

**Minnesota's Timber Harvesting Guidelines:  
An Assessment of Their Financial Cost to  
Forest Landowners and Influence on  
Willingness to Pay for Stumpage**

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## Executive Summary

States have developed guidelines (also known as best management practices or BMPs) in response to growing public concern about the need to mitigate negative environmental consequences associated with timber harvesting (e.g., soil erosion, reduced water quality, loss of wildlife habitat).

Implementing such practices can lead to increased environmental protection and a variety of forest values desired by society. The application of timber harvesting guidelines also produces a range of benefits and costs that accrue to those who own the forest as well as those who harvest the timber.

A study was conducted to determine the extent to which forest landowners incur additional financial costs resulting from the application of Minnesota's timber harvesting guidelines through: (1) lower prices received for timber stumpage, (2) foregone revenue from merchantable timber left on the site after harvest; and (3) additional time required to design and set-up timber sales which incorporate timber harvesting guidelines. The Minnesota Department of Natural Resources and St. Louis County Land Department offered 27 tracts of timber for sale through a sealed bidding process during fall 2002. Each tract was set-up and offered for sale both with and without the requirement to apply a specific set of guidelines. Prospective purchasers were required to submit a pair of bids on each study tract—one to purchase the timber sale with and the other without the use of the guidelines. Foresters who set-up each timber tract for auction recorded the time spent on a variety of timber sale preparation activities. The treatment method for each study tract (i.e., harvest with guidelines; harvest without guidelines) was randomly determined after the close of bidding, and tracts were awarded to the highest bid for the treatment selected.

A total of 80 paired bids were received from 36 logging businesses, resulting in the sale of timber on 23 study tracts. On average, stumpage bids were \$2.66 per cord lower when guidelines were required as part of the timber sale specifications. This amounted to a 10.1 percent discount below bids on the same tracts when guidelines were not specified. With and without guidelines bids were found to be significantly different from each other ( $p < .01$ ). Individual bids for a particular tract when guidelines were required ranged from a 5 percent premium to nearly 40 percent below the bid when guidelines were not required. The wide range in discounted stumpage prices offered by timber harvesters reflects the variable perception as to the extent guidelines affect timber harvesting costs.

The application of guidelines that result in trees being left within the harvest area (e.g., partial harvesting within an inclusion equal to 10 percent of the harvest area, leaving 6 to 12 leave trees per acre) decreased the volume of merchantable timber available for harvest by an average of 2.4 cords per acre. The time required to prepare a timber tract for auction also increased when guidelines were incorporated into the harvest specifications. It took foresters, on average, 57 percent longer to set-up the timber sales when timber harvesting guidelines were incorporated into the sale design—an additional 20 minutes per acre over the time required to set up a timber sale when guidelines were not used.

Based on the bidding behavior of the study participants, the study tracts realized a net decrease in stumpage revenue of \$71.02 per acre when guidelines were used. Foregone revenue from residual trees left on the site averaged \$65.33 per acre across the study tracts. With an assumed opportunity cost of \$20 per hour, the value of additional time required to prepare a tract for harvest using the guidelines averaged \$6.80 per acre. Taken together, total financial costs to forest landowners of incorporating the guidelines into timber sales averaged \$143.15 per acre across the study tracts.

Costs to landowners might have been even higher if timber sale administration and sale closure activities were considered.

Timber harvesters who bid on the study tracts were mailed a questionnaire in spring 2003. The survey revealed a number of important findings about how timber harvesters approach the development of stumpage bids when guidelines are required, as well as how various factors influence their bidding behavior. Most timber harvesters did not consult any special or unique sources in developing their paired bids on the study tracts, suggesting the access to and availability of additional information may not be very important in determining the cost of implementing guidelines. Additionally, only half the responding timber harvesters visited the tract prior to submitting sealed bids for the stumpage. Knowing who the forester was who set up the timber sale, the location of the sale in proximity to other tracts held, and the bidder's inventory of tracts all had less than a moderate influence on stumpage bids. The influence of specific guidelines on bidding behavior was also modest. All of the six guidelines evaluated in our study had less than a moderate influence on the bids developed for the study tracts. In comparing site- and sale-specific tract factors and guidelines, a tract's physical characteristics were perceived to have a greater overall influence on the development of paired bids than did specific guidelines, implying a tract's characteristics factored more prominently in determining the willingness to pay for stumpage than did guidelines.

