age classes below 30 years.

Continuity and Records

Data and summaries from the Sanders County Continuous Forest Inventory Project should be readily available to land managers, property owners, and consultants. Continued remeasurement of the study plots, at the established interval, is required to provide control of management activities on the project area.

Copies of the computer output and summary tables for the project are on file at the Division of State and Private Forestry, Region One, U.S. Forest Service, and the School of Forestry, University of Montana. The original computer input cards and field cards are on file at the School of Forestry, University of Montana.
Appendix A

Plot Establishment

Number of plots- The number of permanent plots needed to establish a CFI was determined by a formula used by the U. S. Forest Service, Northern Region (1967), to find the required sampling intensity for large forested land tracts. The original acreage determination for the selected project area was 98,000 acres.

\[
\text{Number of plots} = 100 + (0.0025 \times \text{acres in tract})
\]
\[
\begin{align*}
\text{"} &= 100 + (0.0025 \times 98,000) \\
\text{"} &= 100 + 245 \\
\text{"} &= 345 \text{ plots}
\end{align*}
\]

Plot location- Plots were located on a map of the project area through the use of a systematic grid method. The scale of the map used was 2 inches = 1 mile. The grid plate contained 16 dots per square inch.

The grid plate was placed on section number 1 of the most northwestern township in the project area. A random number between 1 and 30 was selected. Each dot on the grid plate was examined, moving from the northwestern section corner along the row of dots to the northeast section corner in a west to east direction. From the northeast section corner, the examination sequence dropped to the next row of dots south. The dots were then examined in an east to west direction. This process was repeated, examining each row of dots alternately from west to east and east to west until the first dot falling on private or state-owned land was identified. This dot was then assigned the selected random number. The dots were then counted, using the same pattern described above, from the random number until dot number 30 was reached. Dot number 30 became
a plot location. The counting sequence began again with the next dot assigned number 1, and continued until reaching number 30 again. Each dot numbered 30 became a plot location. Only dots falling on private or state-owned land were counted. Dots falling within boundaries of road rights-of-way, towns, bodies of water, and federal government ownership were not counted.

The plot location process was accomplished on one township at a time, proceeding as the sections within each township are numbered on the map. As each township was completed, the process was applied to the next township east until the east boundary of the project area was reached. Upon reaching the east boundary of the project area, the next row of townships south was selected, beginning again at the west boundary of the project area. The method was repeated until the entire project area had been covered.

The systematic grid method of plot location resulted in the identification of 344 plots, one less than the approximate number of plots recommended by the formula. Subsequent refinement of the acreage computation for the project area reduced the final acreage to 85,328 acres, or 248 acres to be represented by each of the 344 plots established.

The developed plot grid was then overlayed onto aerial photographs of the project area, and the plot locations were pinpricked through to the photographs. The nearest transportation point to the plot center was identified and the distance and bearing from this point was scaled to the plot center.

Plot marking- All plots were well referenced so they could be easily relocated for remeasurement. An iron stake 3/8 inches in diameter and 24 inches long was driven into the ground at the plot center.
Three to six inches of the stake was left above ground and painted red. The stake was referenced by two bearing trees located outside the maximum plot radius and at approximate right angles to each other. The bearing trees were permanently scribed with the plot number on a ground-level blaze facing the plot center. A description of the bearing trees to the plot center was entered on permanent file cards for future reference. The plots were numbered consecutively starting with 201.

Plot measurement- The description and desired parameters of the plots, and the trees within them, were taken and recorded on IBM Punch cards developed for field use. Two types of field card formats were used. One format was applied to a single card to record general information concerning each plot and is called the "Plot Card". Another format was used to record measurements of trees within each plot and required an individual card for each tree. Cards with tree measurement information are called "Tree Cards".

Following are the formats used and measurements coded on the 40-column field cards.

(1) Plot Card
   a. Plot number- three digits
   b. Year of measurement- two digits
   c. Elevation- four digits
   d. Slope percent- two digits
   e. Aspect- one digit
   f. Slope position- one digit
      1- Valley bottom
      2- Lower one-third of slope
      3- Middle one-third of slope
      4- Top one-third of slope
g. Timber type - two digits

01- Douglas fir  
11- Ponderosa pine  
14- Western white pine  
15- Lodgepole pine  
33- Grand fir  
41- Engelmann spruce  
48- Hemlock  
54- Cedar  
55- Western larch  
70- Hardwoods  
91- Larch - Douglas fir  
93- Hemlock - Cedar  
94- Cedar - Grand fir

h. Crown density - one digit

0- Not classified  
1- Well stocked - 70% crown closure  
2- Medium stocked - 40% to 70% crown closure  
3- Poorly stocked - 0% to 40% crown closure  
4- Cut, reproduction  
5- Cut, no reproduction

i. Area condition class - one digit

0- Trees cut  
1- Trees present, but less than 10% of original basal area remaining  
2- Ten percent to 30% of original basal area remaining  
3- Thirty percent to 60% of original basal area remaining  
4- Over 60% of original basal area remaining  
5- Not logged  
6- Natural opening  
7- Farm or range land

j. Erosion - two digits

00- None
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Slight</td>
</tr>
<tr>
<td>11</td>
<td>Moderate</td>
</tr>
<tr>
<td>12</td>
<td>Severe</td>
</tr>
<tr>
<td>20</td>
<td>Shoestring</td>
</tr>
<tr>
<td>21</td>
<td>Slight</td>
</tr>
<tr>
<td>22</td>
<td>Moderate</td>
</tr>
<tr>
<td>23</td>
<td>Severe</td>
</tr>
<tr>
<td>30</td>
<td>Gullying</td>
</tr>
<tr>
<td>31</td>
<td>Slight</td>
</tr>
<tr>
<td>32</td>
<td>Moderate</td>
</tr>
<tr>
<td>33</td>
<td>Severe</td>
</tr>
</tbody>
</table>

k. **Stand age class—three digits.** Stand age is determined by the average age of the dominant trees.

l. **Stand density—one digit**
   - 1- High- 66% to 100%
   - 2- Medium, 33% to 66%
   - 3- Low, 0% to 33%

m. **Soil series—three digits.** These columns were left blank as the soil survey has not been completed for the survey area.

n. The number of tree seedlings, up to 1.0 inches in diameter breast high (d.b.h.), for the two most numerous species were counted on a 1/500 acre plot (radius 5.26 feet) and recorded.

