

This document is made available electronically by the Minnesota Legislative Reference Library as part of an ongoing digital archiving project. <u>http://www.leg.state.mn.us/lrl/lrl.asp</u>

(Funding for document digitization was provided, in part, by a grant from the Minnesota Historical & Cultural Heritage Program.)





SD 436 .M6 T53

T)



Department of Natural Resources Division of Forestrue July 1, 1983

Pursuant to 1982 Laws, Chapter Section 21

831242

TIMBER APPRAISAL STANDARDS

ć.

July 1, 1983

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF FORESTRY

TABLE OF CONTENTS

								PAGE
	·	EXECUTIVE SUMMARY			• • •	• •		i
Ι.		INTRODUCTION & ORGANIZATION	•	• • •	• • •			I-1
II.		MAXIMUM ALLOWABLE APPRAISAL ERROR		• • •		• •	•••	II -1
		Introduction					•••	II-1
		Definitions	•		• • •	•••	• •	II1
		Allowable Error	•	•••		••	•••	II-1
		Methods to Achieve Accuracy	•			•••	•••	II-2
		Summary & Recommendations	•	• • •	• • •	• •	•••	II-4
III.		PROCEDURE FOR DEFECT ALLOWANCE	•	•••	• • •	••	••	III-1
		Introduction	•	•••		• •	•••	III-1
		Methods	•	••		••	••	III-1
		Summary & Recommendations	•	• • •	• • •	••	•••	III-2
IV.		TRACT AREA ESTIMATION	•	•••		• •	•••	IV-1
		Introduction	•	•••	• • •	• •	• •	IV-1
		Methods	•	• • •		•••	•••	IV-1
		Equipment & Tools Needed	•	•••	•••	••		IV-2
		Summary and Recommendations	•	•••		••	•••	IV-2
V.		PRODUCT VOLUME ESTIMATION	•		•••	• •	• •	V-1
		Introduction	•	•••	•••	• •	••	V-1
		Methods to Use	•	•••	••	••		V-1
		Accuracy Required	•	• • •	•••	• •	• •	V-3
		Volume Tables	•	• • •	• •	• • •	• •	V-3
		Equipment and Materials	•		•••	•••	•••	V-4
		Summary and Recommendations	•			• • •	• •	V-4

		PAGE
VI.	PRODUCT VALUE DETERMINATION	VI-1
	Introduction	VI-1
	Value Determination	VI-1
	Summary and Recommendations	VI-4
VII.	CONCLUSIONS AND RECOMMENDATIONS	VII-1
	APPENDIX	III-1
	Allowable Error	A-1
	Defect Allowance	B -1
	Volume Estimation	C-1
	Value Determination	D-1

EXECUTIVE SUMMARY

The Department of Natural Resources (DNR), Division of Forestry is charged by law with managing timber on all state lands (MSA 84.027 Subd. 2 and 90.041 Subd. 1). A significant portion of this management involves appraising and preparing for sale mature and merchantable timber. Various other laws authorize the DNR to sell state timber stumpage according to certain standards and policies.

In June 1981, the Legislative Audit Commission directed the Program Evaluation Division to conduct an evaluation of the DNR's timber sales program. Legislators were concerned about the prices charged by the state for its timber, the ability of different sale methods to produce state revenues, and the adequacy of timber sale procedures. A major portion of this evaluation focused on the quality of timber appraisals. An appraisal experiment was conducted to examine the practices of DNR appraisers. The final report of the timber sales evaluation was completed in February 1982 and submitted to the Legislative Audit Commission for final review. As a result of this evaluation and other concerns expressed by the legislature and the public, Section 21 of the Forest Resource Management Act of 1982 was written to address timber sale procedures.

Section 21 of the Forest Resource Management Act states "By July 1, 1983, the commissioner shall establish specific timber appraisal standards according to which all timber appraisals will be conducted under chapter 90." Various areas of concern were to be addressed when establishing these standards. In response to that charge, this report was prepared, listing in detail the different aspects of timber appraisal procedure.

APPRAISAL STANDARDS

All aspects of appraisal standards were reviewed. These included various methods of sampling procedures to estimate volume, accurate ways to determine the sale area size, methods used to deduct defective tree volumes, ways to calculate net volume on a sale area, and methods for determining prices to be charged for timber.

It should be recognized that many of these subject areas over lap and are difficult to distinguish from one another. Therefore, recommendations for one subject may reflect upon another.

RECOMMENDATIONS & CONCLUSIONS

Many recommendations are made in this report to assure the successful implementation of standard appraisal procedures. Most are neither new nor complicated, but rather revisions of current methods. In summary, it was concluded that accurate appraisals based on given policy standards can be achieved if proper procedures and guidelines are strictly followed. Emphasis must be placed on accurate collection of field data. Accurate measurements rather than estimations, must be required.

It must be realized by everyone concerned that additional time and expertise are necessary if established standards of accuracy are to be met. Quantity may be sacrificed for quality, but this should be viewed as a gain rather than a loss.

Recommendations regarding the various aspects of appraisals are contained in each section of this report, with a summary of all recommendations in Section VII. Generally, this review demonstrates that the Division of Forestry has a reliable

i

EXECUTIVE SUMMARY

timber appraisal system, but that the system can be improved by setting stricter levels of acceptance and by "measuring" rather than "estimating" field data. The recommended appraisal standards should be incorporated into the <u>Timber' Sales</u> Manual.

SECTION I

INTRODUCTION & ORGANIZATION

Management of timber resources on state owned land is carried out under the jurisdiction of the Commissioner of Natural Resources and is the direct responsibility of the Division of Forestry. This is a multimillion dollar operation annually. In fiscal year 1982, the Division of Forestry sold and administered 1,810 timber permits involving more than 430,000 cords of forest products and totaling over 3.6 million dollars in gross receipts to the state. Legislative and public concerns over the administration of state timber sales prompted the Legislative Audit Commission in June 1981, to direct the Program Evaluation Division to conduct an evaluation of the DNR's timber sales program. These concerns primarily involved the prices charged by the state for timber, the ability of different sale methods to produce state revenue, and the adequacy of timber sales procedures. The study of the Program Evaluation Division focused on many facets of the program but mainly on appraisals. Specifically the study examined the questions, (1) how accurate and consistent are DNR's timber appraisals and (2) how adequate are DNR's method of setting prices for state timber? The completed report was submitted in February 1982 and contained several recommendations regarding appraisals and prices.

The appraisal experiment conducted by the Program Evaluation Division to test DNR capabilities indicated that there was much the department could do to standardize its appraisal methods and to provide better training and guidance for its field staff. The report recommended that the legislature require the DNR to establish detailed appraisal standards which would include all the various aspects of appraisal work.

Among other things, the report concluded the application of price guide factors (PGF's) by DNR appraisers was subjective and variable. It recommended that the Division of Forestry eliminate those factors which are applied least consistently and establish stringent guidelines to ensure that the remaining PGF's are applied uniformly.

FOREST MANAGEMENT ACT

As a result, Section 21 was incorporated into the Forest Resource Management Act of 1982. Section 21 reads:

"By July 1, 1983, the commissioner shall establish specific timber appraisal standards according to which all timber appraisals will be conducted under chapter 90. The standards shall include a specification of the maximum allowable appraisal sampling error, and the procedures for tree defect allowance, tract area estimation, product volume estimation, and product value determination. The timber appraisal standards shall be included in each edition of the timber sales manual published by the commissioner. In addition to the duties pursuant to section 90.061, every state appraisal standards. The standards shall not be subject to the rulemaking provisions of chapter 15."

ORGANIZATION & SCOPE

In early Spring 1982, the Director of the Division of Forestry appointed the Timber Sales Task Force to study the Legislative Auditor's report and to make preliminary recommendations regarding the timber sales program. The task force conducted many interviews with district and staff foresters and laid the ground work necessary for establishing standard appraisal procedures. After the Forest Resource Management Act was passed, the Timber Appraisal Standards Committee (TASC) was formed to respond to the legislative charge. The TASC prepared the following report, based in part upon information from the Timber Sales Task Force and with additional interviews and discussion with DNR field foresters, the College of Forestry and the U.S. Forest Service.

This report covers in detail the five major subject areas outlined in the Forest Resource Management Act. They are:

1.	Maximum Appraisal Sampling Error	Section	II
2.	Procedure for Defect Allowance	Section	III
3.	Tract Area Estimation	Section	IV
4.	Product Volume Estimation	Section	V
5.	Product Value Determination	Section	VI

Each section contains recommendations which are in turn summarized in Section VII.

SECTION II

MAXIMUM ALLOWABLE APPRAISAL ERROR

A. INTRODUCTION

The Division of Forestry is charged with managing timber resources on all state owned land that is administered by the Department of Natural Resources. A major part of this management involves selling and harvesting mature timber. Before standing timber can be sold it must be appraised to assure that the State receives its fair value. By law, no timber can be sold for less than its appraised value.

B. DEFINITIONS

The term "appraisal" (sometimes referred to as "cruise") has been defined by several sources. Some of the definitions are:

"An estimate of the volume and value of forest products proposed for sale and specifications of the forestry practices to be followed in cutting and removal of these products." (DNR, 1982)

"Stumpage appraisal is to estimate at a particular point in time, the value of standing timber available for cutting on a particular area." (Forest Management, Davis, 1966, McGraw - Hill, p. 381)

"The act of estimating or evaluating, especially by one fitted to judge." (Webster's Third New International Dictionary, G. & C. Merrian Co., 1976)

"The purpose of estimating standing timber is to determine the quantity of specific products which can be cut from a definite area, and the estimate usually is made to furnish a basis for purchase or sale." (Woodsman's Handbook, Graves & Ziegler, 1912, USDA Forest Service Bulletin 36, p. 58)

"An approximate determination of the volume and quality of standing timber." (DNR, 1983)

It should be noted that in all the definitions the word "estimate" or "approximate" is used. A timber appraisal is just that, an estimate of the volume of wood to be harvested from a particular site or area, prepared by someone qualified to do so. Appraisals are not an exact science and should not be treated as such. Many factors enter into an appraisal. These factors will be discussed in subsequent sections of this report.

C. ALLOWABLE ERROR

Appraisals made to a predetermined degree of accuracy can best be accomplished by requiring exacting sampling information. An appraiser can be statistically correct, but still not achieve accurate volume estimates because time and effort were not expended to gather accurate sample plot information and to determine acreage correctly. Because of the variability in methods used by appraisers, more standardized statistical methods for appraising timber are needed. The methods described in sub-section D are designed to achieve this objective. Because an appraisal is an estimate, based on judgement, and one-hundred percent accuracy is neither attainable nor necessary, some degree of error is inevitable. Limits of error, however, must be established. Following are two recommendations which may serve as limits of error for DNR timber appraisals:

- 1. For sales that will be scaled, the required appraisal accuracy should be within 20% of total volume and value, 80% of the time.
- 2. For sales that are sold on appraised volume (i.e., will not be scaled) the required appraisal accuracy should be within 10% of the total volume, 80% of the time.

Limits of error more exacting than those recommended were considered, but the additional costs and time did not seem justified.

D. METHODS TO ACHIEVE ACCURACY

Several recommendations are made in this section and the following sections on how to achieve the desired standards of accuracy. These recommendations relate to items such as:

- 1. Number of sample plots required.
- 2. Performance record of individual appraisers.
- 3. Position description and performance indicators.
- 4. Exact mandatory plot measurements.
- 5. Revision of tally sheets.
- 6. Standardizing methods of estimating defect.
- 7. Exact measurement of sale area (acres).
- 8. Standardization of sampling methods to determine volume.

All of these items involve standards of accuracy or error levels and all are interrelated. Items 1 - 3 will be discussed in this section; the remaining items will be discussed as follows:

-	Exact plot measurements	Section	V	
-	Revision of tally sheets	Section	III,	V
-	Estimating defect	Section	III	
	Measurements of sale area	Section	IV	
- .	Sampling methods	Section	V	

1. Number of Sample Plots Required.

The number of plots necessary to sample an area for an appraisal to a predetermined degree of accuracy is based on the coefficient of variation (CV). The CV is a statistical measurement of the variation of volume in a stand of timber. It can be determined by a pre-cruise or pre-sampling of the sale area, which often requires more time than the actual appraisal. The CV can also be determined or estimated by other means such as:

- a. A review of literature on past studies and research information.
- b. Summarization of Phase II forest inventory information.
- c. Summarization of past appraisal records.
- d. The appraisers own judgement.

It is recommended that the CV be determined by reviewing existing literature rather than by pre-sampling techniques. This appears to be

the easiest and fastest way to arrive at the CV which will be used in determining the number of plots required to attain a certain degree of accuracy. The University of Minnesota, College of Forestry has agreed to assist the Division of Forestry in preparing CV tables and curves. A sample curve is found in Appendix A-1. This CV curve should be used until more comprehensive statistical data is collected so that new curves can be drawn on a more local basis.

The table on page L-4.1 of the <u>Timber Sales Manual</u> basically contains the information needed to determine the number of sample plots required on an appraisal, but it does not provide enough detail: the CV is not identified, the size of the sale area is not applicable, and the confidence level is not what has been recommended. Therefore, new plot tables should be established to replace those now in the <u>Timber Sales</u> <u>Manual</u>. These new tables should show the CV in percent, the tract area size in acres, and the corresponding number of plots required. Six new sample tables have been prepared by the College of Forestry which show the number of plots necessary for varying degrees of accuracy. They are listed below and are found in Appendices A-2 to A-7.

TABLE	PLOT SIZE	ACCURACY	PROBABILITY
1	Variable	20%	80%
2	Variable	10%	80%
3	1/10 Acre	20%	80%
4	1/10 Acre	10%	80%
5	1/5 Acre	20%	80%
6	1/5 Acre	10%	80%

For practical purposes, tables 1 and 2 would probably be all that would be necessary since the number of plots required varies little between tables. However, all six tables are recommended for initial use. These tables and the CV curve should be adopted and placed in use by July 1, 1983.