Assuming the study is indicative of Minnesota timber sales and associated harvesting practices, the benefits produced by the state's timber harvesting guidelines should, on average, be worth at least \$143.15 per acre to landowners. Benefits produced by implementing guidelines on public forests may easily justify their cost as these lands are managed for the production of both market and nonmarket goods and services. Absent benefits of this magnitude on private forest lands, financial support in the form of incentives and/or compensation may be needed if landowners are expected to routinely apply the guidelines on a voluntary basis.

Government commonly uses a wide range of policy tools to influence the behavior of private landowners and the resulting management of their forests. Research indicates that technical assistance programs are considered the most effective and efficient policy tool for encouraging nonindustrial private forest landowners to apply timber harvesting guidelines. Tax incentives and cost-share programs are emerging tools for encouraging application of forest management guidelines. These programs provide financial incentives to landowners to compensate them for benefits from applying guidelines that largely accrue to society but have no direct benefit to the logging business owner or landowner.

Because of time and budget constraints, the actual costs for a timber harvester to apply Minnesota's timber harvesting guidelines were not assessed as a part of this study. Previous research suggests those costs could be substantial. New metering and sampling technology allows researchers to collect data on per unit productivity over a broad range of factors such as site conditions, operators, and season of harvest. Employing this technology would enable an assessment of the impact Minnesota's guidelines have on timber harvesting productivity and associated variable operating costs.



## Introduction

Many states have developed guidelines (also known as best management practices or BMPs) in response to growing public concern about the need to mitigate the negative effects associated with timber harvesting. The timber harvesting practices called for in these guidelines are intended to protect and enhance a number of ecological, environmental, and aesthetic attributes associated with forest resources. Among these are clean water, ecological diversity, riparian and wildlife habitat, soil productivity, and visual quality. The use of guidelines may also increase the long-term economic value of forest assets. Implementing such practices can lead to increased environmental protection and sustainability of forest resources that benefit the individual forest landowner as well as society as a whole.

The application of timber harvesting guidelines can also result in additional financial costs to forest landowners and timber harvesters. These costs may be explicit or implicit and include:

- Reduced prices forest landowners receive for stumpage sold,
- Foregone stumpage revenue from residual trees left on site,
- Additional timber sale design and planning time,
- Purchase of additional material required to conduct a harvest (e.g., temporary water crossing or erosion control structures),
- Cost of participating in additional training and education programs on use of guidelines,
- Increased variable operating costs (e.g., machinery fuel costs) per unit output, and
- Additional wear and tear on machinery (e.g., maintenance costs) per unit harvested.

These costs can accrue solely to the landowner, the timber harvester, or may be shared between the two. The degree to which landowners and timber harvesters incur these costs is heavily influenced by such factors as the characteristics and conditions of the harvest site, the landowner's land management objectives, specific timber harvesting practices and guidelines applied, harvesting equipment used, and equipment operator proficiency.

This study evaluated the extent to which forest landowners bear additional financial costs as a result of implementing Minnesota's timber harvesting guidelines. Of the many types of

guideline-related costs landowners might incur, the study focused on the following three major types: (1) reduced prices forest landowners receive for stumpage sold, (2) foregone stumpage revenue from residual trees left on the site, and (3) additional timber sale design and harvest planning time.