   **Species—two digits.** Species code was taken from the tree card format number—three digits.

   **Species—two digits.** Species code was taken from the tree card format number—three digits.
(2) Tree Card

a. Plot number- three digits

b. Tree number- three digits. All standing trees, living or dead, 4.6 inches d.b.h. and larger were numbered. The plot was oriented to the North, and numbering proceeded in a clockwise direction. As each tree was given a number, the number was painted on the tree.

c. Species- two digits

   01- Douglas fir
   11- Ponderosa pine
   14- Western white pine
   15- Lodgepole pine
   26- Whitebark and limber pine
   31- White fir
   33- Grand fir
   36- Alpine and corkbark fir
   41- Spruce
   47- Mountain hemlock
   48- Western hemlock
   54- Western red cedar
   55- Western larch
   63- Juniper
   70- Other hardwoods
   73- Aspen
   75- Cottonwood

   d. Diameter- three digits. The diameter of all trees, except those classed as seedlings, was measured at a point 4.5 feet above mean ground level (d.b.h.). The exact point of measurement was marked with a white horizontal paint stripe to identify the point of remeasurement. The diameter measurement was recorded to the nearest 0.1 inch.

e. Tree height- three digits. Total tree height was taken for each measured tree to the nearest foot.

f. Bark thickness- three digits. The thickness of the tree bark was measured on all trees bored for age. Bark thickness was measured to the nearest .05 inch.
g. Tree age- three digits. The dominant trees on the plot were bored to determine age. Age was rounded to the nearest five years.

h. Radial growth- three digits. Radial growth for the past ten years was measured from increment borings of all trees sampled for age. Radial growth was measured to the nearest .05 inch.

i. Crown class- one digit. The crown class for each numbered tree was determined and coded as follows:

1- Dominant. Trees with crowns extending above the general level of the crown cover of the plot. Dominant trees receive full light from above and partly from the sides. The dominant is larger than the average tree in the stand and has a well-developed crown.

2- Co-dominant. Trees with crowns forming the general level of the crown cover and receiving full light from above, but comparatively little from the sides. Co-dominant trees have smaller crowns than dominants and appear crowded on the sides.

3- Intermediate. Trees shorter than the general level of the crown cover of the plot. The intermediate tree receives some direct light from above, but none from the sides. The crown of the intermediate is poorly developed and appears considerably crowded on the sides.

4- Suppressed. Trees with crowns entirely below the general level of the crown cover of the plot. Suppressed trees receive no direct light from either above or the sides.
5- Open crown. Trees growing with light from above and from all sides. Open crown trees have grown without competition in the past.

6- Released. Trees freed from competition by cutting or otherwise removing competing vegetation or branches.

j. Percent of defect- two digits. The percent of the defect in the sawlog portion of the tree was ocularly estimated and recorded. Dead trees were recorded with code 99.

k. Cause of death- one digit. An attempt was made to determine the cause of death of dead trees. Cause of death was recorded as follows:

0- Live tree
1- Insects
2- Disease
3- Fire
4- Other
5- Weather
6- Animals, other than porcupine
7- Porcupines

l. Size of plot- one digit

1- One-fifth acre plot. All trees 4.6 inches d.b.h. and larger were sampled on a 1/5 acre plot with a radius of 52.67 feet.

2- One-twentieth acre plot. All trees 1.1 inches d.b.h. to 4.5 inches d.b.h. were sampled on a 1/20 acre plot with a radius of 26.33 feet.
Appendix B

Number of plots = n = 344
Sum of volumes = $\sum X = 1477225$
Sum of squares = $\sum X^2 = 16185295550$

Mean = $\bar{X} = \frac{\sum X}{n}$

$\bar{X} = \frac{1477225}{344} = 4294.26$ board feet

Standard Deviation = $SD = \sqrt{\frac{\sum X^2 - (\sum X)^2}{n-1}}$

$SD = \sqrt{\frac{16185295550 - (1477225)^2}{344}}$

$SD = \sqrt{28693029.43} = 5356.59$ board feet

Coefficient of variation = $C = \frac{SD}{\bar{X}} \times 100$

$C = \frac{5356.59}{4294.26} \times 100 = 125\%$

Standard error of the mean = $E = \frac{SD}{\sqrt{n}}$

$E = \frac{5356.59}{18.55} = 288.76$ board feet

Sampling error expressed as a percent of the mean: $SE\% = \frac{tE}{\bar{X}} \times 100$