2. Performance Record of Individual Appraisers.

In order to check the performance of DNR appraisers, individual records should be kept for each appraiser. The record should show the level of accuracy being achieved and whether it is within accepted standards. Until this information can be recorded by data processing, it should be kept manually by showing appraised volume and value as compared to scaled volume and value. This record would be used to determine training needs, and progress towards meeting established standards of accuracy. A sample of this form is found in Appendix A-8.

In order to establish information that can be used now, this record system should be adopted immediately. Sale information should be retrieved from the timber sale files for at least the past two years to create the record system. By having this information available in a short period of time, a determination can be made if any corrective action is necessary for individual appraisers. Use of this information will not identify specific errors, but it will show that something is wrong with the method being used by certain appraisers. Some Areas currently are keeping records of appraisers' results. This system should be adopted by all Areas and cover all appraisers. When the Division of Forestry's data processing program is fully on line, appraisal data should be transferred from manual systems to this computerized system.

3. Position Description and Performance Indicators.

To provide supervisors with a means of reviewing an individual's appraisal accuracy, position descriptions for each appraiser should be written containing performance indicators that show the appraisal accuracy desired, based on Division of Forestry policy.

The rewriting of position descriptions should be done immediately so that reviews of performance indicators can be accomplished in March, 1985. A sample position description is found in Appendix A-9.

E. SUMMARY AND RECOMMENDATIONS

Appraisals are estimates, not exacting measures. Therefore, limits of error have been established that are acceptable for the results desired. A summary of recommendations regarding limits of error are listed below:

- 1. A sophisticated statistical sampling procedure is not practical to achieve desired appraisal results for timber sales. However, an approach using more statistics should be incorporated into the system in the future. This may be done by devising a method of collecting and recording sample plot data which can be used in a statistical analysis for compiling local CV tables.
- 2. Exact sampling information should be required when making appraisals. (This will be discussed in more detail in following sections).
- 3. Limits of error for DNR appraisals should be:
 - a. For scaled sales within 20% of the total volume and value, 80% of the time.
 - b. For sold on appraised volume sales within 10% of total volume, 80% of the time.
- 4. The coefficient of variation (CV) should be established from existing data and presented in tables or curves for use by appraisers in conjunction with revised plot tables. Tables or curves have been prepared by College of Forestry and should be functional by July 1, 1983.
- 5. Plot tables have been developed for various plot sizes, CV's, tract sizes and established errors, replacing page L-4.1 of the <u>Timber Sales Manual</u> and should become functional by July 1, 1983.
- 6. Individual appraisal records should be maintained to check the accuracy of an appraiser and to see if appraisals are conducted within established standards. This record-keeping should start immediately.

7. Performance indicators should be incorporated into position descriptions showing the appraisal accuracy desired. This should be done immediately so that performance indicators can be reviewed in March, 1985.

II-5

. . .

SECTION III

PROCEDURE FOR DEFECT ALLOWANCE

A. INTRODUCTION

Defect probably represents the least variance in volume estimation of the five study areas in this report. It also is the most difficult area to address because of the lack of published information regarding methods and procedures to handle defect when appraising timber.

In general, this report recognizes that defect (volume deduction) should be applied to sawlog (i.e., board feet) material only. Defect in pulp and pulp and bolt (i.e., cord) material will be handled by placing the defective material into the next lower product class. For example, defective bolt material will be reduced to pulpwood by reducing the percentage of bolts.

B. METHODS

1. Experience and Training

Most of the literature that describes methods for handling defect state that expertise can only be gained from years of training and experience. Seams, holes, conk, broken branches, and other outward signs have all been used as indicators of decay in standing trees; however, estimating the amount of decay has posed problems because qualitative classifications based on these indicators cannot always be translated into quantitative terms. Appraisers must be able to detect the outward signs of defect and estimate what percentage of the timber is sound, relying upon their knowledge and experience.

To assist the appraiser in gaining this knowledge, at least twice annually each appraiser should follow portions of an appraisal of sawtimber from the cutting site through the sawmill operations to maintain or improve his skill in estimating internal defect from outward indicators.

2. Percent System

This method of cull deduction is applicable to all tree species. The amount of the deduction is based on the volume distribution of the standing trees; some percentage of the volume is deducted for each 8 foot section of a tree. This method is described in detail in Appendix B-1. It should be included in the Timber Sales Manual.

3. Approximate Cull Percent*

Tables and curves have been prepared for Jack Pine, Black Spruce, Balsam Fir, Aspen, Sugar Maple and White Oak indicating the percentage of defect as related to DBH. These tables and curves have limited value because the given diameters are for small sawtimber only and apply only to the

*Information compiled by Alan R. Ek, College of Forestry, for use by the Division of Forestry.

seven species listed above. However, the tables and curves should be used as guides, to be complemented by experience and training. The tables and curves are found in Appendices B-5 and B-6.

4. Multiproduct Cumulative Tally Sheet

A sample tally sheet has been devised by the College of Forestry that allows field classification of trees by stick or log position and by the products represented by an individual stick (i.e., pulpwood, bolt, sawlog, or cull). An important aspect of this tally sheet involves identifying specifically what a defect pertains to; this is significant because some defects do not affect all products. This method would recognize all trees meeting merchantable size standards and assess them in terms of their defects. Tree and log defect pictorial guides would be used in conjunction with this tally sheet. A calculated percentage of defects by this method would be more meaningful in terms of potential utilization. It is recommended that this method be used on a trial basis before being permanently adopted as a standard. The time element will increase by this method because all sticks in a tree have to be tallied which requires more computations. The multiproduct tally sheet and defect guides are found in Appendices B-7 and B-8.

5. Additional Research

The North Central Forest Experiment Station (NSFES) has collected volumes of tree utilization data as part of its statewide inventory projects. This data could be useful for defect information if synthesized properly. Such information might be used to refine the approximate cull percent method, to make it more adaptable. The cost of compiling this information could be quite high; thus, a cost-benefit analysis should be done before undertaking this project. It is recommended that the College of Forestry study this material to determine whether the project of synthesizing the NCFES data into useful defect information is feasible.

C. SUMMARY AND RECOMMENDATIONS

Applying defect standards to appraisal work is very difficult because of the lack of information in a useful form. Recommendations regarding defect standards are summarized below.

- 1. Experience and training. Individual experience and training are probably the most important aspects of appraisal work, and the most difficult to attain. Periodic training trips to cutting sites and sawmill operations are essential if knowledge is to be increased.
- 2. <u>Percent system</u>. This system deducts for defect according to some percentage of a tree's volume based on 8 foot sections.
- 3. <u>Approximate cull percent</u>. The College of Forestry has compiled generalized tables and curves for percent defect. These deductions are based on DBH and have been determined only for seven species. They should be used, with discretion, as guides only.

- 4. <u>Multiproduct cumulative tally sheet</u>. This system deducts for defect in each 8 foot section of a tree according to the product, including cull. It should be used on a trial basis.
- 5. Additional research. The College of Forestry should study the feasibility of compiling NCFES data into useful defect information and incorporating it into the approximate cull percent method.

. Х . v

SECTION IV

TRACT AREA ESTIMATION

INTRODUCTION

Α.

Acreage determination generally has the potential for the largest single error in timber appraisal work. Poor tract size estimates can partially be attributed to lack of necessary tools and inadequate knowledge of current methods. Also, time plays an important role in how exacting an estimate can be. Many methods of estimating acreage are now being used by field people with varying results. Only a few specific methods are recommended in this section. Most good methods rely on some type of measurement, thus reducing the need for rough estimation. As mentioned previously, it is probable that measurements will require additional time, but accurate tract size information is essential. (Note that none of the methods below recommend measuring distances by pacing or estimating.) For the purpose of determining timber volumes acreage should be calculated to the nearest 1/10 acre.

B. METHODS

One of the three following methods should be used for tract area estimation, depending upon the characteristics of the individual tract.

1. Photo dot count

This method should not be used on tracts less than five acres in size and should only be used when the timber type lines can be easily distinguished on a photo. Dot counts should be from the photo only, not transferred onto another map for counting.

2. Closed traverse

The traverse method should be used when on-the-ground boundaries cannot be distinguished on a photo, such as when merchantable spruce is grading into stagnant spruce or when only one portion of a continuous stand is cut with irregular boundaries, such as on the edge of wildlife cuttings. Tools needed for this method are a hip chain or a steel tape, a Suunto-type or staff compass, a field sheet for recording data, and a method for processing the field data from the traverse, either a Redy Mapper or a calculator with programing capabilities such as the TI 59. Boundary lines should be identified either before the traverse or at the same time the traverse is being run on the ground.

Linear measurements on the traverse should be obtained by using a hip chain or a steel tape. Pacing or estimating distances are not acceptable. Angular measurements on the traverse should be obtained by using a Suunto-type or staff compass. Silva-type compasses are not acceptable.

A computer should be used to calculate acreage from field data. Closure error should be no greater than 5%. A Redy Mapper may be used to compute acreage and to prepare maps.

3. Direct measurement

This method can be used for rectangular tracts. Length and width measurements should be taken with a hip chain or a steel tape. Pacing or estimating distances are not acceptable.

To determine the acreage, the following formulas should be used:

Measurement in chains: Acres = Length in chains x width in chains

Measurement in feet: Acres = Length in feet x width in feet 43,560

C. EQUIPMENT AND TOOLS NEEDED

The following equipment should be made available for all appraisers and funds should be made available to purchase this equipment where necessary.

- 1. Dot counting grids for various scale photos.
- 2. A compass for measuring angles: handheld, liquid-filled, sight-through, equivalent to Suunto KB-14, or a staff compass used with a Jacob staff similar to K&E surveying compass model 80-000.
- 3. For measuring distances, a hip chain, Topofil, or some similar device capable of one-man use, or a steel tape or chain.
- 4. For computing acres
 - a. A Redy Mapper.
 - b. A handheld programmable calculator, TI 59 or a similar model.
 - c. Micro computer terminals located in Area offices.

D. SUMMARY AND RECOMMENDATIONS

Recommendations for determining the acreage of a sale area are summarized below:

- 1. <u>Photo dot count</u>. This method should be used only on tracts of five acres or larger and where type lines are easily distinguished on a photo.
- 2. <u>Closed traverse method</u>. This method should be used when on-the ground boundaries cannot be distinguished on the photo. The error of closure should be no greater than five percent.
- 3. <u>Direct measurement</u>. This method should be used only on rectangular shaped tracts.

In other than the photo dot count method, all measurements should be made as exact as possible; angles and distances should be measured, not estimated. Data processing equipment should be used when computing acreages.

IV-2

Funds should be made available for all necessary tools, and only certified equipment should be purchased.

Determining acreages more exactly will increase appraisal time, but this is necessary for computing more correct sale volumes. The benefits should far out weigh the costs of the extra time expended.

SECTION V

PRODUCT VOLUME ESTIMATION

A. INTRODUCTION

A key element in the appraisal system is determinating the volume of standing timber on a sale area. The timber volume must be estimated before a value can be placed on the saleable timber and the sale conducted.

Currently the Division of Forestry has no documented standard method for appraising timber. New employees rely entirely on past experience, education, and what information they can pick up from fellow workers. Certain methods and procedures are recommended below for determining the timber volume, and consequently, the value of a sale area. These methods should be included in the Timber Sales Manual.

B. METHODS TO USE

There are various systems which may be used for determining timber volumes on large and small tracts. Different systems may be more suited for different conditions.

Volumes are estimated by taking sample plots throughout the sale area and then applying that information to the entire area. In general, there are two methods for obtaining volumes by the sample plot system (1) variable size plots and (2) fixed size plots. Both methods are recommended. They function best under the following conditions:

- Large areas with definite boundaries, such as areas to be clear cut.
- Large volumes of pulpwood and/or sawtimber.
- Areas in which timber is not marked for cutting.
- Areas in which timber is generally uniform in size and stocking.
- There are no high value species that would be sold on appraised volume.

1. Variable Plot Sampling

This method is also known as point sampling, prism cruising, the angle gauge method, the Bitterlich method, and by other names.

The recording of field data when using variable plot sampling requires the cumulative tally sheet, F-11 (Appendix C-1), which reads volumes directly.

2. Fixed Plot Sampling

When variable plot sampling is neither practical nor desirable, the fixed plot system could be used. This system is well adapted to a wide range of situations.

When using the fixed plot system, it is recommended that only 1/10 or 1/5 acre size plots be used. One tenth acre plots are more common, although 1/5 acre plots are more practical on sawtimber size trees where the stand is not entirely uniform. The recording of field data during fixed plot sampling is done on form F-248 (Appendix C-2), or recorded directly into the appraiser's field book. One-fourth acre size plots could be used, but should be confined to strip-cruising (e.g., power line or highway right-of-way). In such situations, the plot size would be 1/2 chain (33') wide by 5 chains (330') long.

3. Other Sampling Methods

For determining volumes by methods other than variable plot or fixed plot sampling, two other systems are recommended.

- a. <u>100% tree measurement</u> This system is applicable in situations where measuring each tree is either desirable or necessary. It requires taking measurements of all attributes of each tree (i.e., DBH, height, defect, etc.). Volumes are computed from approved volume tables. This system is warranted when:
 - 1) The number of trees are too few for practical sampling.
 - 2) The variation in tree size or tree volume is great.
 - 3) Trees are high value and scattered (such as Black Walnut or Oak in Southeastern Minnesota).
 - 4) There are small sales which are sold on appraised volume.
- b. Sample tree measurement This system involves counting all the trees in a tract but measuring only predetermined sample trees. It is applicable in situations where only a small estimating error is acceptable, but the measurement of all trees is neither practical nor necessary. Sample tree measurement may be used where:
 - 1) The number of trees are great enough to permit drawing a representative sample.
 - 2) The variation between trees or groups of trees is small, either by natural occurrence or by stratification.
 - 3) The area is large and not conducive to the use of other systems.
 - 4) The sale will be a strip or rim cut.

This system may also be used in combination with other systems. For example, variable or fixed plots may be used in low value timber while scattered higher value timber might warrant sample tree measurement because of the need to be sampled more closely.