### 1. Reduced stumpage prices per unit sold

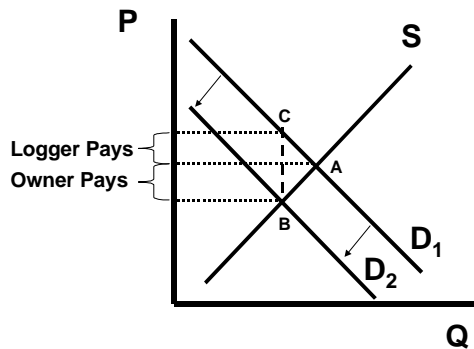
A general model for stumpage price can be expressed as its delivered wood price less harvesting and transportation costs (Klemperer 1996). For any given timber tract, a timber harvester's maximum willingness to pay (WTP) for stumpage reflects a range of tract, sale, and bidder-specific variables such as:

- Existing wood contracts with mills,
- Tract characteristics (e.g., size, volume, slope),
- Timber characteristics (e.g., species, size),
- Sale characteristics (e.g., proximity to other timber sales held by bidder),
- Logging equipment used,
- Logging experience and proficiency,
- Method of stumpage sale,
- Knowledge of local stumpage markets,
- Number of timber sale contracts held, and
- Logging practices or restrictions specified.

This latter category includes perceived marginal costs incurred from applying timber harvesting guidelines.

Forest landowners realize reduced stumpage prices to the extent a timber sale transaction differentiates the price paid for timber when these guidelines are required. A generalized model can help illustrate how any guideline-induced timber harvesting costs are shared among forest landowners and timber harvesters through the stumpage bidding process. In Figure 1, a market in equilibrium is depicted by *A* where the supply of wood available for harvest provided by forest landowners equals the demand for wood by timber harvesters. The imposition of additional harvesting costs resulting from guidelines is shown by the vertical height of dashed line *BC*. With these new costs, the demand for wood by timber harvesters decreases (shifts to the left) from  $D_1$  to  $D_2$ , resulting in a new market equilibrium being established at *B*. Because the new equilibrium price is less than the total cost of the guidelines, both landowners and timber harvesters share the burden of these added costs. The portion of the total additional cost borne by the landowner is represented by the vertical

distance between points A and B, whereas the additional cost borne by timber harvesters is equal to the vertical distance between A and C.



**Figure 1.** Model depicting the incidence of guideline-induced cost on timber harvesters and forest landowners.

The shapes of the supply and demand curves dictate the *incidence* of additional cost among timber harvesters and forest landowners—the degree to which each party bears the added cost.

A timber harvester’s knowledge or perception of guideline effects on harvesting production costs, demand for harvestable tracts, proficiency and efficiency in harvesting timber, and competition in purchasing timber to harvest all influence the degree to which guidelines influence the price of stumpage.

## 2. Foregone stumpage revenue from residual trees

A central feature of many timber harvesting guideline programs is the requirement to leave residual trees on the site to provide ecological and societal benefits (e.g., clean water, wildlife habitat). Trees may be left as a result of partial harvesting practices implemented within riparian management zones, the creation of legacy patches within a harvest area, and leaving live trees scattered or in clumps across the site for visual, wildlife, and ecological purposes. Leaving residual trees on the site represents a real cost to forest landowners in the form of lost revenue from the timber sale that, depending on the occurrence and timing of future harvesting activity on the site, may or may not be captured. The opportunity cost of leaving residual trees on the site is represented by the timber harvester’s willingness to pay for the stand’s merchantable timber during the harvest.

## 3. Additional time required to prepare a tract of timber for sale

Preparing a tract of timber for harvest when incorporating Minnesota’s timber harvesting guidelines may require additional timber sale set-up time both within the field and when doing office tasks. Additional field time may be needed to incorporate guidelines into the design of the timber sale for such practices as marking the boundaries of no cut (e.g., cultural sites, ecologically-significant areas) and partial harvest areas (e.g., riparian management zones within the harvest site), identifying the placement of landings and trails to minimize ecological disturbance and loss of site productivity, and additional timber cruising requirements. Similarly, incorporating the guidelines into timber sale contracts or notices of advertisement for sale may impose additional time for office-related activities such as writing sale regulations, developing a sale map, or calculating sale volume.

This study is unique in that it is one of the few (possibly the only) that relied on actual timber harvester-landowner transactions to assess whether landowners bear additional costs associated with applying timber harvesting guidelines. It is important to note the study did NOT identify the magnitude of total costs resulting from implementation of the guidelines. Such conclusions can only be made after fully measuring a timber harvester’s actual timber harvesting production costs with and without guidelines.