$SE\% = \frac{(1) \times (288.76)}{4294.26} \times 100 = 6.72\%$
APPENDIX C

Plot Card Program

   11x12, 1X13, 1X12, 1X13
10 FORMAT (13, 1X12, 1X14, 1X12, 2(1X11), 1X12, 2(1X11), 1X12, 1X13
   1X11, 1X13,
   PUNCH 11, J
11 FORMAT (14HPLOT NUMBER = 13)
   PUNCH 12, K
12 FORMAT (7HYEAR = 12)
   PUNCH 13, L
13 FORMAT (12HELEVATION = 14)
   PUNCH 14, M
14 FORMAT (16HSLOPE PERCENT = 12)
   IF(N)6, 6, 8
   6 PUNCH 7
7 FORMAT (8HNO SLOPE)
   GO TO 23
8 GO TO(15, 17, 19, 21), N
15 PUNCH 16
16 FORMAT (12HNORTH ASPECT)
   GO TO 23
17 PUNCH 18
18 FORMAT (11HEAST ASPECT)
   GO TO 23
19 PUNCH 20
20 FORMAT (12HSOUTH ASPECT)
   GO TO 23
21 PUNCH 22
22 FORMAT (11HWEST ASPECT)
23 GO TO(24, 26, 28, 30), JJ
24 PUNCH 25
25 FORMAT (30HSLOPE POSITION = VALLEY BOTTOM)
   GO TO 32
26 PUNCH 27
27 FORMAT (28HSLOPE POSITION = LOWER THIRD)
   GO TO 32
28 PUNCH 29
29 FORMAT (29HSLOPE POSITION = MIDDLE THIRD)
   GO TO 32
30 PUNCH 31
31 FORMAT (26HSLOPE POSITION = TOP THIRD)
32 IF(JK-1)213, 33, 35
213 PUNCH 214
214 FORMAT (13HTIMBER TYPE =)
   GO TO 74
33 PUNCH 34
34 FORMAT (25HTIMBER TYPE = DOUGLAS FIR)
   GO TO 74
35 IF(JK-11)36,36,38
36 PUNCH 37
37 FORMAT (28HTIMBER TYPE = PONDEROSA PINE)
  GO TO 74
38 IF(JK-14)39,39,41
39 PUNCH 40
40 FORMAT (24HTIMBER TYPE = WHITE PINE)
  GO TO 74
41 IF(JK-15)42,42,44
42 PUNCH 43
43 FORMAT (28HTIMBER TYPE = LODGEPOLE PINE)
  GO TO 74
44 IF(JK-33)45,45,47
45 PUNCH 46
46 FORMAT (23HTIMBER TYPE = GRAND FIR)
  GO TO 74
47 IF(JK-41)48,48,50
48 PUNCH 49
49 FORMAT(30HTIMBER TYPE = ENGELMANN SPRUCE)
  GO TO 74
50 IF(JK-48)51,51,53
51 PUNCH 52
52 FORMAT(21HTIMBER TYPE = HEMLOCK)
  GO TO 74
53 IF(JK-54)54,54,56
54 PUNCH 55
55 FORMAT(19HTIMBER TYPE = CEDAR)
  GO TO 74
56 IF(JK-55)57,57,59
57 PUNCH 58
58 FORMAT(19HTIMBER TYPE = LARCH)
  GO TO 74
59 IF(JK-70)60,60,62
60 PUNCH 61
61 FORMAT(23HTIMBER TYPE = HARDWOODS)
  GO TO 74
62 IF(JK-91)63,63,65
63 PUNCH 64
64 FORMAT(31HTIMBER TYPE = LARCH, DOUGLAS FIR)
  GO TO 74
65 IF(JK-92)66,66,68
66 PUNCH 67
67 FORMAT(40HTIMBER TYPE = PONDEROSA PINE, DOUGLAS FIR)
  GO TO 74
68 IF(JK-93)69,69,71
69 PUNCH 70
70 FORMAT(27HTIMBER TYPE = HEMLOCK, CEDAR)
  GO TO 74
71 IF(JK-94)72,72,74
72 PUNCH 73
73 FORMAT(29HTIMBER TYPE = CEDAR, GRAND FIR)
74 IF(JL)201,201,75
201 PUNCH 202
202 FORMAT (30HCRON DENSITY = NOT CLASSIFIED)
     GO TO 86
75 GO TO(76,78,80,82,84),JL
76 PUNCH 77
77 FORMAT(28HCRON DENSITY = WELL STOCKED)
     GO TO 86
78 PUNCH 79
79 FORMAT(30HCRON DENSITY = MEDIUM STOCKED)
     GO TO 86
80 PUNCH 81
81 FORMAT(30HCRON DENSITY = POORLY STOCKED)
     GO TO 86
82 PUNCH 83
83 FORMAT(32HCRON DENSITY = CUT, REPRODUCTION)
     GO TO 86
84 PUNCH 85
85 FORMAT(35HCRON DENSITY = CUT, NO REPRODUCTION)
86 IF(JM)87,87,89
87 PUNCH 88
88 FORMAT(32HAREON CONDITION CLASS = TREES CUT)
     GO TO 105
89 GO TO(91,93,95,97,99,101,103),JM
91 PUNCH 92
92 FORMAT(76HAREON CONDITION CLASS = LESS THAN 10 PERCENT OF ORIGINAL
     1BASEL AREA REMAINING)
     GO TO 105
93 PUNCH 94
94 FORMAT(72HAREON CONDITION CLASS = 10 TO 30 PERCENT OF ORIGINAL BASA
     1L AREA REMAINING)
     GO TO 105
95 PUNCH 96
96 FORMAT(72HAREON CONDITION CLASS = 30 TO 60 PERCENT OF ORIGIANL BASA
     1L AREA REMAINING)
     GO TO 105
97 PUNCH 98
98 FORMAT(71HAREON CONDITION CLASS = OVER 60 PERCENT OF ORIGINAL BASAL
     1 AREA REMAINING)
     GO TO 105
99 PUNCH 100
100 FORMAT(33HAREON CONDITION CLASS = NOT LOGGED)
     GO TO 105
101 PUNCH 102
102 FORMAT(38HAREON CONDITION CLASS = NATURAL OPENING)
     GO TO 105
103 PUNCH 104
104 FORMAT(41HAREON CONDITION CLASS = FARM OR RANGE LAND)
105 IF(JN)106,106,196
106 PUNCH 107
107 FORMAT(14HEROSION = NONE)
     GO TO 127
196 LM = JN-10
     121,121,121,121,121,121,121,123,125),LM
109 PUNCH 110
110 FORMAT(22HEROSION = SLIGHT SHEET)
     GO TO 127
111 PUNCH 112
112 FORMAT(24HEROSION = MODERATE SHEET)
     GO TO 127
113 PUNCH 114
114 FORMAT(22HEROSION = SEVERE SHEET)
     GO TO 127
115 PUNCH 116
116 FORMAT(27HEROSION = SLIGHT SHOESTRING)
     GO TO 127
117 PUNCH 118
118 FORMAT(29HEROSION = MODERATE SHOESTRING)
     GO TO 127
119 PUNCH 120
120 FORMAT(27HEROSION = SEVERE SHOESTRING)
     GO TO 127
121 PUNCH 122
122 FORMAT(25HEROSION = SLIGHT GULLYING)
     GO TO 127
123 PUNCH 124
124 FORMAT(27HEROSION = MODERATE GULLYING)
     GO TO 127
125 PUNCH 126
126 FORMAT(25HEROSION = SEVERE GULLYING)
     GO TO 127
127 PUNCH 128,KJ
128 FORMAT(18HSTAND AGE CLASS = 13)
     IF(KK)210,210,211
210 PUNCH 212
212 FORMAT(15HSTAND DENSITY =)
     GO TO 135
211 GO TO(129,131,133),KK
129 PUNCH 130
130 FORMAT(20HSTAND DENSITY = HIGH)
     GO TO 135
131 PUNCH 132
132 FORMAT(22HSTAND DENSITY = MEDIUM)
     GO TO 135
133 PUNCH 134
134 FORMAT(19HSTAND DENSITY = LOW)
135 PUNCH 137
137 FORMAT(14HSIO SERIES = )
138 PUNCH 139
139 FORMAT(9HSEEDLINGS)
     DO 215 I=1,2
195 IF(KM)191,191,140
140 IF(KM-01)141,141,143
141 PUNCH 142,KN
142 FORMAT(2X13,12H DOUGLAS FIR)
     GO TO 190
38