The use of the sample tree measurement system requires greater care in its application than does 100% tree measurement. All individual measurements must be accurate and the selection of sample trees must be free of bias. This system also requires a careful count of the total number of trees. Total volume for the tract is based on individual sample tree volume multiplied by the number of trees represented by each sample. Acreage measurement is not necessary for volume determination since every tree on the tract is counted. Regardless of which sampling method is used, field data must be recorded on some type of tally sheet. From this tally sheet, volumes are computed.

C. ACCURACY REQUIRED

Any sampling system requires that accurate counts and measurements be taken to attain desired error levels. Accurate field data is absolutely necessary to achieve desired results in appraising timber.

1. Accurate Tree Count

It is important that all trees on a plot are correctly counted. On variable plot sampling the distance to all borderline trees should be measured and checked with the appropriate plot radius factor, rather than arbitrarily deciding to tally every other tree. The fixed plot radius should be measured a sufficient number of times to ensure that the plot size is correct.

2. Accurate Tree Measurements

At least one tree on each plot should be measured to ensure that DBH and height estimates are accurate.

3. Accurate Area Determination

(Discussed in Section IV.)

4. Number of Plots Necessary

(Discussed in Section II.)

D. VOLUME TABLES

1. Cumulative tally sheets are tables that show volumes which apply directly to recorded field data. It is known that the tally sheets for variable plot sampling (F-11) and for fixed plot sampling (F-248) contain an error of about 10%, because of the relationship between basal area and the volume tables used to make the forms. Therefore these tally sheets should be revised to correct the error so that the volumes are more accurate. (The College of Forestry has been contacted and has agreed to revise the forms.)

2. Other Volume Tables

Tree measurement information. When plot information is not recorded а. on cumulative tally sheets, but rather by individual tree, standard volume tables should be used. Volume Table 1, in board feet and Volume Table 6 in cords, contained in USDA Bulletin #1104, January, 1955, should be recognized as the standard tables. These tables are found in appendices C-3 & C-4 and on page 1.9 and 1.10 in the Timber Management Field Book, (USDA, Northeastern Area, State & Private Forestry, 1975 edition). These two tables should be given a DNR number, form printed, and carried in stock for use by

all appraisers. The printed form size should be such that it can be affixed to the inside of the appraisers field book.

b. <u>Stump count</u>. When determining estimated volume from stump counts, such as in timber trespass situations, Table 3, on page J-2.3 of the <u>Timber Scaling Manual</u> is recommended, (Appendix C-5). This table should be used in conjunction with volume tables 1 and 6. Merchantable heights should be measured from reference to adjacent timber stands or ground indicators.

Note: Table 18 on pages J-2.14 and 2.15 of the <u>Timber Scaling</u> Manual should be removed and no longer used. Information in this table is not based on reliable scientific research.

3. Computation Of Volumes

Data processing systems should be used whenever possible for computing volumes from any sampling method; calculations should not be performed manually where computers are available. The data systems unit should devise programs to do these types of computations.

E. EQUIPMENT AND MATERIALS

The following equipment and materials should be available for all appraisers; funds should be made available to purchase these items when necessary:

- 1. Compass
- 2. Diameter tape
- 3. Increment borer
- 4. Clinometer or a similar device for measuring heights
- 5. 75' loggers tape
- 6. Angle gauge all should be certified 10 factor, regardless of which type is used. The following types are recommended:
 - a. wedge prism
 - b. aluminum die-cut "cruz-all"
 - c. Panama angle gauge
 - d. Bitterlich stick

7. Five digit tally counter

8. Volume tables

Note: Handmade angle gauges or "thumbs" should not be used for variable plot sampling.

F. SUMMARY AND RECOMMENDATIONS

In order to achieve the accuracy desired in product volume estimation, standards must be adopted and adhered to. Recommendations for these standards are summarized below:

1. Sampling Methods. Only the following methods should be used:

- a. Sample plot methods
 - (1) Variable plot sampling, using 10 factor angle gauges only.
 - (2) Fixed plot sampling, using only 1/10, 1/5 or 1/4 acre plots.
- b. 100% tree measurement
- c. Sample tree measurement
- 2. Data Collection
 - a. To attain accurate tree counts, borderline trees are to be measured rather than estimated; the radii on fixed plots also are to be measured rather than estimated.
 - b. Trees should be measured to ensure that accurate DBH and heights are being recorded.
 - c. Data collection should be standardized so that volume computations and other cruise data can be processed by computer.
- 3. Volume Tables
 - a. Cumulative tally sheets for variable plot and fixed plot sampling should be revised, (i.e., forms F-11 and F-248).
 - b. Volume Table 1 in board feet and Volume Table 6 in cords, USDA Bulletin #1104, should be the standard, and should be printed in sufficient quantities for distribution to all appraisers, and for inclusion into appraisers' field books.
 - c. Table 3, page J-2.3 of the <u>Timber Scaling Manual</u>, should be used for determining volumes from stump counts.
 - d. Table 18, page J-2.14 of the <u>Timber Scaling Manual</u>, should be deleted.
 - e. Volume computations from field data should be accomplished by data processing equipment whenever possible.
- 4. Equipment
 - a. Funds should be made available for all necessary equipment and only certified equipment should be purchased.
 - b. No home-made tools are to be used.

SECTION VI

PRODUCT VALUE DETERMINATION

A. INTRODUCTION

According to state law, all timber on state lands must be sold at or above its appraised value. A significant part of timber appraisal work involves determining the value of timber that is to be sold. A uniform presale appraisal procedure should be used on state lands by which the state will receive a fair return for stumpage and the purchaser will receive a normal profit.

Basically, timber value is determined by a base price established for the representative products and adjusted by the use of Price Guide Factors (PGF's). This section will concentrate on product determination and PGF's.

B. VALUE DETERMINATION

The value of a tract of timber is determined by the volume of various products represented by such timber, the base prices established for these products, and the adjustment of these base prices for factors such as the quality and quantity of timber in a stand, access and harvesting problems, and market conditions.

1. Price Guide Factors (PGF's)

The Legislative Auditors Report in 1982 indicated that the Division of Forestry should establish guidelines to ensure that methods of adjusting base prices be applied uniformly. The report also recommended that the Division of Forestry consider eliminating those PGF's which are applied least consistently. In addition, the report indicated that the present factors are difficult to apply uniformly due to production functions and quantity standards which are not well defined and/or quantity standards which are not realistic. This results in appraisers being able to adjust the factors to fit what they consider the conditions in their local area and establish what they feel is a reasonable price for the wood they are selling.

a. Revision of PGF

The Timber Appraisal Standards Committee (TASC) recognizes that there is a need for a complete evaluation and revision of both the pulpwood and sawtimber PGF's. This evaluation should result in the establishment of PGF's with well-defined production functions that represent the cost of production and well-defined quantity standards. The revision of PGF's is beyond the scope of the TASC. Therefore, it is recommended that an outside firm be contracted to thoroughly revise the PGF system and that the deadline for the completed revision should be set for July 1, 1984. One requirement for the new PGF's is that they should be documented in such a fashion that they can be reviewed periodically to ensure that they remain current and applicable. In the interim period, it is recommended that minor changes be made in the existing PGF's so that they can be applied more uniformly.

b. Pulpwood PGF

It is recommended that the present pulpwood PGF table (page B-4.5 of the <u>Timber Sales Manual</u>) be replaced by the table in Appendix D-1. This new table contains numerous minor changes that will make it more uniform for use among appraisers. Some of the revisions are:

- 1) Elimination of the terms poor, fair, average, good, and excellent from the table heading.
- 2) A change in the cords-per-acre and the DBH criteria for felling, limbing, bucking, and skidding factors based on Phase I forest inventory data.
- 3) A factor for both road maintenance and construction rather than one combined factor.
- 4) A clearer definition of an all-weather road in the footnotes. The hauling distance to the nearest mill will become more accurate through reference to a "market list" prepared by Utilization and Marketing staff.

In addition to the revision of this PGF table, the narrative in the <u>Timber Sales Manual</u> has been rewritten to better describe the use of the table. The revised PGF table, market list, and revised pages for the Timber Sales Manual are found in Appendix D.

c. Sawtimber PGF

The present sawtimber PGF table (page B-4.6 of the <u>Timber Sales</u> <u>Manual</u>) is incomplete and should be replaced by another table which more clearly defines the use of the various quantities and factors (see Appendix D-2).— The recommended replacement comes from an earlier version of the table and should be used until a complete revision is completed for all PGF's. In addition to this recommendation for a different sawtimber PGF table, the narrative in the <u>Timber Sales Manual</u> beginning on page B-4.4 regarding the use of this table has been rewritten and a list defining markets by geographic location has been prepared. These documents are found in Appendix D.

The revised PGF tables for pulpwood and sawtimber, the manual narratives, and the market location lists should be incorporated into the present <u>Timber Sales Manual</u> and be required for use by July 1, 1983. By requiring strict use of the revised PGF tables, narratives, and market lists, a more uniform approach can be expected for determining prices of timber. This should reduce personal bias and subjective price adjustment by individual appraisers.

Appraisers should be checked so that they do not improperly manipulate the use of the PGF's. A frequent mistake made in arriving at prices is attempting to alter the base rate, through factoring, to match current market conditions. This is wrong because factoring is meant to reflect conditions of logging in the field rather than the market price. The annual determination of base prices, which are subject to field review, is the proper time to adjust base rates to market conditions.

2. Product Determination

It is generally agreed that most DNR appraisers do not appraise bolts to the present standards; therefore the full value of this product is not realized. Present bolt standards are a 6 inch top for conifers and an 8 inch top for hardwoods.

In order to eliminate the problem of underestimating the percentage of bolts in a stand, it is recommended that the bolt designation be eliminated from product appraisals and that standing timber be appraised only as cords (i.e., pulpwood) or as board feet (i.e., sawtimber). Recommended appraisal standards would be:

For aspen (balm and cottonwood), birch, and all softwoods Cords - up to 14.9" DBH Bd. ft. - 15" DBH plus

For all other species (dense hardwoods) Cords - up to 9.9" DBH Bd. ft. - 10" DBH plus

Other product specifications would remain as they are now, i.e., minimum merchantable top diameters:

Conifers (Softwoods) 3" top for pulpwood & posts 6" top for sawtimber

Aspen and other hardwoods 4" top for pulpwood 8" top for sawtimber

An annual review by Utilization and Marketing staff should be conducted to determine whether these specifications need changing in view of current utilization and industry standards. This would be done at the same time base prices are reviewed.

If the bolt designation were eliminated from appraisals, the base stumpage price of cordwood would have to be adjusted to reflect the percentage of bolt material found in an average stand according to geographic locations. The percentage of bolt material could be determined by using forest inventory Phase II information. A computer program could be developed for this purpose.

It is recommended that bolt appraisals be eliminated by July 1, 1986.

3. Market Determination

Often a market does not exist for a particular product yet specifications indicate that an appraisal should take this product and its appropriate value into consideration. When this situation occurs, the following is recommended:

Upon request by the Area Forest Supervisor, the Utilization and Marketing staff will determine whether a market exists for a particular product in a particular geographic location. If no market exists, the appraiser will have the option of adjusting the price of that product; for example, the price of "pulp & bolt" material may be adjusted to the "pulp" price, in addition to using the "O" factor for market value in the PGF's. The price may be adjusted only after the Utilization and Marketing staff has determined that there is no market.

C. SUMMARY AND RECOMMENDATIONS

Appraising is not an exacting science; variations occur between the methods used by different appraisers, not only in making volume estimates but also in value estimates. In an effort to make these appraisals more consistent, especially in estimating value, the following recommendations have been made:

- 1. The PGF system used by the DNR to adjust base prices is inadequate and outdated. It should be thoroughly reviewed and revised. An outside firm should be contracted to thoroughly revise the PGF system and the deadline for completing the revision should be set for July 1, 1984.
- 2. The newly established PGF's, should be reviewed periodically so as to be kept current and applicable.
- 3. Until new PGF's can be established the existing PGF tables should be revised as follows:
 - a. Eliminate the poor, fair, average, good, and excellent headings from the tables since they are difficult to apply uniformly to a stand of timber.
 - b. Change the quantity factors in the tables to reflect more accurately the base data, e.g., DBH and volume per acre.
 - c. Define items in the table more clearly, so that all appraisers interpret them the same way.
 - d. Rewrite the instruction pages in the <u>Timber Sales Manual</u> so that they are interpreted uniformly by all appraisers.
 - e. Define specific markets by preparing a list showing product types and geographic market locations.
 - f. Require strict use of PGF's, which prohibits individual manipulation of factors to fit market conditions or any other conditions.
- 4. Recommend that the bolt designation be eliminated from product appraisals; thus timber will be appraised only in terms of cords and board feet. This change should be implemented by July 1, 1986.
- 5. Allow appraisers to adjust prices when markets do not exist for certain products, but only after the Utilization and Marketing staff has determined that no market exists.

SECTION VII

CONCLUSIONS & RECOMMENDATIONS

A. CONCLUSIONS

After a thorough review of the DNR timber appraisal system, it has been concluded that:

- 1. The Division of Forestry has a reliable timber appraisal system but it can be improved upon if certain changes are made and if standards and policies are strictly adhered to.
- 2. No new methods are being recommended, rather current methods are being strengthened or refined to bring appraisals up to established standards.
- 3. The length of field time necessary to conduct appraisals will probably increase if recommended standards are to be achieved.
- 4. Additional funds will be needed to provide appraisers with necessary equipment and materials.
- 5. Training sessions will be necessary to inform appraisers of newly established standards and to instruct them on how to achieve those standards.

B. RECOMMENDATIONS

In conjunction with the above conclusions, it is recommended that the following actions be implemented:

- 1. Maximum Allowable Appraisal Error
 - a. A sophisticated statistical sampling procedure should not be necessary to achieve desired appraisal results. However, an approach using more statistics should be incorporated into the system in the future. This may be done by devising a method of collecting and recording sample plot data which can be used in a statistical analysis for compiling local CV tables. A statistical approach of this sort combined with an emphasis on careful and accurate collection of field data should bring appraisals within policy standards.
 - b. Limits of error for DNR appraisals should be:
 - 1) For scaled sales 20% of the total volume and value 80% of the time.
 - 2) For sales that will not be scaled 10% of the total volume 80% of the time.
 - c. The coefficient of variation (CV) should be established from existing data and put into tables or curves. These tables and curves have been prepared by the College of Forestry and should become functional by July 1, 1983.