## Review of Previous Studies

### Benefits and Costs of Applying Timber Harvesting Guidelines

Little empirical evidence exists on the extent to which a timber harvester is able to pass any additional cost on to forest landowners in the form of a lower price for standing timber.

Blinn et al. (2000) indicated that several studies reported the application of water quality best management practices reduced gross harvest revenues by 2.78 to 10.67 percent. In Year 2000 dollars, the application costs ranged from \$8.60 to \$105 per acre and \$1.33 to \$9.90 per cord. Most reported values were in the range of \$20 to \$33 per acre and \$1.33 to \$2.55 per cord. Costs would be higher where additional practices (e.g., cultural resources, wildlife habitat) are implemented.

Felling and skidding productivity decreased by approximately 8 to 27 percent and costs increased by approximately 2 to 47 percent using selection harvesting as compared to clearcutting approaches. Some studies reported that decreases in productivity and increases in logging costs associated with implementing additional guidelines were not strong enough to change bidding behavior on timber sales. Those studies noted that as concerns about stumpage availability continued or even grew, bidding behavior did not change significantly because logging firms need to acquire stumpage to stay in business. However, those results were more short-term in nature and long-term bidding trends were not studied.

Kittridge et al. (1999) compared historical stumpage price data in adjacent states (one with comprehensive statewide forest practice regulations; the other without) and found that implementing the harvesting practices called for in the regulations did not impact stumpage prices, suggesting the incidence of any marginal harvesting costs was borne by the timber harvester.

## Benefits and Costs of Minnesota's Guidelines

Minnesota's Sustainable Forest Resources Act of 1995 required that the Minnesota Forest Resources Council "... analyze the costs and benefits of new site-level practices and landscape-level programs" before implementing timber harvesting and forest management guidelines (Minnesota Statutes, Chapter 89A). In response, the Minnesota Forest Resources Council (MFRC) funded two studies to address a variety of objectives related to the benefits and costs of implementing guidelines, including to:

- Estimate and compare the economic and financial costs and benefits of implementing Minnesota's proposed (at that time) timber harvesting guidelines (Vasievich and Edgar 1998);
- Summarize published literature about how a timber harvester's operational efficiency, labor and capital requirements, cost structure, and profitability are impacted by applying forest management guidelines (Blinn et al. 2000). The summary focused on impacts of applying riparian and wildlife guidelines; and

- Assess and summarize existing knowledge about the economic structure and performance of the timber production, harvesting, and delivery markets (Blinn et al. 2000).

Vasievich and Edgar (1998) reported the effects of Minnesota's guidelines on timber harvesters could be substantial. Assuming a timber harvester had not previously applied any of the existing guidelines, the application cost for the guidelines was estimated to be as much as \$3 per cord for the on-site activities. The authors felt the highly competitive logging industry might not be able to pass along the additional costs to log buyers or cover the costs through reduced stumpage prices paid to landowners. They also reported the major effect of the guidelines on landowners would be to incorporate them in planning efforts and when professional foresters conduct management activities and timber sales. The authors estimated adequate planning to incorporate the guidelines during timber harvesting operations would cost \$10 to \$12 per acre.

In a separate study, Blinn et al. (2000) assessed Minnesota's forest management guidebook (Minnesota Forest Resources Council 1999) to determine each guideline's probable operational and cost impact. As many of the guidelines resulted in similar types of changes to a harvesting operation, the changes were grouped into categories of effects and a review of the literature was conducted to summarize existing information. The specific categories of effects summarized were: (1) increase in harvest planning, (2) reduction in the volume harvested per unit of area, (3) reduction in operating productivity, (4) reduction in the available operating time, (5) additional activities or cost factors (i.e., erosion control, stream crossings, wet area crossings, disposal of logging slash, road closing or obliteration), and (6) practices with the potential to reduce cost. The literature reported the most expensive guidelines are related to stabilizing roads, skid trails, and landings, especially in areas where topography is not level.