143 IF(KM-11)144,144,146
144 PUNCH 145,KN
145 FORMAT (2X13,15H PONDEROSA PINE)
   GO TO L()
146 IF(KM-14)147,147,149
147 PUNCH 148,KN
148 FORMAT (2X13,11H WHITE PINE)
   GO TO 190
149 IF(KM-15)150,150,152
150 PUNCH 151,KN
151 FORMAT(2X13,15H LODGEPOLE PINE)
   GO TO 190
152 IF(KM-26)153,153,155
153 PUNCH 154,KN
154 FORMAT(2X13,38H WHITE BARK, LIMBER, BRISTLE LONE PINE)
   GO TO 190
155 IF(KM-31)156,156,158
156 PUNCH 157,KN
157 FORMAT(2X13,10H WHITE FIR)
   GO TO 190
158 IF(KM-33)159,159,161
159 PUNCH 160,KN
160 FORMAT(2X13,10H GRAND FIR)
   GO TO 190
161 IF(KM-36)162,162,164
162 PUNCH 163,KN
163 FORMAT(2X13,24H ALPINE AND CORKBARK FIR)
   GO TO 190
164 IF(KM-41)165,165,167
165 PUNCH 166,KN
166 FORMAT(2X13,7H SPRUCE)
   GO TO 190
167 IF(KM-47)168,168,170
168 PUNCH 169,KN
169 FORMAT(2X13,17H MOUNTAIN HEMLOCK)
   GO TO 190
170 IF(KM-48)171,171,173
171 PUNCH 172,KN
172 FORMAT(2X13,16H WESTERN HEMLOCK)
   GO TO 190
173 IF(KM-54)174,174,176
174 PUNCH 175,KN
175 FORMAT(2X13,18H WESTERN RED CEDAR)
   GO TO 190
176 IF(KM-55)177,177,179
177 PUNCH 178,KN
178 FORMAT(2X13,6H LARCH)
   GO TO 190
179 IF(KM-63)180,180,182
180 PUNCH 181,KN
181 FORMAT(2X13,8H JUNIPER)
   GO TO 190

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182 IF(KM=70)183,183,185
183 PUNCH 184,KN
184 FORMAT(2X13,16H OTHER HARDWOODS)
   GO TO 190
185 IF(KM=73)186,186,188
186 PUNCH 187,KN
187 FORMAT(2X13,6H ASPEN)
   GO TO 190
188 IF(KM=75)189,189,190
189 PUNCH 190,KN
190 FORMAT(2X13,11H COTTONWOOD)
190 KM=LJ
215 KN=LK
   GO TO 999
191 PUNCH 197
197 FORMAT(6H NONE)
999 PUNCH 1000
1000 FORMAT(79X,1H+)
   GO TO 1
END.