- d. Plot tables have been developed for various size plots, CV's, tract sizes, and established errors, replacing page L-4.1 of the <u>Timber</u> Sales Manual, and should become functional by July 1, 1983.
- e. Individual appraisal records should be kept for each appraiser to determine whether appraisals are being conducted within established accuracy standards. This record-keeping should start immediately.
- f. Performance indicators should be incorporated into position descriptions showing the appraisal accuracy desired. This should be done immediately so that a review can be conducted in March, 1985.

2. Procedure for Defect Allowance

- a. Individual training of appraisers should be increased through visits to sawmill operations to view the extent of log defects.
- b. Methods for deducting defect should be standardized to the extent possible by using one or more of the following methods:
 - 1) Percent system deducts for defect according to an established percentage of the tree's volume based on 8 foot sections.
 - Approximate cull percent defects are determined through the use of tables and curves compiled by the University of Minnesota, College of Forestry.
 - 3) Multiproduct cumulative tally sheet plot volumes are recorded by each 8 foot section of a tree according to the product. It should be used on a trial basis before official adoption.
- c. The College of Forestry should study the feasibility of compiling NCFES data into useful defect information.

3. Tract Area Estimation

- a. Three methods of determining acreage are recommended:
 - 1) Photo dot count
 - 2) Closed traverse
 - 3) Direct measurement

Each method is adapted to certain conditions. However, in methods other than the photo dot count, it is stressed that all measurements must be made as exactly as possible; angles and distances should be measured, not estimated. Error of closure with the traverse method should be no greater than 5%.

b. Data processing equipment should be used when computing acreages from field data.

4. Product Volume Estimation

a. To achieve the accuracy desired in timber volume appraisals, the
Division of Forestry should adopt the following sampling methods No other methods should be used.

- 1) Variable plot sampling
- 2) Fixed plot sampling, using only 1/10, 1/5 or 1/4 acre plots
- 3) 100% tree measurement
- 4) Sample tree measurement
- b. Data collection in all sampling methods should be measured rather than estimated, as required.
- c. Only certain volume tables should be used. Recommendations include:
 - 1) Table 1, USDA bulletin #1104, in board feet.
 - 2) Table 6, USDA bulletin #1104 in cords.
 - 3) Table 3, page J-2.3 of the <u>Timber Scaling Manual</u>, for determining volumes from stump counts.
 - 4) Table 18, page J-2.14 of the <u>Timber Scaling Manual</u> should be deleted.
 - 5) Cumulative tally sheets F-11 and F-248 should be revised.
 - 6) Volume computations from field data should be accomplished by data processing equipment whenever possible.
- d. Funding should be made available for all equipment necessary for sample plot data collection. No homemade tools should be used.

5. Product Value Determination

- a. The current PGF's are inadequate and require thorough revision. This should be accomplished by an outside firm or agency and should be completed by July 1, 1984.
- b. Until new PGF's can be established, the following should be done:
 - 1) The headings poor, fair, average, good, and excellent should be removed from the tables.
 - 2) The quantity factors in the tables should be changed to reflect more accurately the base data, e.g., DBH and volume per acre.
 - 3) Items in the table should be defined more clearly. Some of the footnotes and instructions in the <u>Timber Sales Manual</u> should be rewritten so that they are interpreted uniformly by all appraisers.
 - 4) The Utilization and Marketing staff should define specific markets by product and geographic location.

- 5) Strict use of PGF's should be required.
- c. The bolt product designation should be eliminated from product appraisals; timber should be appraised only in terms of cords and board feet. This change should be implemented by July 1, 1986.
- d. Appraisers should be allowed to adjust prices when markets do not exist in the sale area, but only after the Utilization and Marketing staff has determined that no market exists for the product.

APPENDICES

	PAGE
APPENDIX A - Allowable Error	A-1
APPENDIX B - Defect Allowance	B-1
APPENDIX C - Volume Estimation	C-1
APPENDIX D - Value Determination	D-1

í

. .

. COEFFICIENT OF VARIATION (%) . The relation of coefficient of variation to average tree count. . ą .

AVERAGE TREE COUNT

<u>Allowable_Error</u>

NUMBER OF PLOTS NEEDED

Point Sampling 20% Allowable Error 80% Of The Time

CV						AC	RES						
010	5	10	15	20	25	30	40	50	60	100	200	400	
						الله جين وين حيب حيب حيب مليه الله عال							
20	5	5	5	5	5	5	5	5	5	5	5	5	
30	5	5	5	5	5	5	5	- 5	5	5	5	5	
40	7	8	8	8	8	8	8	8	8	8	8	8	
50	11	11	11	11	12	12	12	12	12	12	12	12	
60	14	15	15	16	16	16	16	16	16	16	16	16	
70	18	20	20	21	21	21	21	21	21	21	21	21	
80	22	24	25	26	26	27	27	27	27	27	27	28	
90	26	30	31	32	32	33	33	34	34	34	34	.34	
100	30	35	37	38	39	40	40	41	41	42	42	42	
110	34	41	44	45	46	47	48	49	49 `	50	50	51	
120	38	47	51	53	54	55	56	57	58	59	60	60	
130	42	53	57	60	62	63	65	66	67	68	70	70	
140	45	58	65	68	70	72	74	. 76	77	79	80	81	
150	49	64	72	76	79	81	84	86	87	90	92	93	
160 -	52	70	79	84	88	91	94	96	98	101	104	105	
170	55	75	86	93	97	100	104	107	109	113	117	118	
180	58	81	93	101	106	110	115	119	121	126	130	132	
190	60	86	100	109	115	120	126	130	133	139	144	147	
200	63	91	107	117	125	130	137	142	146	153	159	162	

<u>Allowable_Error</u>

NUMBER OF PLOTS NEEDED

Point Sampling 10% Allowable Error 80% Of The Time

CV .						AC	CRES						
olo	5	10	15	20	25	30	40	50	60	100	200	400	
20	7	8	8	8	8	8	8	8	8	8	, 8	8	
30	14	15	15	16	16	16	16	16	16	16	16	16	
40	22	24	25	26	26	27	27	27	27	27	27	28	
50	30	35	37	38	39	40	40	41	41	42	42	42	
60	38	47	51	53	54	55	56	57	58	59	60	60	
70	45	58	65	68	70	72	74	76	. 77	79	80	81	
80	52	70	79	84	88	91	94	96	98 🐇	101	104	105	
90	58	81	93	101	106	110	115	119	121	126	130	132	
100	63	91	107	117	125	130	137	142	146	153	159	162	
110	67	100	120	134	143	150	160	167	172	182	191	195	
120	71	109	133	149	161	171	184	192	199	213	225	231	
130	74	117	145	165	179	191	207	218	226	245	261	270	
140	77	124	156	179	197	210	230	245	255	278	299	311	
150	79	130	166	193	213	230	254	271	284	313	339	354	
160	81	136	175	205	229	248	276	297	312	349	382	401	
170	83	141	184	218	244	266	299	323	341	385	425	449	
180	84	146	192	229	258	283	320	348	370	421	471	500	
190	86	150	200	239	272	299	341	373	398	458	518	553	
200	87	154	206	249	284	314	361	397	425	496	565	608	

<u>Allowable Error</u>

NUMBER OF PLOTS NEEDED

1/10 Acre Plot Size
20% Allowable Error
80% Of The Time

CV						AC	RES					
olo	5	10	15	20	25	30	40	50	60	100	200	400
												· ·
20	5	5	5	5	5	5	5	5	5	5	5	5
30	5	5	5	5	5	. 5	5	5	5	5	5	5
40	7	7	8	8	8	8	8	8	8	8	8	8
50	10	11	11	11	11	11	11	12	12	12	12	12
60	13	14	15	15	15	15	16	16	16	16	16	16
70	15	18	19	20	20	20	21	21	21	21	21	21
80	18	22	24	24	25	25	26	26	27	27	27	27
90	21	26	28	30	31	31	32	32	33	34	34	34
100	23	30	33	35	36	37	38	39	40	41	42	42
110	26	34	38	41	43	44	45	46	47	49	50	50
120	28	38	43	47	49	51	53	54	55	57	59	60
130	29	42	48	53	55	57	60	62	63	66	68	70
140	31	45	53	58	62	65	68	70	72	76	79	80
150	33	49	58	64	68	72	76	79	81	86	90	92
160	34	52	63	70	75	79	84	88	91	96	101	104
170	36	55	67	75	81	86	93	97	100	107	113	117
180	37	58	71	81	88	93	101	106	110	119	126	130
190	38	60	75	86	94	100	109	115	120	130	139	144
200	39	63	79	91	100	107	117	125	130	142	153	159

<u>Allowable_Error</u>

TABLE 4	
---------	--

•.

NUMBER OF PLOTS NEEDED

1/10 Acre Plot Size 10% Allowable Error 80% Of The Time

CV					ACRES							
olo	5	10	15	20	25	30	40	50	60	100	200	400
					· · · · · · · · · · · · · · · · · · ·					,		
20	7	7	8	. 8	8	8	8	8	8	8	8	8
30	13	14	15	15	15	15	16	16	16	16	16	16
40	18	22	24	24	25	25	26	26	27	27	27	27
50	23	30	33	35	36	37	38	39	40	41	42	42
60	28	38	43 [·]	47	49	51	53	54	55	57	59	60
70	31	45	53	58	62	. 65	68	70	72	76	79	80
80	34	52	63	70	75	79	84	88	91	96	101	104
90	37	58	71	81	88	93	101	106	110	119	126	130
100	39	63	79	91	100	107	117	125	130	142	153	159
110	40	67	86	100	111	120	134	143	150	167	182	191
120	41	71	92	109	122	133	149	161	171	192	213	225
130	43	74	98	117	132	145	165	179	191	218	245	261
140	43	77	103	124	141	156	179	197	210	245	278	299
150	- 44	79	107	130	150	166	193	213	230	271	313	339
160	45	81	111	136	157	175	205	229	248	297	349	382
170	45	83	114	141	164	184	218	244	266	323	385	425
180	46	84	117	146	170	192	229	258	283	348	421	471
190	46	86	120	150	176	200	239.	272	299	373	458	518
200	47	87	122	154	181	206	249	284	314	397	496	565

<u>Allowable_Error</u>

NUMBER OF PLOTS NEEDED

l/5 Acre Plot Size 20% Allowable Error 80% Of The Time

· CV						ACRI	ES					
olo	` 5	10	15	20	25	30	40	50	60	100	200	400
20	5	5	5	5	5	5	5	5	5	5	5	5
30	5	5	5	5	5	5	5	5	5	5	5	5
40	6	7	7	7	8	8	8	8	8	8	8	8
50	8	10	10	11	11	11	11	11	11	12	12	12
60	10	13	14	14	15	15	15	15	15	16	16	16
70	12	15	17	18	19	19	20	20	20	21	21	21
80	13	18	20	22	23	24	24	25	25	26	27	27
90	. 15	21	24	26	27	28	30	31	31	32	34	34
100	16	23	27	30	32	33	35	36	37	39	41	42
110	<u> </u>	26	31	34	37	38	41	43	44	46	49	50
120	18	28	34	38	41	43	47	49	51	54	57	59
130	19	29	37	42	45	48	53	55	57	62	66	68
140	19	31	39	45	50	53	58	62	65	70	76	79
150	20	33	42	49	54	58	64	68	72	79	86	90
160	20	34	44	52	58	63	70	75	79	88	96	101
170	21	36	46	55	62	67	75	81	86	97	107	113
180	21	37	48	58	65	71	81	88	93	106	119	126
190	22	38	50	60	68	75	86	94	100	115	130	139
200	22	39	52	63	71	79	91	100	107	125	142	153

<u>Allowable Error</u>

NUMBER OF PLOTS NEEDED

1/5 Acre Plot Size
10% Allowable Error
80% Of The Time

CV						ACRE	ES					
00	5	10	15	20	25	30	40	50	60	100	200	400
20	6	7	7	7	8	8	8	8	8	8	8	8
30	10	13	14	14	15	15	15	15	15	16	16	16
40	13	18	20	22	23	24	24	25	25	26	27	27
50	16	23	27	30	32	33	35	36	37	39	41	42
60	18	28	34	38	41	43	47	49	51	54	57	59
70	19	31	39	45	50	53	58	62	65	70	76	79
80	20	34	44	52	58	63	70	75	79 [.]	88	96	101
90	21	37	48	58	65	71	81	88	93	106	119	126
100	22	39	52	63	71	79	91	100	107	125	142	153
110	22	40	55	67	77	86	100	111	120	143	167	182
120	23	41	57	71	82	92	109	122	133	161	192	213
130	23	43	59	74	87	98	117	132	145	179	218	245
140	23	43	61	77	90	103	124	141	156	197	245	278
150	<u>.</u> 23	44	63	79	94	107	130	150	166	213	271	313
160	24	45	64	81	97	111	136	157	175	229	297	349
170	24	45	65	83	99	114	141	164	184	244	323	385
180	24	46	66	84	101	117	146	170	192	258	348	421
190	24	46	67	86	103	120	150	176	200	272	373	458
200	24	47	67	87	105	122	154	181	206	284	397	496

<u>Allowable Error</u>

A-7

-

APPRAISER

A – 8

BADGE NUMBER

PERMIT NUMBER	DATE OF APPRAISAL	APPRAISED VOLUME*	APPRAISED VALUE	SCALED VOLUME*	SCALED VALUE	PERCENT DIFFERENCE	REMARKS
	-					V	· ·
						\$	
						V	
						\$	
						V	
L						\$	
					1	V	
						\$	
						V	
						\$	
					-	V	
~						\$	

* Volume converted to cords unless 100% log sale.