Blinn et al. (2000) reported that less competitive markets would increase the likelihood of timber harvesters transferring additional costs for implementing guidelines. They reported it unlikely that timber harvesters would be able to pass compliance costs on to the mills in the form of higher delivered prices, because the mills have too much market power (by virtue of their large size

and small numbers) and too many alternative wood sources both within and outside the state. However, the authors believed it likely that timber harvesters would be able to pass implementation costs on to landowners in the form of lower stumpage prices. The authors concluded that guideline compliance costs are likely to be borne ultimately by the landowner, not by the timber harvester or the consumer.

### Costs of Preparing Timber Sales that Incorporate Harvesting Practices

There is little published literature that assessed differences in timber sale set-up with and without the requirement to apply forest management guidelines. An independent firm (Price Waterhouse), hired by the British Columbia provincial government to assess changes in British Columbia's logging costs from 1992-1996 (Clark 1997), documented a 75 percent increase in logging costs, the sources and relative contribution of each being:

44%	Stumpage (largely a fee to finance reforestation)
23%	General rate increases, inflation, land-use changes, tenure administration
21%	Conforming to Forest Practice Code's logging standards
12%	Planning (additional plans, amendments to approved plans) and administration
100%	Total

Costs associated with planning included the time required to set up a timber sale to incorporate British Columbia's Forest Practice Code.

## Background

### Minnesota's Timber Harvesters

The Minnesota Logger Education Program (2002) reported that approximately 445 logging businesses are members of that organization. However, an unknown number of additional logging businesses in the state are not members. The most recent profile of Minnesota's timber harvesters is a study funded by the MFRC that presents respondent logging firm characteristics and production during 1996 (Puettmann et al., 1998). This profile found that, on average, the size of the state's timber harvesting enterprises is relatively small. The

average number of individuals employed by a timber harvesting operator is slightly more than three individuals, with greater than 60 percent of the logging businesses having only one or two employees. In 1996, those firms with one or two employees harvested only 17 percent of that year's total reported production, but obtained more of their wood from nonindustrial private forest landowners than did larger operators. More than 95 percent of the logging businesses profiled are owner/operators from north of the Twin Cities. Itasca, Koochiching, and St. Louis counties account for the greatest number of logging businesses.

Puettmann et al. (1998) reported that logging businesses are typically operated by individuals with considerable experience in the industry. The average length of time working within the logging profession is approximately 23 years, with 60 percent having at least 20 years of experience. In 1996, the average ownership tenure of logging businesses was 17.6 years. Forty percent had owned their logging business for at least 20 years. In general, the equipment used by timber harvesters is fairly old. The average age of harvesting equipment in Minnesota from the 1996 survey ranges from nine years for delimiters to 16 years for skidders, forwarders, farm tractors, and bulldozers

### Timber Harvesting in Minnesota

In 2001, the most recent year in which statewide timber harvesting statistics are available, the annual timber volume harvested in Minnesota was approximately 3.56 million cords (Minnesota Department of Natural Resources 2003). Nearly half of the state's timber volume is removed from nonindustrial private forest lands. Timber harvesting occurs on approximately 200,000 acres each year, or just over 1 percent of the state's forest land base. Most harvest areas are small, averaging 24 acres in size. In 1996, clearcutting (both with and without leaving residuals) represented the dominant method of harvesting in Minnesota, applied on 83 percent of the harvest sites. The vast majority of timber harvesting is mechanical—approximately 84 percent of the volume was mechanically felled in 1996 and 16 percent was chainsaw felled. Nearly half the timber volume is harvested during the winter. In 1996, winter harvesting accounted for 47 percent of all harvesting activity followed by fall (23 percent), summer (21 percent), and spring (9 percent). It was

noted that transport of felled material from the stump to the landing was becoming more mechanized through use of grapple skidders and forwarders as compared to cable skidders. Firms with higher production rates tend to have more “state-of-the-art” harvesting technology (Puettmann et al. 1998).