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TREE CARD PROGRAM

*0604

DIMENSION R(46,10), AB(18,18), BC(18), IA(10,18)
READ 280,((IA(I,J),I=1,10),J=1,18)

280 FORMAT (10A2)
READ 1,((R(I,J),I=5,50),J=1,10)
1 FORMAT (16F5.3)

201 N2 = 0
NN = 0
DO 191 I=1,18
DO 190 J=1,18
190 AB(I,J) = 0.0
191 BC(I) = 0.0
READ 181, N1
181 FORMAT (/13)
200 IF(N1-N2)220,220,230
230 READ 2,NK,L,M,A,B,C,N,D,EE,JK,JL
2 FORMAT (13,1X13,1X12,F4.1,F4.0,F4.2,1X13,F4.2,1X11,F3.2,2(1X11)
N2 = N2+1
P = 5.5
AN = N
BA = (((A/2.)*2)*3.142)/144.0)*5.0
S = (A*A*B*5.0)/100.0
IF(A-4.5)9,9,5
5 DO 8 I=4,49
IF(A-P)6,6,8
6 I = I+1
GO TO 9
8 P = P+1.0
I = 50
9 IF(M-1)179,10,29
10 J = 4
IF(A-9.5)12,12,11
11 X = S*1.003-126.66
26 IF(JK)12,309,12
309 AB(K,11) = AB(K,11)+X*(1.0-E)
BC(1) = BC(1)+X*(1.0-E)
12 IF(AN)13,13,219
219 AB(K,14) = AB(K,14)+AN
BC(5) = BC(5)+AN
AB(K,18) = AB(K,18)+1.0
BC(9) = BC(9)+1.0
AB(K,15) = AB(K,15)+B
BC(6) = BC(6)+B
BC(8) = BC(8)+D
BC(7) = BC(7)+C
13 IF(A-4.5)14,14,15
14 AB(K,1) = AB(K,1)+BA*4.0
BC(4) = BC(4)+BA*4.0
NN = NN+20
GO TO 200
NN = NN+5
  IF(A-9.5)16,16,17
16 IF(JK)18,18,19
18 AB(K,2) = AB(K,2)+BA
   BC(4) = BC(4)+BA
   AB(K,7) = AB(K,7)+S*R(I,J)
28 BC(3) = BC(3)+S*R(I,J)
   GO TO 200
19 IF(JK-9)300,301,300
300 AB(K,12)=AB(K,12)+S*R(I,J)
   AB(1,16)=AB(1,16)+S*R(I,J)
   GO TO 200
301 NN=NN-5
27 BC(2) = BC(2)+S*R(I,J)
   GO TO 200
17 IF(JK)20,20,21
20 AB(K,9) = AB(k,9)+S*R(I,J)
   BC(3) = BC(3)+S*R(I,J)
   GO TO (22,23,24,25,22,22),JJ
22 AB(K,3) = AB(K,3)+BA
23  BC(4) = BC(4)+BA
   GO TO 200
23  AB(K,4) = AB(K,4)+BA
   GO TO 235
24  AB(K,5) = AB(K,5)+BA
   GO TO 235
25  AB(K,6) = AB(K,6)+BA
   GO TO 235
21 IF(JK-9)303,304,303
304 NN=NN-5
303 AB(K,10) = AB(K,10)+S*R(I,J)
   GO TO 27
29 IF(M-11)179,30,32
30 J = 2
   K = 2
   IF(A-9.5)12,12,31
31 X = S*1.201-251.7
   GO TO 26
32 IF(M-14)179,33,35
33 J = 1
   K = 3
   IF(A-9.5)12,12,34
34 X = S*1.189-136.645
   GO TO 26
35 IF(M-15)179,36,38
36 J=8
   K = 4
      IF(A-9.5)12,12,37
37 X = S*1.208-40.425
   GO TO 26
38 IF(M-26)179,39,41
39 J=8
   K = 5
      IF(A-9.5)12,12,37
40 IF(M-31)179,42,44
41 J = 5
   K = 6
      IF(A-9.5)12,12,43
42 X = S*1.293-170.635
   GO TO 26
43 IF(M-33)179,45,47
44 J = 5
   K = 7
      IF(A-9.5)12,12,43
45 IF(M-36)179,48,50
46 J = 5
   K = 8
      IF(A-9.5)12,12,49
47 X = S*1.011-57.015
   GO TO 26
48 IF(M-41)179,51,53
49 J = 6
   K = 9
      IF(A-9.5)12,12,52
50 IF(M-47)179,54,56
51 J = 5
   K = 10
      IF(A-9.5)12,12,55
52 X = S*1.149-59.255
   GO TO 26
53 IF(M-48)179,57,59
54 J = 5
   K = 11
      IF(A-9.5)12,12,55
55 IF(M-54)179,60,62
56 J = 7
   K = 12
      IF(A-9.5)12,12,61
57 X = S*0.878-53.71
   GO TO 26
58 IF(M-55)179,63,65
59 J = 3
   K = 13
      IF(A-9.5)12,12,64
43