INSTRUCTIONS FOR USING FORM

- (1) Enter name of appraiser and badge number.
- (2) When sale is made, record permit number, date of appraisal, appraised volume and appraised value.
- (3) When sale is closed, enter the scaled volume and value of final billing.
- (4) Determine the percent difference between appraised volume and value and scaled volume and value.
- (5) If an appraisal was check appraised (such as for "Sold on Appraised Volume Sale") the result should be entered in remarks column.
- (6) Enter in remarks column any reason that may influence the amount scaled as compared to the amount appraised such as: sale was closed prematurely, timber was added to the permit, sold on appraised volume, etc.

POSITION DESCRIPTION **B**

i

7

<u>Allowable Error</u>

EMPLOYEE'S NAME

PE-00042-03 (9-82)

i

sp. o.	PRIN	CIPAL	. RES	PONS	BILI	TIES,	TASK	S AND	PERFO	RMANCE	INDICATO	DRS			Priority	% of Time	Discretio
•	To qua	mana ntit	age Sy,	sta qua	te lit	owne y	ed t	imbe etc.	r res	ources	s so th	nat t	he				
	Α.	To lar	car nds	ry in	out acc	the ord <i>a</i>	tin tince	mber wit	sale h mar	es prog agemen	gram or nt plar	n sta ns.	te				
	1.	a.	App wil vol	orai l b ume	sal e a an	s on ccur d va	tin ate lue	mber to	sale withi 0_per	n <u>20</u> cent o	will perce of the	be s ent o time	caled f the	1			
		b.	App App <u>10</u> the	orai orai p ti	sal sed erc me.	s on Vol ent	tin ume of	mber " wi the	sale ll be volum	es that e accur ne <u>80</u>	are ' ate to perce	'Sold wit ent o	on hin f				
ł																	
																2 - 1	
													,				
	·																
1																	
	-																-
									À – 9	I.							

MEASURING DEFECT BY THE PERCENT SYSTEM*

A necessary step in measuring tree volume is to make deductions for cull and other material that will be lost through manufacture.

Due to the hidden nature of most defects, appraisers will need a good foundation of knowledge and experience from which to estimate the extent of cull. As mentioned previously they should make frequent visits to sawmills and cutting operations to view defect characteristics which are exposed in cutting.

This system of cull deduction is applicable to all species. A good working knowledge of scaling practices is helpful in making deductions by this method.

The amount of deduction by the percent method is based on a volume distribution chart (Appendix B-2). This chart shows the percent of volume for each 8 foot section of the tree.

To apply this system:

- 1. Find the section of the tree affected by defect.
- 2. Determine which part or fraction of the section is actually lost.
- 3. From the volume distribution chart find the percent of volume in the section and multiply this value by the percentage loss due to defect. This product represents the percentage loss of the tree.
- 4. Round the percentage of the deduction to the nearest 10%, (5% should be rounded to 10%).

MEASURING MERCHANTABLE HEIGHTS

Definition: Merchantable height for sawtimber is the height above a 1' stump to a point on the stem where merchantability is limited by branches, defect, deformity, or size.

Merchantable height is terminated at a point beyond which no more units meeting product specifications can be cut. This may occur as a result of the tree diameter falling below what is considered merchantable size, the stem breaking up into crown, excessively large or numerous branches, or defects which will exclude the cutting of lumber through the section. See Appendices B-3 andB-4.

* From Service Foresters' Handbook February 1978 NASPF.

DISTRIBUTION	OF	TREE	VOLUME
(PER	CEN	ίТΙ	



Merchantable Height-No. 8' Sawlogs

SAMPLE SITUATION

For a sawtimber tree with a merchantable height of 32' to a minimum top DIB, the distribution of volume in the tree is 30% in the first 8' butt section, 30% in the second, and 20% in each of the third and fourth 8' sections. If the tree had a 2' cull section between 14' and 16' above the stump, the total defect for the section is 25% (2' equals 25% of the 8' section), multiplied by 30%, which equals 7.5%, rounded to 10%.

в-2



ESTIMATING MERCHANTABLE HEIGHT IN FORKED TREES

- 1. Minimum product below fork. Estimate and tally only the best fork.
- 2. No product below fork. Tally as two trees. Measure or estimate DBH 3¹/₂' above fork.

MEASURING MERCHANTABLE HEIGHT vs TALLIED HEIGHT SAWTIMBER

EXCESS APPROX. 4' DO I I STUMP C STUMP

1. Merchantable height equals 20'.
Tallied height equals one 16'
log. Record defect occurring
in 20' against a 1 log tree.



- 2. Merchantable height equals l2'6". Tallied height equals one log. Record defect occurring in l2'6" section.
- 1. & 2. Because merchantable height is talled in 8' bolts or 1/2
 logs, the volume table may not always give an accurate
 volume for the individual tree. The table will give a more
 accurate volume for 1 and 2 combined.

Jack	Pine $\frac{1}{}$	Black Sp	$\frac{1}{}$	Balsa	<u>m Fir</u> <u>1</u> /	Aspe	$\underline{n} \frac{1}{2}$	Sugar N	Maple $\frac{1}{}$	W. Oa	$k^{2/}$
Dbh	(%)	Dbh	(%)	Dbh	(%)	Dbh	(%)	Dbh	(%)	Dbh	(%)
			0.0	- -	0.0				1 0		1 07
5.4	0.0	1.6	0.0	3.5	0.0	4.1	4.3	4	1.3	4.5	1.07
6.8	0.1	3.9	0.2	4.8	0.4	5.6	6.1	5	2.0	6.5	1.25
7.9	0.3	5.9	0.8	6.0	2.3	7.1	7.9	6	2.6	.8,5	1.43
. 8.8	0.8	7.4	1.6	7.0	4.5	8.6	9.8	7	3.1	10.5	1.61
9.6	1.3	8.0	2.0	7.9	6.3	9.7	11.9	8	3.5	12.5	1.79
10.2	2.2	8.9	2.7	8.7	8.3	10.6	14.3	9	4.6	14.5	1.96
		9.9	3.7	9.3	10.6			10	6.2	16.5	2.14
A de la composición d										18.5	2.32
•					· · · · · ·			•		20.5	2.50

Approximate Cull Percent*

* Compiled by Alan R. Ek, College of Forestry, from references listed below, for use by the Division of Forestry, June 27, 1983.

22.5 2.68

<u>1</u>/ Data from Morawski et al (1958) (Tables 3,8,13,15 and 22). In the case of Tables 3,8,13 and 15, age/percent defect relationships converted to Dbh/percent defect relationships using age/Dbh relationships in Gevorkiantz and Duerr, 1938.

 $\frac{2}{2}$ Data from Berry and Beaton (1972).

References:

Berry, F.H. and J.A. Beaton. 1972. Decay in oak in the central hardwood region. U.S.D.A. Forest Service Res. Paper NE-242. 11 p.

Gevorkiantz, S.R. and W.A. Duerr. 1938. Methods of predicting growth of forest stands. U.S.D.A. Forest Service, Lake States Forest Expt. Sta. Economic Notes No. 9. 59 p.

Morawski, Z.J.R., J.T. Basham and K.B. Turner. 1958. A survey of a pathological condition in the forests of Ontario. Ontario Dept. of Lands and Forests, Division of Timber, Report No. 25 (Cull Studies). 96 p.

APPROXIMATE CULL PERCENT CURVE





B - 6

MULTIPRODUCT CUMULATIVE TALLY SHEET

(TO BE PREPARED BY COLLEGE OF FORESTRY)

DEFECT PICTORIAL GUIDES

TO BE USED WITH THE MULTIPRODUCT

CUMULATIVE TALLY SHEET

(TO BE PREPARED BY COLLEGE OF FORESTRY)

r	1	4
H-	Ł	
• -		

ANGLE GAUGE

IBM FOREST INVENTORY Volume Estimation

MERCHANTABLE TYPE DATA SHEET

STATE OF MINNESOTA DEPARTMENT OF CONSERVATION DIVISION OF FORESTRY

	COL. NO.			COL.NO.			COL. NO.
I. DESCRIPTION	- 1-7	6. ACREAGE	-	16 - 18	II. SITE	()	27
2. AREA	8-9	7. COMP. NO.		19	12.FOREST DEV.	()	28
3. DISTRICT	10	8 LAND USE	()	20	13.STAND VIGOR	()	29
4. TYPE NO.		9. UNDERS'Y	()	21 - 24	14.0PERABILITY	()	30
5. COND. CLASS ()	12-15	IO STAND AGE		25-26	I5.REC. DEV.	()	31

CUMULATIVE 104.18 MINUTE ANGLE GAUGE TALLY SHEET

SPEC	NO. CULL	VOL. IN CDS MERCHT. STEMS UNDER 5"D.B.H. TO 3" TOP	-	TOTA	AL + NO. OF SAM	ION	0-5 N	NO OF T	NO.	OF PLOTS
		1 2 2 3 4 5 6 6 7 8 1 2 4 5 6 8 9 10 11 13 2 3 5 6 8 10 11	+	- 01	T UDS. 7 HUIL		01 60.	10.01		
		9 10 10 11 12 13 14 14 15 16 14 15 16 18 19 20 21 23 24 25 13 15 16 18 19 21 22	-+				<u>.</u>			
		1 2 2 3 4 5 6 6 7 8 1 2 4 5 6 8 9 10 11 13 2 3 5 6 8 10 11 9 10 10 11 12 13 14 14 15 16 14 15 16 18 19 20 21 23 24 25 13 15 16 18 19 21 22								
		1 2 2 3 4 5 6 6 7 8 1 2 4 <u>5 6 8 9 10 11 13 2 3 5 6 8 10 11</u>						l	1	
	NO. CULL	VOL. IN CDS MERCHANTABLE STEMS OVER	5" D).B.H.	то 4" тор				TOTAL + NO.	OF SAMPLES
SPEC.	TREES				5	6	7	8	= NET CDS. /	ACRE
		1 2 2 3 1 3 4 6 7 8 2 4 6 8 10 12 14 16 2 5 7 10 12 15 17 20 4 5 6 7 10 11 13 14 16 17 18 20 22 24 26 28 30 32 22 25 27 30 32 35 37 44		36 2023	9 12 15 18 3 26 29 32 35 17	1 7 10 13 7 20 24 27	4 8 11	4 8		
		8 8 9 10 18 20 21 23 24 25 34 36 38 40 44 46 48 50 42 45 47 50 52 55 57 61		38 41	44 47 50 53 3	30 34 37 40	27 30 3	4 21 25		
L		11 12 13 15 27 28 29 31 32 34 52 54 56 58 60 62 64 66 62 64 67 69 72 74 77 79 14 15 16 17 35 37 38 40 41 42 68 70 72 74 76 78 80 82 82 84 87 89 92 94 97 99	3	56 58 73 76	61 64 67 70 4 79 82 85 88 5	4 47 50 54 57 60 64 67	38 42 4	29 33 37 42		· · · · · · · · · · · · · · · · · · ·
		1 2 2 3 1 3 4 6 7 8 2 4 6 8 10 12 14 16 2 5 7 10 12 15 17 20 4 5 6 7 10 11 13 14 15 17 19 20 22 24 25 29 30 30 25 27 30 30 35 37 40		3 6	9 12 15 18 3	7 10 13	4811	4 8		
		8 8 9 10 18 20 21 23 24 25 34 36 38 40 44 46 48 50 42 45 47 50 52 55 57 60		20 23 38 41	44 47 50 53 3	7 20 24 27 10 34 37 40	27 30 3	21 25		
		11 12 13 13 27 28 29 31 32 34 52 54 56 58 60 62 64 66 62 64 67 69 72 74 77 75 14 15 16 17 35 37 38 40 41 42 68 70 72 74 76 78 80 82 82 84 87 89 92 94 97 92) 5	56 58	61 64 67 70 4	4 47 50 54	38 42 4	29 33	the second	
	·	1 2 2 3 1 3 4 6 7 8 2 4 6 8 10 12 14 16 2 5 7 10 12 15 17 20	<u>-</u>	3 6	9 12 15 18 3	7 10 13	4 8 11	4 8	·	
		4 5 6 7 10 11 13 14 16 17 18 20 22 24 26 28 30 32 22 25 27 30 32 35 37 44	2 8	20 23	26 29 32 35 17	7 20 24 27	15 19 23	12 17		
1		1 2 2 3 1 3 4 6 7 8 2 4 6 8 10 12 14 16 2 5 7 10 12 15 17 20	2 3	36	9 12 15 18 3	7 10 13	4811	48		
}		4 5 6 7 10 11 13 14 16 17 18 20 22 24 26 28 30 32 22 25 27 30 32 35 37 40	2 2	20 23	26 29 32 35 17	7 20 24 27	15 19 2	12 17		
1 ·		1 2 2 3 1 3 4 6 / 8 2 4 6 8 10 12 14 16 2 5 7 10 12 15 17 20 4 5 6 7 10 11 13 14 16 17 18 20 22 24 26 28 30 32 22 25 27 30 32 35 37 40		36 2093	9 12 15 18 3	o 7 10 13 7 20 24 27	4 8 11	4 8		
		1 2 2 3 1 3 4 6 7 8 2 4 6 8 10 12 14 16 2 5 7 10 12 15 17 20) 7	3 6	9 12 15 18 3	7 10 13	4 8 11	4 8		
		4 5 6 7 10 11 13 14 16 17 18 20 22 24 26 28 30 32 22 25 27 30 32 35 37 40) [2	20 23	26 29 32 35 17	7 20 24 27	15 19 23	12 17		
	NO. GULL	VOL, IN HUNDREDS BD. FT. SCRIBNER TO 6" TOP (MOS	TC	ONIF	ERS & ASPEN))			TOTAL + NO.	OF SAMPLES
SPEC.	TREES	NO. OF 16 LUGS PER TREE		3	31/2		4	5	= NET BD.F	T. /ACRE
		3 6 5 10 16 7 14 22 29 36 43 9 18 27 36 45 54 11 22 33 44 55 66 1	3	26 39	52 15 30	45 16	33 50			[
		<u>14 17 36 42 47 94 101 106 115 122 129 117 121 135 144 153 162 143 154 165 176 187 197 1</u>	55 17	130 14	3 156 105 120 1	135 116	62 99 132 149			
		3 6 5 10 16 7 14 22 29 36 43 9 18 27 36 45 54 11 22 33 44 55 66 1	3	26 39	52 15 30	45 16	33 50			
		14 17 36 42 47 94 101 108 115 122 129 117 121 135 144 153 162 143 154 165 176 187 197 1	יס 17	130 14	3 156 105 120 1	135 116	132 149			
		3 6 5 10 16 7 14 22 29 36 43 9 18 27 36 45 54 11 22 33 44 55 66 1 9 12 21 26 31 50 58 65 72 79 86 63 72 81 90 99 108 77 88 99 110 121 132	3	26 39	52 15 30	45 16	33 50 82 99			
		14 17 36 42 47 94 101 108 115 122 129 117 121 135 144 153 162 143 154 165 176 187 197 1	17 1	130 14	3 156 105 120 1	135 116	132 149			
		3 6 5 10 16 7 14 22 29 36 43 9 18 27 36 45 54 11 22 33 44 55 66 1 9 12 21 26 31 50 58 65 72 79 86 63 72 81 90 99 108 77 88 99 10 121 132	3	26 39	52 15 30	45 16	33 50 82 99			
		3 6 5 10 16 7 14 22 29 36 43 9 18 27 36 45 54 11 22 33 44 55 66 1	3	26 39	52 15 30	45 16	33 50			
		9 12 21 26 31 50 58 65 72 79 86 63 72 81 90 99 108 77 88 99 110 121 132 1	5	78 91	104 60 75 9	90 66	82 99			
		3 6 6 12 18 8 17 26 34 42 11 22 33 44 55 14 27 40 54 68 81 1	6	32 48	64 18 37 56	74 21	42 63	26 51		
		9 12 24 30 36 51 60 68 76 85 66 77 88 99 110 94 108 122 135 148 162 1 15 19: 42 48 54 94 102 110 118 127 121 132 143 154 165 175 189 202 215 229 242 1	30 S	96 112	128 92 111 1	130 84	105 126	76 102		
		3 6 6 12 18 8 17 26 34 42 11 22 33 44 55 14 27 40 54 68 81 1	6 3	32 48	64 18 37 56	74 21	42 63	26 51		
		9 12 24 30 36 51 60 68 76 85 66 77 88 99 110 94 108 122 135 148 162 1 15 19 42 48 54 94 102 110 118 127 121 132 143 154 165 175 189 202 215 229 242 1	30 1	96 112	128 92 111 1	130 84	105 126	76 102		
		3 6 6 12 18 8 17 26 34 42 11 22 33 44 55 14 27 40 54 68 81 1	6	32 48	64 18 37 56	74 21	42 63	26 51		
		9 12 24 30 36 51 60 68 76 85 66 77 88 99 110 94 108 122 135 148 162 8 5 19 42 48 54 94 102 110 118 127 121 132 143 154 165 175 189 202 215 229 242 1	30 9 44 1	96 112 160 176	128 92 111 1 5 192 148 166 1	130 84 185 147	105 126 159 180	76 102		
· ·		3 6 6 12 18 8 17 26 34 42 11 22 33 44 55 14 27 40 54 68 81 1	6 3	32 48	64 18 37 56	74 21	42 63	26 51	<u> </u>	· ·
		9 12 24 30 36 51 60 68 76 15 66 77 88 99 110 94 108 122 135 148 162 8 3 6 6 12 18 8 17 26 34 42 11 22 33 44 55 14 27 40 54 68 81 1	6	96 112 32 48	64 18 37 56	74 21	42 63	26 51		
		9 12 24 30 36 51 60 68 76 85 66 77 88 99 110 94 108 122 135 148 162 6	10 9	96 112	128 92 111 1	30 84	105 126	76 102		
		9 12 24 30 36 51 60 68 76 85 66 77 88 99 110 94 108 122 135 148 162 8	5	32 48 96 112	64 18 37 56 128 92 111 1	74 21 30 84	42 63 105 126	26 51 76 102		
MAN	AGEME	NT PLANS:	ור		SPECIES VO	L./A. C	.P. NE	T VOL. /	TYPE - CORDS	COL. NO.
					ASPEN					32-37
				ARY 8(B. SPR.					38-43
		• • • • • • • • • • • • • • • • • • •	7	Mg	BALSAM		- -			44-48
				S.						49-53
				88						54.50
				N O	1 AM.					59-50
} .				SAR AR	W. SPR.					59-62
				ŏ₹	BALM'GIL.					63-67
				≞	N.&W.PINE					68-71
EST	IMATOR :				CEDAR]			72-75
DAT	E :				P. BIR.					76-79