## Selling Public Timber Stumpage in Minnesota

Public forest land management agencies in Minnesota, notably the Minnesota Department of Natural Resources-Division of Forestry (DNR), county land departments, and the USDA-Forest Service, offer tracts of timber for sale which have been identified through a timber management planning process. Prior to offering timber for sale, tracts are cruised by a forester or forestry technician to determine sale volumes by species and product, mark sale boundaries, identify access points and landing locations, mark individual trees or reserve areas within the tract for either removal (e.g., during a thinning) or retention (e.g., a riparian management zone, a leave tree patch, a visual screen), and identify specific forest management guidelines to be used on the site. Timber tract sale specifications (e.g., create a site map, calculate and report sale volume, length of contract, sale regulations) are documented on a form which is reviewed by prospective buyers after the specifications are approved within the agency.

While the laws and rules vary by agency, public tracts generally must be advertised for at least 30 days before conducting the sale. Tracts are advertised for sale through the Internet, direct mailings, or listings available in agency offices. Timber sale notices indicate the date, time, and location of the auction, as well as detailed information about each tract offered such as tree species present and estimated merchantable timber volume and value. On the date of the auction, an official representative of the agency oversees and administers the auction process.

The methods of selling public timber stumpage (the right to harvest timber) vary from an over-the-counter noncompetitive agreement with an individual buyer (typically small volume sales) to oral and written sealed bid auctions where stumpage is sold to the highest bidder. Oral auctions tend to be the most common method used by the state’s public land management agencies to sell stumpage.

In Minnesota, only the USDA-Forest Service and a couple of counties regularly auction tracts using the written sealed bid method. During an oral auction, bidding starts at the appraised price for the tract’s timber and may increase in increments of 1 percent or more as sale interest continues. Bidding ends when there is no further interest in the sale (i.e., no one is willing to further raise the current bid price). With this method of bidding, a buyer may be able to purchase a timber tract without reaching their maximum willingness to pay for the stumpage.

For tracts sold under a written sealed bidding process, prospective buyers normally complete a form indicating their per unit bid price for each species and/or a total bid price for a tract. That bid is then sealed in an envelope and submitted to the land management agency. None of the envelopes containing submitted bids are opened until the specified date and time when the tracts are awarded. The fact that participants of sealed bid auctions are generally not aware of overall bidding activity for a particular tract and only have one opportunity to bid on each tract offered increases the likelihood that submitted bids reflect the participant’s maximum willingness to pay for that tract’s stumpage.

## Implementing Minnesota’s Timber Harvesting Guidelines

In 1998, the MFRC adopted voluntary guidelines for conducting timber harvesting and forest management activities within the state. The guidebook addresses a number of important resource attributes and values associated with forest resources such as riparian management zones, wildlife habitat, soil and water resources, visual quality, and historic and cultural sites (Minnesota Forest Resources Council 1998). The guidelines suggest a range of practices to consider for protecting/enhancing these important features when conducting forest management and timber harvesting operations. Beginning in 2000, the MFRC initiated a program to monitor guideline implementation as it occurs among public and private forest ownerships within the state. Results from two years of baseline guideline implementation monitoring suggest the application of guidelines varies considerably by specific practices recommended in the guidebook as well as by landowner group (Phillips and Dahlman 2002).

## Methods and Approach

### Study Objectives

The overall objective of the study was to assess the extent to which forest landowners incur additional financial costs as a result of requiring the application of Minnesota's guidelines during a timber sale. Specific study objectives were to:

- *Determine the extent to which the requirement to apply Minnesota's timber harvesting guidelines results in lower stumpage prices received by forest landowners.* Application of Minnesota's timber harvesting guidelines may increase the per unit (i.e., cord) harvesting costs incurred by Minnesota's timber harvesters as compared to pre-guideline operations. The study examined the extent to which timber harvesters pass any of those real or perceived increased production costs to forest landowners (i.e., shift the incidence of guideline-related costs) in the form of reduced willingness to pay for timber stumpage.
- *Determine the extent to which the application of Minnesota's timber harvesting guidelines results in reduced income to forest landowners due to leaving merchantable trees on a site.* Several guidelines recommend that merchantable trees be left unharvested for ecological and aesthetic purposes. Such practices may include retaining trees and other forest vegetation adjacent to rivers, lakes, wetlands, cultural resources, or areas containing endangered, threatened, and special concern species, as well as leaving scattered trees across the harvest site for wildlife habitat and to make the harvest area look less visually intrusive. Leaving merchantable trees on the site represents a real financial cost to the forest landowner in the form of foregone revenue that otherwise could have been realized during the harvest. Unless the residual trees are removed within a few years of the initial harvest, the present value of future removals can be a substantial discount from its value at initial harvest.
- *Determine the extent to which Minnesota's timber harvesting guidelines impose*

*additional sale set-up costs to forest landowners.* Landowners who incorporate Minnesota's guidelines in their timber sales may find that preparing a timber tract for harvest requires additional field and associated office time. The study examined the extent to which use of the guidelines imposes additional timber sale preparation time. This included an analysis of total additional staff time required to prepare a timber tract for auction, as well as the additional time for specific guideline-related field and in-office tasks.

- *Determine methods used by timber harvesters to develop paired bids on the study tracts, as well as perceptions of how tract characteristics and specific guidelines influenced bidding behavior.* A timber harvester's willingness to pay for stumpage is influenced by many variables, including stipulations on how timber harvesting is to be conducted. The study examined how individuals bidding on the study tracts developed their bids with and without the requirement to use guidelines and the relative influence various tract characteristics and guidelines had on the bids they submitted.

### The Bidding Model

An important concern of the study was being able to attribute differences in a timber harvester's willingness to pay for stumpage solely to the requirement to use of guidelines. To do so, all other variables that might influence bid prices needed to be strictly controlled. These included a tract's physical features (e.g., size, access to roads and markets, logging difficulty, and quantity and quality of merchantable wood) as well as sale characteristics (e.g., date of auction, length of sale, season of sale, method of payment, down payment requirements). By controlling for all variables except the requirement to use guidelines, any difference in bid values was presumed to be attributed to the guidelines.

Finding enough paired timber tracts in Minnesota with identical physical characteristics was not considered a feasible option. Therefore, the bidding approach employed in the study was that a single tract would be offered for sale in two distinct ways—one with and one without the requirement to

use guidelines. Prospective purchasers would be required to submit a pair of bids on each tract—one corresponding to each way the tract was advertised for sale. Any discount in per cord bids when guidelines are required suggests the timber harvester was passing a portion (possibly all) of the perceived additional costs to forest landowners in the form of lower willingness to pay for stumpage. No difference in bid prices indicates timber harvesters were not passing any guideline-induced costs on to forest landowners. A premium placed on stumpage bids when guidelines are required suggests possible cost savings associated with their implementation.

## Bidding Method

A sealed bid auction format was employed to determine each prospective buyer's "maximum willingness to pay" for each study tract with and without the requirement to apply the timber harvesting guidelines. Although the oral auction format is the most common method used by the state's public land management agencies to sell timber, the major drawback of such an approach is its limitation in eliciting a bidder's maximum willingness to pay for the stumpage. Participants in oral timber auctions have extensive knowledge of bidding activity on a particular tract—knowledge that may contribute to stumpage being purchased at less than the bidder's maximum willingness to pay for the timber. In contrast, sealed bid auction participants generally do not have a priori knowledge of bidding activity. Each prospective buyer only has one opportunity to bid on a tract and therefore is more likely to bid their "maximum willingness to pay" for the stumpage. Moreover, the paired bid design employed in this study made the oral auction format infeasible (i.e., it was impossible to sell a tract twice).

## Minimum Number of Paired Bids Required To Make Statistical Inferences

A minimum number of paired bids was needed to provide conclusive results. The authors contacted the University of Minnesota's Statistical Consulting Service to seek assistance in determining this minimum number of paired bids to be generated from the study. Given the study design, bidding model, and a priori knowledge about the likely effect additional guideline costs would have on bidding behavior, the authors were

advised that at least 10 paired bids from timber harvesters were needed to make statistical inferences (95 percent confidence interval) about the bidding behavior observed in the study.