64 \( X = S \times 0.997 - 148.95 \)
   GO TO 26
65 IF \((M-63)\) 179, 66, 68
66 \( J = 5 \)
   \( K = 14 \)
   GO TO 11
68 IF \((M-70)\) 179, 69, 71
69 \( J = 9 \)
   \( K = 15 \)
   IF \((A - 9.5)\) 12, 12, 70
70 \( X = S \times 1.046 - 79.83 \)
   GO TO 26
71 IF \((M-73)\) 179, 72, 74
72 \( J = 10 \)
   \( K = 16 \)
   IF \((A - 9.5)\) 12, 12, 73
73 \( X = S \times 1.197 - 92.72 \)
   GO TO 26
74 IF \((M-75)\) 179, 75, 179
75 \( J = 9 \)
   \( K = 17 \)
   IF \((A - 9.5)\) 12, 12, 70
179 \( J = 2 \)
   \( K = 18 \)
   IF \((A - 9.5)\) 12, 12, 31
220 DO 225 \( K = 1, 18 \)
   IF \((A(B(K,18))\) 225, 225, 224
224 \( A(B(K,15)) = \frac{A(B(K,15))}{A(B(K,18))} \)
   \( A(B(K,14)) = \frac{A(B(K,14))}{A(B(K,18))} \)
225 CONTINUE
   IF \((B(C(9))\) 252, 252, 250
250 \( B(C(10)) = \frac{B(C(5))}{B(C(9))} \)
   \( B(C(11)) = \frac{B(C(6))}{B(C(9))} \)
   \( B(C(12)) = \frac{B(C(7))}{B(C(9))} \)
   \( B(C(13)) = \frac{B(C(8))}{B(C(9))} \)
252 PUNCH 211, NK, NN
211 FORMAT \((14H\text{PLOT NUMBER} = 13/49H\text{NUMBER OF TREES PER ACRE 1 INCH DBH AND LARGER} = 15/35H\text{AVERAGE AGE AND HEIGHT OF DOMINANTS})\)
   DO 260 \( K = 1, 18 \)
   IF \((A(B(K,14))\) 260, 260, 261
261 PUNCH 262, \((I(A(I,K)), I=1,10)\), \(A(B(K,14))\), \(A(B(K,15))\)
262 FORMAT \((10A2,F&.1,F8.1)\)
260 CONTINUE
   PUNCH 213, BC(10), BC(11), BC(13), BC(12)
213 FORMAT \((13H\text{ALL SPECIES}, F14.1, F8.1/19H \text{RADIAL GROWTH} = F6.2/20H \text{BARK THICKNESS} = F5.2/12HVOLUME TABLE/8H \text{SPECIES}, 16X26HCUBIC FEET TO A 4 INCH TOP, 5X19HSCRIBNER BOARD FEET/26X5H\text{GREEN}, 14X4H\text{DEAD, 13X5H\text{GREEN}/20X7H4.6 - 9.5, 5X4H9.6+, 3X7H4.6 - 9.5, 4X4H9.6+, 6X4H9.6+})\)
   DO 263 \( K = 1, 18 \)
   IF \((A(B(K,7))\) 264, 264, 265
264 IF \((A(B(K,9))\) 266, 266, 265
266 IF \((A(B(K,8))\) 267, 267, 265
267 IF \((A(B(K,10))\) 263, 263, 265

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PUNCH214,(IA(I,K),I=1,10),AB(K,9),AB(K,8),AB(K,10),AB(K,11)

FORMAT(10A2,F8.1,3F9.1,F11.1)

CONTINUE

PUNCH 216,BC(3),BC(2),BC(1)

FORMAT(7H14TOTAL,18XF9.1,9XF9.1,4XF10.1,16HBASAL AREA TABLE/8H SPECIES,12X14DIAMETER CLASS/22X5H4.5-9.5,12X5H4.6-9.5,13X4H9.6+/40X3HD 20M,4X5HCODOM,4X3HINT,5X3HSUP)

DO 269 K=1,18
   DO 268 L=1,6
      IF (AB(K,L))268,268,270
   268 CONTINUE
   269 CONTINUE

PUNCH 218,BC(4)

FORMAT(10H14TOTAL = 10XF8.2)

PUNCH 308
   DO 305 K=1,18
   DO 306 L=12,13
      IF (AB(K,L))306,306,307
   306 CONTINUE
   305 CONTINUE

FORMAT(//16HCUBIC VOLUME CUT/8H SPECIES,12X14DIAMETER CLASS/22X7H 14.6-9.5,6X3H9.6)

FORMAT(10A2,F8.1,F9.1)

PUNCH 310,AB(1,16)

FORMAT(7H14TOTAL18XF9.1)

PUNCH 511

FORMAT(79X,1H-)

GO TO 201

END
SUMMARY PROGRAM

*1004
DIMENSION T1(10,6),T2(11,14),T3(11,14),T4(11,14),T5(11,5),T6(10,14)
     T7(7,9),A(14,11),D(11),C(7,11)
READ 32,((C(I,J),I=1,13),J=1,11)
32 FORMAT(7A2)
91 DO 40 I=1,14
     DO 40 J=1,11
40 A(I,J)=0.0
READ 22,A
50 READ 23,N
     IF(N-14)50,51,51
51 READ 24
     READ 1,N3,(D(L),L=1,5)
     DO 52 I=1,13
     IF (N3-I) 35,35,52
52 CONTINUE
     GO TO 42
35 DO 43 K=1,5
     A(I,K)=D(K)+A(I,K)
     GO TO 41
42 READ 25
     READ 2,N4,(D(L),L=6,11)
     DO 56 I=1,14
     IF (N4-I) 56,59,56
56 CONTINUE
     IF(I-14)36,37,37
36 DO 45 K=6,11
     A(I,K)=D(K)
     GO TO 57
37 L=1
     M=0
      DO 60 I=1,13
      L=L+1
      DO 38 J=L,13
      IF(A(I,5)-A(J,5))60,60,61
38 CONTINUE
      M=I
60 CONTINUE
      IF(A1-1.)62,63,63
58 M1=1
      GO TO 49
63 IF (D(5)-1.) 65,67,67
59 M1=2
      GO TO 49
65 IF (D(5)-1000. ) 68,69,69
56 M1=3
      GO TO 49
67 IF (D(5)-3000.) 70,71,71
59 M1=4
      GO TO 49