Volume Estimation



١

IBM FOREST INVENTORY

MERCHANTABLE TYPE DATA SHEET

DIUS 1/5	AGRE	PLOT - 52.7 FEET					RADIUS I/K	ACRE PLO	r - 37.2	FEET
Descrip	tion		COL.NO. 1-7	6. Acreage	·	COL. NO.	II. Site	()	COL N
Mgmt. U	nit		8-9	7. Class St. Own. ()	19	12. Forest Dev.	()	28
Čomp. N	0.		10	8. Land Use ()	20	13. Type Cl	()	29
Type No	b .			9. Unders'y ()	21-24	14. Oper.	()	30
Cond. Cl	ass	()	12-15	IO.Stand Age		25-26	15. Gause - Ac. Lo	ss ()	31
			CUI	MULATIVE 1/5 /	CRE TALLY SHEE	T				
DBH	SPEG	NUMBER OF	8 FOOT BOLTS (3" T	OP DIA.) PER TREE		DEFECT -	CORDS	T		
		0 1 1 1 2 2 2 3	3 3 4 4 1 1 2 2	2 3 4 4 5 6 6 7 7	123456678	SPECIES				TO
		4 4 5 5 5 6 6 6 7	77788991	0 10 11 12 12 13 13 14 15	9 10 11 12 13 14 15 15 16				J. OF PLD	15
4		12 12 13 13 13 13 14 14 15	15 15 15 16 23 23 24 2	4 25 26 26 27 27 28 29 29	25 26 27 28 29 30 31 32 33					
		0 1 1 1 1 2 2 2 3 4 4 5 5 5 6 6 6 7	3 3 4 4 1 1 2 2 7 7 7 8 8 9 9 1	3 4 4 5 6 6 7 7 0 10 11 12 12 13 13 14 15	1 2 3 4 5 6 6 7 8			I		
		8 8 9 9 9 10 10 10 10	11 11 11 12 15 16 16 1	7 18 18 19 20 20 21 21 22	17 18 19 20 21 22 23 24 25					
-		0 1 1 1 1 2 2 2 3	<u>3 3 4 4 1 1 2 3</u> 9 10 11 12 1 2 4 1	<u>3 4 4 5 6 6 7 7</u> 5 6 7 8 10 11 12 13 14	2 4 5 7 9 11 13 14 2	4	14 3 6 9			
		13 14 15 16 17 18 18 19 20	21 22 23 24 16 17 18 1	9 2022 23 24 25 26 28 29	16 18 20 22 23 25 27 29 1	7 19 22 24 26	29 12 15 18			
		37 38 39 40 41 42 43 43 44	45 46 47 48 44 46 47 4	4 35 36 57 58 40 41 42 43 8 4950 52 53 54 55 56 58	45 47 49 50 52 54 56 58 4	16 48 50 53 55	43 21 24 27 58 30 33 36			
N		1 2 3 4 5 6 6 7 8	9 10 11 12 1 2 4 1	5 6 7 8 10 11 12 13 14 2022 23 24 25 26 28 29	2 4 5 7 9 11 13 14 2	2 5 7 10 12	14 3 6 9			
		25 26 27 28 29 30 31 31 32	33 34 35 36 30 31 32 3	4 35 36 37 38 40 41 42 43	31 32 34 36 38 40 41 43 3	1 34 36 38 41	43 21 24 27		1	
-		1 2 3 4 5 6 6 7 8 NUMBER OF	9 10 11 12 1 2 4 8 FOOT BOLTS (4")	5 6 7 8 1011 12 13 14 DR LARGER) PER TREE	2 4 5 7 9 11 13 14 2	2 5 7 10 12	14 3 6 9			
			2	3	4	1 23 26 20	5			
		10 11 12 13 14 15 16 18 19	21 22 24 25 27 28	24 26 28 30 32 35 37 3	9 41 / 35 37 40 43 46 4	9 52 55 58	15 19 23			
		22 23 24 25 26 27 42 43	45 46 48 49 51 52 /	63 65 67 69 71 73 76 78	80/85 88 90 93 96 98 10	1 104	42 46 50 54			
P		10 11 12 13 14 15 16 18 19	21 22 24 25 27 24	26 28 30 32 35 37 39 4	32 35 37 40 43 46 49	5 26 29 74	27 31 35			
11-		16 17 18 18 19 /28 30 3	<u>1 33 34 36 37 39/43</u> 7 9 10 12 13 15 / 2 4	45 48 50 52 54 56 58 60	58 60 63 66 69 72 75 78 3 6 9 12 14 17 20 23 26	$\frac{80}{329}$ $\frac{39}{481}$	<u>42 46 50 54</u> 2 15 19 23			
· -		8 9 10 11 12 13 16 18 19	21 22 24 25 27/22	4 26 28 30 32 35 37/3	2 35 37 40 43 46 49 52	55 27 31	35 39 42 46	L		
		78910111213 16 18 19	21 22 24 25 27/22 24	26 28 30 32 35 37/32	35 37 40 43 46 49 52	31 35 3	9 42 46 50			
		2 3 5 6 8 10 11 2 5 7 10	12 15 17 20 22' 3 7 10 32 35 37 40/31 35 3) 14 17 21 24 28 /5 9 58 42 45 49 52 /51 55	14 18 23 28 32 37 41 46 60 65 69 74 78 83 88	/6 12 17 23 2 35 41 46 52	29 6 7			
CRE		21 22 24 26 27 42 45 47	50 52 55 57/56 60 6	3 66 70 73 77 92 97	01 106 111 115 120 125 56	64 70 76	28 34 24 33			
A -		23568102571012	15 17 20/3 7 10 14	17 21 24 28/5 9 14	18 23 28 32 37 41 6 12	17 23 29/7	14 21 /8 16			
8 8		11 13 14 16 18 22 25 27 30	32 35 37/31 35 38	42 45 49 46 51 55	50 65 69 74 78 35 41 ·	46 52 58/28	34 24 33	L		
s		2 3 5 6 8 2 5 7 10 12	15 17 20/3 7 10 14 1	21 24 /5 9 14 18 23	28 32 37 41 6 12 17 2	3 29/7 14	21 /8 16 24			
- ORI-		10 11 13 14 22 25 27 30 3	2 35 37/28 31 35 38 17 20/3 7 10 14 17	<u>42 45 /46 51 55 60 6</u> 21 24 /5 9 14 18 23	<u>5 69 74 78 / 35 41 46 5</u> 28 32 37 / 6 12 17 23	<u>2 58/28 34</u> 29 / 7 14 1	<u>41/33 41 49</u> 21 / 8 16 24			
		10 11 13 14 22 25 27 30 3	2 35/28 31 35 38 4	2 45 41 46 51 55 60	65 69 74 / 35 41 46 52 1	58/28 34 4	1/33 41 49	· ·		
. 0 S		12 5 7 10 4 7 11 15 18 2	48/35 41 46 51 56	61 59 66 73 79 86 92	40 46 53 8 17 25 33 42	40 50 60	48 60 72			
히는		22 25 27 51 55 59 62 66	70/66 71 76 81 86 9	1 /112 119 126 132 139	145 92 100 108 117	70 80 90	84 96 108			
L L		12 15 17 29 33 37 40 44	35 41 46 51 56 61	53 59 66 73 79 86 9	2 50 58 67 75 83 50	0 20 30 40 0 60 70 80	48 60 72	L		
		2 5 7 10 4 7 11 15 18 22	5 10 15 20 25 30	7 13 20 26 33 40 46	8 17 25 33 42 / 10 8 17 25 33 42 / 10 2	20 30 40/1 20 30 40/1	2 24 36 48			
ME		4 7 11 5 10 15 20 25 30 7	14 21 28 34 41 /9	18 27 36 45 54 63 /1	1 23 34 45 56 68 /14 2	7 41 54 16	32 49 18			
12 3		4 7 11 5 10 15 20 25 /7	4 21 28 34 41 9 18	8 90 99 108 117 79	23 34 45 56 68/14 27 4	1 54 68 / 16	32 49 18 36	L		
×		4 7 11 5 10 15 20 25 7 1	<u>4 21 28 34 41 / 9 18</u>	<u>27 36 45 54 / 11 23</u> 7 36 45 54 / 11 23	34 45 56 68/14 27 41 34 45 56 68/14 27 41 F	54 68 16 3	2 49 18 36			
		5 10 7 13 20 27 9 18	27 36 45 12 23	35 47 58 70/15 29 4	4 58 73 87 / 18 35 53	70 88 21 4	2 63 24 47	1 1		
14 -		15 20/34 40 47 /54 63 5 10/7 13 20 27 /9 18 2	72 8 90 8 93 10	<u>5 116 128 / 102 117 13</u> 47 58 / 15 29 44 5	8 73 87 / 18 35 53 70	88 21 42	63 24 47	I		
		510 7 13 20 27 9 18 2	36 45/12 23 35	47 58 15 29 44 58	73 87 /18 35 53 70 8	38 21 42	63 24 47			
16 E		/11 22 33	44 55/14 29 44 58	72 18 36 54 72 90	0 108 22 44 66 87 10	9 26 52 78	104/29 59			
			4 55/14 29 44 58	72 18 36 54 72 90 3 22 44 66 88/110 1	108 22 44 66 87 10	9 26 52 78	27/36 72	<u>↓</u>		
18		/14 27 40 54	68 18 35 52 70 88	22 44 66 88 110 13	2 27 53 80 106 133	32 63 951	27/36 72	ļ		
20		/16 32 48 64	1 21 42 62 83 104	20 02 18 104 130 156 6 52 78 104 130 156	32 63 95 126 158	1 38 76 113 15 38 76 113 15	1 4 3 85		·	
22		/	24 49 74 98 31	61 92 122 153 184	37 74 111 148 185 227	4 4 88 132 17	750 100 150			
24		· / /	36 71	107 142 178 214 249 4	3 86 128 171 216 257 /5	1 102 153 204	58 115 173			
			<u> </u>	01 142 1/8 214 249/ 43	10 DATA	T		<u>+</u>		
5AP		PLOT-RADIUS 16.6 FT.	PIECE PRO	DUCTS SPECIES	COL. NO. SPECIES	GR. √OL. C. -	P NET VOLUME -	CORDS	GOL. NO	D.
			SPECIES	ALLY Aspen	32 - 37					
SPEC.	·			Black Spr	. 38-43					_
	1			Balsam	44-48				·	
				Jack Pine	49-53					
DBH				H ^{TC}	59-60					
	_			BI C-2	53.67					
ہ	·			W	8-71					
рвн				Normage	100 12-75 1011	Cord Car	10 - Col 80		1	
1	1	1 1 1 1		Il Danay Riv	mb 76 70 1 10 10	-Qena (000	ne uur. au		4	1