46

71 IF (D(5)-5000.) 72,73,73
72 M1=5
    GO TO 49
73 IF (D(5)-7500.) 74,75,75
74 M1=6
    GO TO 49
75 IF (D(5)-10000.) 76,77,77
76 M1=7
    GO TO 49
77 IF (D(5)-15000.) 78,79,79
78 M1=8
    GO TO 49
79 M1=9
49 IF (D(6)-01.) 80,81,81
80 M2=1
    GO TO 48
81 IF (D(6)-30) 82,83,83
82 M2=2
    GO TO 48
83 IF (D(6)-50.) 84,85,85
84 M2=3
    GO TO 48
85 IF (D(6)-120.) 86,87,87
86 M2=4
    GO TO 48
87 IF (D(6)-170.) 88,89,89
88 M2=5
    GO TO 48
89 M2=6
48 DO 90 I=2,14
    T2(M1,I)=T2(M1,I)+A(I-1,1)
    T3(M1,I)=T3(M1,I)+A(I-1,5)
90 T4(M1,I)=T4(M1,I)+A(I-1,6)+A(I-1,7)+A(I-1,8)+A(I-1,9)+A(I-1,10)+A(I-1,11)
    DO 107 I=1,13
107 T2(M1,1)=T2(M1,1)+A(I,1)
    T3(M1,1)=T3(M1,1)+D(5)
    T4(M1,1)=T4(M1,1)+A(14,6)
    T6(M1,1)=T6(M1,1)+248.
    T6(M1,M+1)=T6(M1,M+1)+248.
    DO 92 I=2,4
    DO 92 J=1,13
92 T7(M2,I)=T7(M2,I)+A(J,6)
    T7(M2,5)=T7(M2,5)+A(14,6)
    T7(M2,1)=T7(M2,1)+248.
    T1(M1,1)=T1(M1,1)+A1
    DO 93 I=1,13
93 T1(M1,2)=T1(M1,2)+A(I,3)+A(I,4)
    GO TO 91
94 DO 95 I=1,9
    T1(10,1)=T1(10,1)+T1(I,1)

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DO 96 J=1,14
DO 96 I=1,9
T2(10,J)=T2(10,J)+T2(I,J)
T3(10,J)=T3(10,J)+T3(I,J)
T4(10,J)=T4(10,J)+T4(I,J)
96 T6(10,J)=T6(10,J)+T6(I,J)
DO 97 J=1,9
DO 97 I=1,7
T7(8,J)=T7(8,J)+T7(I,J)
97 T5(I,1) = T6(I,1) / T6(I,1)
T5(I,2) = T2(I,1) / T6(I,1)
T5(I,3) = T1(I,2) / T6(I,1)
T5(I,4) = T3(I,1) / T6(I,1)
98 T5(I,5) = T4(I,1) / T6(I,1)
CC = T6(10,1) - T6(1,1)
C1 = CC - T6(2,1)
T5(10,1) = T1(I,1) / T6(1,1)
T5(11,1) = (T1(10,1) - T1(2,1)) / C1
T5(10,2) = T2(10,1) / CC
T5(11,2) = (T2(10,1) - T2(2,1)) / C1
T5(10,3) = T3(10,1) / CC
T5(11,3) = (T3(10,1) - T3(2,1)) / C1
T5(10,4) = T4(10,1) / CC
T5(11,4) = (T4(10,1) - T4(2,1)) / C1
T5(10,5) = T5(10,1)
DO 99 I=2,9
T5(I,3) = XN / T6(I,1)
99 DD = T5(10,3) = T1(I,2)
T5(10,3) = DD / CC
T5(11,3) = (DD - T5(2,3)) / C1
DO 100 I=2,14
T2(11,10) = (T2(10,1) / T2(10,1)) * 100.
T3(11,1) = (T3(10,1) / T3(10,1)) * 100.
100 T4(11,1) = (T4(10,1) / T4(10,1)) - 100.
PUNCH 3
PUNCH 4
PUNCH 5
PUNCH 6
PUNCH 7.
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DO 101 J=1,11
 101 PUNCH 10,((C(I,J),I=1,7),(T2(J,K),K=1,5)
    PUNCH 7
    PUNCH 11,((T2(I,J),J=6,12),I=1,11)
    PUNCH 7
    PUNCH 12,((T2(I,J),J=12,14),I=1,11)
    PUNCH 7
    PUNCH 13
    DO 102 J=1,11
 102 PUNCH 10,((C(I,J),I=1,7),(T3(J,K),K=1,5)
    PUNCH 7
    PUNCH 11,((T3(I,J),J=6,12),I=1,11)
    PUNCH 7
    PUNCH 12,((T3(I,J),J=12,14),I=1,11)
    PUNCH 14
    DO 103 J=1,11
 103 PUNCH 10,((C(I,J),I=1,7),(T4(J,K),K=1,5)
    PUNCH 7
    PUNCH 11,((T4(I,J),J=6,12),I=1,11)
    PUNCH 7
    PUNCH 12,((T4(I,J),J=12,14),I=1,11)
    PUNCH 15
    DO 104 J=1,11
 104 PUNCH 10,((C(I,J),I=1,7),(T6(J,K),K=1,5
    PUNCH 7
    PUNCH 11,((T6(I,J),J=6,12),I=1,11)
    PUNCH 7
    PUNCH 12,((T6(I,J),J=12,14),I=1,11)
    PUNCH 16
    DO 105 J=1,9
 105 PUNCH 17,((C(I,J),I=1,7),(T5(J,K),K=1,5)
    PUNCH 18,((T5(I,10),K=1,5),(T5(I,11),K=1,5)
    PUNCH 7
    PUNCH 19,((T7(1,10),I=1,5),(T7(2,1),I=1,5)
    PUNCH 20,((T7(3,1),I=1,5),(T7(4,1),I=1,5),(T7(5,1),I=1,5),(T7(6,1),I=1,5)
    PUNCH 7
    DO 106 I=1,7
 106 PUNCH 21,(T7(I,J),J=6,9)
  GO TO 91
1 FORMAT (I2,18X,F8.1,3F9.1,F11.2)
2 FORMAT (I2,18X,F8.2,F9.2,F8.2,F7.2,2F8.2/)
3 FORMAT(19X26HSANDERS COUNTY CFI PROJECT///64HAPPENDIX TABLE 1. PRO
  1JECT ACRE AND VOLUME BY BOARD FOOT CLASSES///41X11HGREEN CUBIC/12H
  2STAND CLASS,15X9HTOTAL NO.6X11HFOOT VOLUME,4X10HDEAD CUBIC/13HBY
  3BOARD FEET,4X6HNO. OF,4X10HSTEMS 1.0',6X7H4.6' TO,6X11HFOOT VOLUME
  4)
FORMAT(10H PER ACRE, 7X5HACRES, 5X10HAND LARGER, 4X11H 9.5' D.B.H., 4X11H 9.6' D.B.H.)
5 FORMAT(/9H NO TIMBER, 7X7F.0//1OH NO SAWLGS, 6X7F.0, 3F14.0//13H 1000 B
1D. FT., 3XF7.0, F4.0//10H 1000--3000, 8XF7.0, 3F14.0//9H 1000--3000, 8X
2F7.0, 3F14.0//9H 1000--7500, 8XF7.0, 3F14.0//10H 7500--10000, 7XF7.0, 3F14.
30//11H 10000--15000, 6XF7.0, 3F14.0//6H 15000+10XF7.0, 3F14.0//5H TOTAL, 1
41XF9.0, 3F14.0)
6 FORMAT(/3H TOTAL BOARD, 5X1HTOTAL BASAL/6X1HFOOT VOLUME, 5
1X10H AREA 1.0+/6X12H+.6+' D.B.H., 6X6HD.B.H.///18XF15.8, 13XF15.0)
7 FORMAT(/7X1H2)
8 FORMAT(///6X11HTOTAL BOARD, 5X1HTOTAL BASAL/6X1HFOOT VOLUME, 5
1X10H AREA 1.0+/6X12H+.6+' D.B.H., 6X6HD.B.H.///18XF15.8, 13XF15.0)
9 FORMAT(/7X1H2)
10 FORMAT(/7A2, F13.0)
11 FORMAT(/14HALPINE, GRAND,, 12H ENGLEMANN, 47X5HOTHER/13HAND
1HITE FIR, 5X6HSPRUCE, 8X7HHEMLOCK, 8X5HCEHAR, 8X5HLARCH, 4X9HHAHDWODWS/ 2/6F13.0)
12 FORMAT(/3X9HALL OTHER/8X5HASPEN, 3X1OHCUJTONWOOD, 4X7HSPESIES/ 1/3F13.0)
13 FORMAT(/6X58HTABLE 3 BOARb FOOT VOLUME BY SPECIES BY BOARb FOOT CLA
1SSES//35X12H 9.6+' D.B.H.)
14 FORMAT(/6X51HTABLE 4 BASAL AREA BY PER ACRE CLASS//3
10X12H 1.0+' D.B.H.)
15 FORMAT(/6X56HTABLE 6 TIMBER TYPE AREAS BY BOARD FEET PER ACRE CLASS
1ES//35X5HACRES)
16 FORMAT(/6X6HTABLES 5 AVERAGE NUMBERS AND VOLUMES PER ACRE BY BOARD 1FOOT CLASSES//12H STAND CLASS, 16X1OHCUJIC FOOT, 3X1OHCUJIC FOOT, 3X1
20HBOARD FOOT, 1/13HB BOARD FEET, 3X 9HNUMBER OF, 14H VOLUME GREEN, 13
3H VOLUME DEAD, 4X6HVOLUME, 2X10HBASEAL AREA/10H PER ACRE, 5X10HSTEMS
41.0+', 3X 9H 4.6'-9.5', 7X5H4.6+', 7X5H9.6+', 4X5H1.0+')
17 FORMAT(/7A2, 5F12.0)
18 FORMAT(/14H AVERAGE FOR 5F12.0/14H TIMBERED LAND/14H AVERAGE FOR
1R, 5F12.0/13H SAWLOG LAND)
19 FORMAT(/9X4HHTABLE 7 BASAL AREA TABLE BY BASAL AREA CLASSES//15X11H 1TOTAL ACRES, 10X16HTOTAL BASAL AREA, 14X5HTOTAL/16X8HIN BASAL, 12X17H
2B2Y D.B.H. CLASSES, 11X1HSQUARE FEET/12H BASAL AREA, 3X1OHERA CLAS
3S, 3X9H1.0 '=' 4.5', 3X1OH4.6'--9.5', 6X5H9.6'+, 3X1OHBASEAL AREA//14H NO
4BASEAL AREA, 5F12.0/14H 0.01 TO 30.00, 5F12.0/13H SQUARE FEET)
20 FORMAT(/14H30.01 TO 50.00, 5F12.0/13H SQUARE FEET/14H50.01 TO 120.0 1, 5F12.0/13H SQUARE FEET/14H120.0 TO 170.0, 5F12.0/13H SQUARE FEET 2/3X11H170.01+ , 5F12.0/13H SQUARE FEET/4X8HTOTAL, 5X5F12.0)
21 FORMAT(/19X19HPER ACRE BASAL AREA, 11X7HAVGAGE/10X17HBY D.B.H. CLA
1SSES, 10X8HPER ACRE/2X9H1.0'--4.5', 3X9H496'--9.5', 7X5H9.6'+, 2X10HBASEA
2L AREA, 5XF12.0)
22 FORMAT (/48X, F6.0//)
23 FORMAT (/12)
24 FORMAT (/48X)
25 FORMAT (/48X)
END
BIBLIOGRAPHY