Volume_Estimation

Table 1 - Composite table; gross volume¹ in board-feet (Scribner rule) by number of 16-foot logs

Diameter		· · · · · · · · · · · · · · · · · · ·			-,			······································	
breast								. •	
high			Volum	e when n	umber of 1	6-foot log	s is-		
(inches)	1/2	1	11/2	2	2 ¹ 2	3	312	4	5
	Board-	Board-	Board-	Board-	Board-	Board-	Board-	Board-	Board-
	feet	feet	feet	feet	feet	feet	feet	feet	feet
8	10	16	24	31				·	
9	13	23	31	39	46			· 	
10	17	30	40	49	57	62			
11	22	38	51	62	71	78			
12	28	48	66	78	89	100	108		
13	34	59	81	96	112	126	138	145	
14	40	70	96	116	141	160	170	178	
15	47	81	113	137	166	188	204	220	
16	54	93	129	158	191	224	248	263	<u> </u>
17	63	106	148	182	218	257	285	308	340
18	72	122	168	207	248	292	325	355	395
19	81	137	190	234	280	328	368	405	455
20	90	156	212	262	317	366	415	450	520
21	100	173	238	293	351	405	460	505	585
22	111	194	262	328	392	450	510	560	660
23	123	215	290	360	435	500	560	620	730
24	137	236	319	400	470	550	620	690	800
25	149	258	348	440	520	600	680	760	880
26	165	281	381	480	565	650	740	820	950
27	179	305	415	520	/ 620	710	800	890	1,030
28	195	331	450	560	670	760	860	960	1,120
29	210	356	485	600	720	830	930	1,030	1,200
30	227	383	520	650	770	890	1,000	1,110	1,290
31	245	410	560	700	830	950	1,080	1,200	1,380
32	260	440	600	740	890	1,020	1,150	1,280	1,470
33	279	470	640	790	950	1,080	1,230	1,370	1,560
34	294	500	680	840	1,010	1,160	1,300	1,460	1,670
35	312	530	720	900	1,080	1,230	1,390	1,560	1,790
36	330	565	770	960	1,140	1,310	1,480	1,650	1,900
37	349	600	820	1,020	1,210	1,390	1,570	1,750	2,010
38	365	630	860	1,070	1,270	1,470	1,660	1,840	2,120
39	384	660	900	1,130	1,330	1,550	1,750	1,940	2,240
40	405	700	950	1,180	1,400	1,630	1,850	2,050	2,350

¹ The bold figures in the upper portion of the table show volume to a top diameter of 6.0 or more, but less than 8.0 inches and hence are applicable only to softwoods.

USDA Bulletin #1104

Diameter								
breast high			Vol	ume when nu	umber of h	olts is -		
(inches)	1	2	3	4	5	6	7	8
	Cords	Cords	Cords	Cords	Cords	Cords	Cords	Cords
4	0.007	0.011			<u> </u>			
5	.011	.019	0.022					
6	.017	.028	.044	0.047				
7	.023	.038	.053	.068	0.076			
8	.031	.050	.068	.087 ~	.106	0.116		
9	.040	.065	.088	.109	.130	.153	0.170	
10	.049	.082	.111	.133	.160	.188	.211	
11	.060	.100	.137	.165	.190	.221	.250	0.270
12	.070	.121	.165	.198	.225	.260	.300	.330
13	.082	.143	.197	.236	.268	.305	.350	.42
14	.095	.167	.228	.273	.311	.353	.40	.47
15	.107	.193	.262	.318	.364	.41	.46	.52
16	.122	.220	.300	.367	.42	.47	.53	.59
17	.138	.250	.340	.42	.48	.54	.59	.66
18	.155	.282	.382	.47	.55	.60	.65	.73
19	.173	.318	.43	.53	.61	.68	.73	.81
20	.194	.353	.48	.59	.68	.76	.81	.89
21	.217	.395	.54	.66	.76	.84	.90	.98
22	.240	.44	.60	.73	.84	.93	1.00	1.07
23	.262	.48	.66	.80	.92	1.03	1.10	1.17
24	.288	.52	.72	.88	1.00	1.12	1.21	1.28
25	.312	.58	.78	.96	1.10	1.23	1.33	1.38
26	.340	.62	.84	1.04	1.19	1.33	1.44	1.51
27	.363	.67	.91	1.13	1.29	1.45	1.56	1.63
28	.388	.72	.97	1.20	1.38	1.55	1.67	1.76
29	.41	.76	1.03	1.29	1.49	1.66	1.80	1.90
30	.43	.80	1.10	1.37	1.59	1.7	1.03	2.04

Table 6 - Composite table; gross volume in rough cords to a variable top diameter inside bark, by number of bolts

¹ The bold figures in the upper portion of the table are to a minimum top diameter (inside bark) of 3.0 or more, but less than 4.0 inches. Other top diameters are variable but not less than 4.0 inches.

USDA Bulletin #1104

C – 4

Volume Estimation

Stump Diameter $\frac{2}{}$	Diameter Breast Height							
(inches)	Softwoods	Hardwoods	Aspen					
4.0	3	3	3					
5.0	4	4	4					
6.0	5	5	5					
7.0	6	6	6					
8.0	6	7	7					
9.0	7	7	7					
10.0	8	8	8					
11.0	9	9	9					
12.0	10	10	10					
13.0	11	11	11					
14.0	12	12	12					
15.0	13	13	13					
16.0	14	14	14					
17.0	15	14	14					
18.0	15	15	15					
19.0	16	16	16					
20.0	17	17	17					
21.0	18	18	18					
22.0	19	19	19					
23.0	20	20	19					
24.0	21	21	20					
25.0	22	21	21					
26.0	23	22						
27.0	23	23						
28.0	24	24						
29.0	25	25						
30.0	26	26						
31.0	27	27						
32.0	28	28						
33.0	29	28						
34.0	30	29						
35.0	31	30						
36.0	32	31						

Table 3 - DIAMETER AT BREAST HEIGHT AND STUMP DIAMETER RELATIONSHIP $\frac{1}{}$ (From Lake States Forest Experiment Station Technical Note #507)

 $\frac{1}{2}$ Data were collected in 1956 and 1957 in Minnesota.

 $\frac{2}{}$ Stump diameters were measured at 12" above ground level for sawtimber and 6" above ground level for smaller trees.

This table on page J-2.3 of the Timber Scaling Manual, 1981.

C – 5

ŝ

PRODUCTION	ITEMS TO		STANDARD									
FUNCTION	CONSIDER	Quantity	Factor	Quantity	Factor	Quantity	Factor	Duantity	Factor	Quantity	Factor	
Felling Limbing Bucking	Cds./Acre DBH & Sticks/Tree Other Factors(2) Total	0-5 5" 2	.04 .04 .02 .10	5-8 6-8" 2.5	.07 .09 <u>.04</u> .20	8-13 8" 3.5	.12 .15 <u>.08</u> .35	13-20 8-10" 4	.15 .19 <u>.11</u> .45	20+ 10"+ 4 +	.18 .24 .13 .55	
Skidding	Cds./Acre Slope % # Chains Total	0-5 25+ 10+	.02 .02 .01 .05	5-8 15-25 7-10	.05 .03 .02 .10	8-13 15 5-7	.07 .05 .03 .15	13-20 10-15 3-5	.09 .07 .04 .20	20+ 0-9 0-2	.11 .09 .05 .25	
Hauling Distance	Secondary ⁽³⁾ Road Haul Haul to Mill (4) Total	15+ 90+	.03 .02 .05	10-15 60-90	.07 .03 .10	5-10 40-60	.10 .05 .15	3–5 20–40	.14 .06 .20	0-3 0-20	.18 07 25	
Road Maintenance/ Construction	Maintenance \$/Cd. (5) \$/Cd. (5) Construc. Total	.30+ .90+	.01 .04 .05	.2030 .7090	.02 .08 .10	.1520 .5570	.03 .12 .15	.1015	.04 .16 .20	010 040	.05 .20 .25	
Market Outlook	Demand		.00		.05		.10		.15		.20	
Quality	% Cull (6) Soundness	20+	.00	15-20	.05	10-15	.10	5-10	.15	0-5	.20	
Grand Total			.25		.60		1.00		1.35		1.70	

PULPWOOD & PULP & BOLT FACTOR (1)

1) To be used as a combination for all species on sale.

- 2) Other considerations limbs, underbrush, stocking distribution, rocks, terrain and residual stand requirements.
- 3) Distance in miles from logging site to all weather road. (State, County or Township road, maintained year round, and designed for two-way traffic).
- 4) Haul to nearest mill including secondary road haul mileage. (Use Market List attached).
- 5) Estimate construction and maintenance cost based on soil type, terrain, grading, snowplowing, etc.
- 6) The percent cull is the main criteria, however, clarity of bole, straightness and sticks per tree should be considered.

D - 1

SAWLOG PRICE GUIDE FACTORS

PRODUCTION FUNCTION		S	TANDARD		
Felling Limbing Bucking <u>1</u> /	.08 Scattered timber less that and ave. $1/2$ to $1_2^1 \log 1$ trees, heavy limbs, heavy tree cull 35% or more, re	.15 an 1300 BF/A. Der tree, short y underbrush, Docky terrain.	.20 Moderate cut, 800 to 2400 BF/A. 1 to $1\frac{1}{2}$ logs per tree, clean bole trees, moderate to light underbrush, ave. terrain, tree cull 15-35%.	.25 Heavy cut 1500+ BF/A and little limbing, clear bo no underbrush or reprodu slightly rolling to leve or less.	.32 2+ logs per tree, le to top diameter, ction. Terrain 1. Tree cull 10%
Skidding <u>2</u> /	.04 Less than 1300 BF/A. Res problem, steep slopes, h heavy underbrush, scatte swampy or low areas cons applicable.	.10 idual stand illy and rocky red timber, idered if	.18 Moderate cut. 800 to 2400 BF/A. Light to moderate underbrush. Average terrain, residual stand no problem. Generally highland skidding.	.23 Heavy cut. 1500 BF/A. Re problem, level to gently underbrush.	.29 sidual stand no rolling, no
Hauling <u>3</u> /	.05 40+ miles to defined mil road rough, rocky, windi weather.	.15 1 site. Woods ng, not all	.30 20-40 miles to defined mill site. Woods road in average terrain of moderate length.	.36 20 miles or less to defin road generally all weath few rocks, in slightly ru terrain.	.42 ned mill site. Woods er, short, dry, olling to level
Market Outlook 4/	.02 Wood difficult to dispos markets, small lots a pro of logs.	.04 e of, periodic oblem, poor run	.09 Market generally avail- able, average run of logs.	.12 Local markets readily ava small lots, very good run	.15 ailable, including n of logs.
Road Const. & Maint.	.03 Extremely high road cost rough rocky terrain. Wet factor.	.05 s, \$1.50+ per MBF, areas a noted	.08 Moderate road costs \$1.00 per MBF, average terrain.	.10 Little or no road costs, MBF gently rolling to le wet areas no problem.	.13 less than 50d per vel slopes, rocks,
Quality <u>5</u> /	.03 Logs of small sizes in a knots, branch stubs, few cull factor 35% or more, high percent of #2 or #3	.06 verage, numerous clear bole trees, in log grade terms logs.	.15 Logs of medium sizes, average number of good logs with clear boles. Tree cull defect 15-35% ave. run of #1 logs.	.24 Large percent of logs of 20+%, mostly good clear knots, swelling or branc defect less than 10%. Ab #1 logs in terms of log	.34 large sizes, bole trees, few h stubs, tree cull ove average run of grade.
TOTAL	.25	.55	1.00	1.30	1.05

GENERAL FACTOR GROUPS: Interpolation is allowed within group factors.

Group Factor 1/ Major factors: M. Bd. Ft./A. & logs per tree: Where overlap occurs make factor choice on secondary conditions. Group Factor $\frac{7}{2}$ / Major factors: M. Bd. Ft./A. & residual stand: overlap choice on secondary conditions, same as #1. Group Factor $\frac{3}{2}$ / Use sawlog market list Group Factor $\frac{4}{2}$ / Use quarterly factor established Group Factor $\frac{5}{2}$ / Quality - if log grade background and skill is known, base factor choice on these conditions.

D

L Ν

C. Use of the Price Guide Factors (From Timber Sales Manual page B-4.1)

1) Production and Marketing Factors

The Price Guide Factor System is a method of establishing a price on a timber appraisal based on the stand conditions and markets at the time of appraisal. The Production Functions considered are those that contribute to the profit potential of a logging chance. The factors, or spread points, indicate the expected profit ratio that each function will have on the overall profitability of the operation.

A separate Price Guide Factor is used for pulpwood (including pulp and bolts) and sawtimber. Bolt percentages are established during the appraisal process, but will use the same price guide factors as for pulpwood in computing the species bolt price.

2) Pulpwood Factors

a) Felling, Limbing and Bucking

This category has three subfactors to consider in establishing the total factor for this production function. The factor for each of these items can be selected from throughout the range of the standards.

For example, a stand may have a volume of 7 cds./acre for a factor of .07, and an average DBH of 8" and 3.5 sticks/tree for a factor of .15 with a factor .02 assigned due to underbrush, stocking, etc. for a total factor of .24.

b) Skidding

This function is also broken down into three subfactors which are cords/acre, degree of slope, and average number of chains per skid. The value given each subfactor can be selected from throughout the range of the standards.

c) Haul Distance

This function is divided into two subfactors, Secondary Road Haul and Mill Haul.

(1) Secondary Road Haul

This is the truck haul distance in miles from the logging site to the start of an all weather road. An all weather road is defined as a State, County or Township road, maintained year round and designed for two-way traffic.

(2) Mill Haul

This subfactor is interpreted as the haul distance in miles from the logging site to the nearest mill having precedence for taking the species. The market should be selected from the Pulpwood Market list. (Rail sidings or brokerage yards will not be considered a mill site).

Value Determination

d) Road Maintenance and Construction

These two subfactors are intended to assist in reflecting the cost of road building and/or maintenance of the road network. Unlike other agencies, the State does not prescribe road specifications and allows the purchaser to build a minimum type road, just to get out the products.

The total cost for each subfactor must be determined and the factor is based on the cost per cord of the wood being hauled over the road.

(1) Road Maintenance

Factors to consider are snowplowing, grading, filling of holes and ruts, etc.

(2) Road Construction

Factors to consider are terrain, soil type, rocks, wet areas and culverts or bridges to install.

e) Market Outlook

This factor is determined on the basis of the general market conditions and the specific market conditions in a local area. The general market condition will be established by St. Paul on a quarterly basis and the specific market conditions will be determined at the local level with Regional approval.

The procedure to be followed is that prior to the beginning of each quarter, St. Paul will notify the field as to what market factor is to be used for the next three month period. If due to a local market condition, the field thinks a different factor should be used, they can with Regional approval, be allowed a five point spread, up or down, from this factor. In no case, however, can the market factor exceed 20 or be less than 0.

Example: The general market factor for softwood pulpwood is set at 5 by St. Paul. The Littlefork Area thinks their market conditions are better, so with Region approval, a factor of 10 is established for softwood pulpwood in the Littlefork Area for that quarter.

f) Quality

This factor refers to the soundness and quality of the trees being harvested. The factor selected is based primarily on the estimated cull percentage, however, other factors such as straightness, clarity of bole and sticks per tree should be considered. Note: cull is not considered as a volume deduction in pulpwood but it does affect the profitability of the logging operation and the percent of bolts.

3) Sawtimber Factors

Users of this guide will notice that there is overlap throughout the standards for most of the production functions. This was intentional to

avoid concentration and choices being made on a single subfactor such as volume per acre being harvested or logs per tree, etc. Also, interpolation is allowed between the standards for each production function so that all items are considered.

a) Felling, Limbing and Bucking

The major factors to consider are the bd. ft./acre to be harvested and the logs per tree. If overlap occurs, select factor on other conditions.

b) Skidding

The major factors to consider are the bd. ft./acre to be harvested and the residual stand problems. Again, if overlap occurs, select factor on other conditions.

c) Hauling

The main factor to consider is the haul distance in miles to the nearest mill purchasing the species being harvested. The nearest mill should be selected from the Sawlog Market list. (If there are known mills closer than what is listed, they should be used in computing haul distance). The other factor to consider is the condition of the woods road.

d) Market Outlook

The determination of this factor is the same as the determination of the pulpwood market factor. The factor will be established by St. Paul on a quarterly basis and can be adjusted at the local level with Regional approval. The maximum the factor can be adjusted is 5 points up or down and cannot be lower than .02 or higher than .15.

e) Road Construction and Maintenance

The total road construction and maintenance costs must be estimated and the factor is based on the cost per MBF of logs to be moved over the road system.

f) Quality

This factor commands careful analysis because of its relationship to log values and market demand. The major items to consider are log grades, percent cull and log size.

Appraisers with a knowledge of log and/or tree grades should use this item in determining the factor. If not, the factor should be established based on percent cull, log size and the amount of clear boles in the trees being harvested.

4) General Information

The price guide factors can be used individually by species, but are best applied and it is recommended that they be used in a combination of all species being appraised as pulpwood or sawtimber.

Value Determination

In using the price guide factors, the sum of all the factors multiplied by the species base price is the selling price for the sale. If a price increase or decrease from this established price still has merit, it should be applied to the final selling price and <u>not</u> by manipulation of one or more of the price guide factors.

The price guide factors should be listed on the Appraisal Report (F-121) in the same order as in the Guide with parentheses around the sub-groups.

PULPWOOD MARKET LIST

The closest mill listed to the sale area should be used in determining the <u>Haul to</u> Mill distance.

FIRM & LOCATION

Blandin Paper Company Grand Rapids, MN

Blandin Wood Products Company Grand Rapids, MN

Boise Cascade Corporation International Falls, MN

Hennepin Paper Company Little Falls, MN

Minnesota Sawdust & Shavings Anoka, MN

Northwood Panelboard Company Bemidji, MN

Potlatch Corporation Cloquet, MN

Potlatch Corporation Bemidji, MN

Potlatch Corporation Cook, MN

SPECIES PURCHASED

Aspen Balsam Fir Spruce

Aspen

Aspen Balm of Gilead Birch Balsam Fir Pine Spruce Tamarack

Aspen Balsam Fir Spruce

Aspen

Aspen Balm of Gilead Birch

Aspen Birch Balsam Fir Pine Spruce

Aspen

Aspen

Value Determination

FIRM & LOCATION

Remer Timber Company Remer, MN

St. Regis Paper Company Sartell, MN

Superwood Corporation Duluth, MN

Superwood Corporation Bemidji, MN

Consolidated Papers, Inc. Wisconsin Rapids, WI

Mosinee Paper Corporation Mosinee, WI

Nekoosa Papers, Inc. Nekoosa, WI

Rhinelander Paper Company Rhinelander, WI

Superior Fiber Corporation Superior, WI

Abitibi Forest Products Thunder Bay, Ontario

Great Lakes Forest Products, Ltd. Thunder Bay, Ontario

MacMillan Bloedel Thunder Bay, Ontario

SPECIES PURCHASED

Aspen Balsam Fir Spruce

Aspén Balsam Fir Spruce Aspen

Aspen

Balsam Fir Pine Spruce Tamarack

Pine

Aspen Balsam Fir Pine Spruce

Spruce Tamarack

Aspen

Spruce

Aspen Balm of Gilead Birch Balsam Fir Pine Spruce Tamarack

Aspen Balm of Gilead Birch
SAWTIMBER MARKET LIST

The closest mill listed to the sale area should be used in determining the <u>Haul to</u> <u>Mill</u> distance. If a species is not indicated, the mill listed has a precedence for purchasing all species of sawlogs.

FIRM & LOCATION

SPECIES

AITKIN COUNTY

Demenge Sawmill McGregor, MN

Northern Timber Co. Aitkin, MN

Peterson Bros. Mill Isle, MN

Younghans Supply Co. Palisade, MN

BECKER COUNTY

BELTRAMI COUNTY

Noeske Lumber Co. Osage, MN

Two Inlets Mill Park Rapids, MN

Dickinson Lumber Co. Bemidji, MN

Erickson Sawmill Kelliher, MN

Frenzel Mill Kelliher, MN

Parmark Fence Co. Kelliher, MN

Red Lake Indian Mills Redby, MN

Sorheims Mills Blackduck, MN Aspen

Aspen Hardwoods

Aspen Softwoods

Aspen Hardwoods

Aspen Softwoods

Aspen Softwoods

FIRM & LOCATION

CARLTON COUNTY

Diamond International Corp. Cloquet, MN

Potlatch Corporation Cloquet, MN

CASS COUNTY

Claude Blanchard Mill Pine River, MN

Jesse Dabill Mill Pine River, MN

James Foster Sawmill Cass Lake, MN

Johnson Lumber Co. Bena, MN

Rosie Johnson Walker, MN

Pine River Lumber Pine River, MN

Jay Schmidtke Backus, MN

Weaver Lumber Co. Longville, MN

Wheeler Lumber Division St. Regis Paper Co. Cass Lake, MN

Headwater Lumber Co. Bagley, MN

Manahawkin Sawmill, Inc. Bagley, MN

Martin Lumber Co. Shevlin, MN

COOK COUNTY

CLEARWATER COUNTY

Hedstrom Lumber Co. Grand Marais, MN SPECIES

Aspen

Softwoods

DUNTY

Aspen

Aspen Hardwoods

Aspen Hardwoods

Aspen Softwoods

Aspen Hardwoods

FIRM & LOCATION

SPECIES

CROW WING COUNTY

Jerry Callahan Brainerd, MN

į,

Cross Lake Wood Products Cross Lake, MN

Habighorst Forest Products Crosby, MN

Schilling Logging & Lumber Brainerd, MN

Wynn & Wynn Sawmill Emily, MN

DOUGLAS COUNTY

FILLMORE COUNTY

Ramon Nelson Carlos, MN

Root River Hardwoods Preston, MN

Three Oak Company Peterson, MN

Dean Poe Cannon Falls, MN

HOUSTON COUNTY

GOODHUE COUNTY

Frey Forest Products LaCrescent, MN

Northwest Tie Co. Spring Grove, MN

Staggemeyer Stave Co. Calendonia, MN

Kahlstorf Lumber Co. Lake George, MN Aspen Hardwoods

Aspen Hardwoods

Hardwoods

Hardwoods

Hardwoods

Aspen Hardwoods

Aspen Hardwoods

Hardwoods

Hardwoods

HUBBARD COUNTY

Softwoods

FIRM & LOCATION

SPECIES

HUBBARD COUNTY CONTINUED

ITASCA COUNTY

Lof Lumber Co. Nevis, MN

Steamboat Sawmill Bemidji, MN

Walsh Lumber Co. Park Rapids, MN

Cohasset Mill & Lumber Cohasset, MN

Cole Forest Products Grand Rapids, MN

Kangas Mill & Lumber Bovey, MN

Liila Lumber Sales Grand Rapids, MN

Marcell Mill & Lumber Marcell, MN

Rajala Mill Co. Bigfork, MN

Rajala Timber Co. Deer River, MN

Schindler Bros. Mill Togo, MN

Squaw Lake Lumber Squaw Lake, MN

KANABEC COUNTY

Karg & Sons Timber Products Isle, MN

KOOCHICHING COUNTY

Big Falls Forest Products Big Falls, MN

Boise Cascade, Manila Mill Big Falls, MN Aspen Softwoods

Hardwoods Softwoods

Aspen Hardwoods

Aspen Hardwoods

Aspen

Aspen Softwoods

Aspen Softwoods

Aspen Hardwoods

<u>Value Determination</u>

FIRM & LOCATION

SPECIES

KOOCHICHING COUNTY CONTINUED

Dave's Wood Products International Falls, MN

Green Forest Products Littlefork, MN

Minnesota Cedar Products Northome, MN

Northland Hardwood Lumber Northome, MN

Page & Hill Forest Products Big Falls, MN

Promersbergers Mill Littlefork, MN

J.C. Campbell Co. Two Harbors, MN

LAKE OF THE WOODS

LAKE COUNTY

Gerald Erickson Baudette, MN

Franklin Fence Co. Williams, MN

Williams Wood Products Williams, MN

LESUEUR COUNTY

McCarty Lumber & Logging Waterville, MN

Ray Tracey Kilkenny, MN

Hutch Wood Products Hutchinson, MN

Madsen & Sons Hutchinson, MN Cedar

Aspen Softwoods

Hardwoods

Aspen

Softwoods

Hardwoods

Hardwoods

MCLEOD COUNTY

Hardwoods

Hardwoods

FIRM & LOCATION

SPECIES

MARTIN COUNTY

Hanson Woodshed Sherburn, MN

MILLE LACS COUNTY

Ratzlaff Logging & Lumber Onamia, MN

Ratzloff Logging & Lumber Princeton, MN

NICOLLET COUNTY

Minnesota Valley Forest Products Courtland, MN

OTTERTAIL COUNTY

Hansen's Wood Shred Wadena, MN

Northwood Specialty Co. Parkers Prairie, MN

PINE COUNTY

Horton Sawmill Willow River, MN

Rydberg Construction Co. Pine City, MN

Willow River Lumber Moose Lake, MN

Allan Carlson Pencer, MN

Earnest Carlson Pencer, MN

Frank Glesner Warroad, MN Hardwoods Softwoods

Aspen Hardwoods

Aspen Hardwoods

Hardwoods

Aspen Hardwoods

Aspen Hardwoods

Aspen Hardwoods

Aspen Hardwoods

Aspen Hardwoods

ROSEAU COUNTY

Softwoods

Aspen Softwoods

FIRM & LOCATION

SPECIES

ST. LOUIS COUNTY

Bois Forte Enterprises Nett Lake, MN

Hill Wood Products Cook, MN

#±

John V. Hutchinson Floodwood, MN

Clayton Iverson Biwabik, MN

Matko Sawmill Eveleth, MN

Orr Manufacturing Orr, MN

Wakefiled Sawmill Duluth, MN

Green Isle Logging & Lumber Green Isle, MN

U.S. Forest Products Henderson, MN

STEARNS COUNTY

SIBLEY COUNTY

Lyman Hull St. Joseph, MN

TODD COUNTY

Viking Forest Products Motley, MN

WABASHA COUNTY

A & B Sawmill Kellogg, MN Aspen Hardwoods

Aspen

Aspen

Hardwoods

Hardwoods

Hardwoods

<u>Value Determination</u>

FIRM & LOCATION

SPECIES

WADENA COUNTY

Gateway Industries Menahga, MN

Wesley Makela Sebeka, MN

Minnesota Forest Products Menahga, MN Aspen Hardwoods

North Star Logging & Lumber Menahga, MN **n** *