## Participating Agencies

The study relied on tracts of timber auctioned by the state's public land management agencies. The DNR and St. Louis County Land Department (SLC) agreed to participate in the study. The DNR was targeted because it had timber auctions planned at several area offices during Fall 2002, and was interested in exploring greater use of sealed bid auctions as the vehicle for selling timber. SLC was approached as it regularly conducts timber sales through a sealed bidding process and also had auctions scheduled for fall 2002. During the study design phase, the authors were in frequent contact via conference calls and e-mail with two individuals from the DNR and one from SLC. That study design team assisted the authors in developing all study protocols and forms as well as serving as points of contact for on-the-ground field staff implementing the study. Several conference calls were conducted with design team members after the study protocols were developed but prior to the tract auction dates to clarify and modify study protocols, as needed. In addition, a meeting with DNR Region 2 and St. Paul staff, SLC Land Department and MN Forest Resources Council staff, and logging interests was pivotal in developing the bidding methodology used in the study.

## Site Characteristics

Only forested tracts that met the following criteria were considered for inclusion in the study.

- Field staff would feel comfortable selling the tract without the requirement to apply guidelines,
- Upland site (i.e., no riparian areas),
- Aspen had to comprise at least 50 percent of the merchantable volume,
- At least 10 acres in size,
- No permanent water present on the site,
- Clearcut harvesting was acceptable,
- Natural regeneration was planned,
- Harvesting would only occur under frozen soil conditions,
- The site did not contain any known unique features (e.g., cultural resources, endangered or threatened species),

- Sale administrators could temporarily shut down any sale if excessive rutting is or will occur, and
- Both the “with” and “without” guidelines pair in each sale had to have the same sale expiration date.

## Timber Harvesting Guidelines Used

Guidelines perceived to be applied across a wide range of tract and harvest conditions and/or imposing significant additional cost to apply were used in the study. Each advertised tract which included timber harvesting guidelines specified the following:

- Delineate an inclusion during the sale set-up process within the tract’s boundaries representing approximately 10 percent of the sale area, within which operators could only remove up to 50 percent of the merchantable volume (designed to mimic riparian management zone guidelines which provide recommendations for residual basal area);
- Retain at least six scattered leave trees/acre greater than 6 inches diameter breast height (DBH) across the site;
- Follow guidelines for road and skid trail location and construction, water diversions, and landings;
- Back haul the slash across the site to avoid piling it at the landing; and
- Leave all snags possible where safety permits.

All DNR tracts were offered as three-year sales. Three of the SLC tracts were offered as 28-month sales and the other two as 16-month sales. The duration of a timber sale contract for an individual tract did not vary according to whether guidelines were or were not required.

## Timber Sale Preparation

An important cost to forest landowners is the additional time needed to prepare or set-up timber sales when Minnesota’s timber harvesting guidelines are required. A number of field and office-based tasks are necessary to prepare a tract of timber for sale or public auction. Typically, this involves marking the tract’s sale boundaries with paint or flagging tape, cruising the tract to obtain an estimate of the merchantable timber volume, and preparing the necessary paperwork (e.g., drawing

maps, writing up the timber sale specifications). Those tasks specifically attributed to the use of guidelines include identifying, marking, and estimating timber volume within inclusions or other special harvest areas, identifying the placement of skid trails, water crossings, and landing sites, and incorporating the guidelines in maps, diagrams, and written descriptions or advertisements of the tract.

*Tracking Sale Set-up Time.* A timber sale set-up time sheet was developed by the authors, with input from the study design team, for forestry field staff to complete when designing each study site. The form (Appendix A) included spaces to report time to accomplish each of the following activities:

- Identify and mark sale boundaries,
- Estimate sale volume (e.g., cruising time),
- Plan and mark the boundary of the 10 percent partial harvest inclusion (individual trees inside the inclusion were not marked),
- Estimate the sale volume within the inclusion,
- Identify placement of access road(s) or water crossings and water diversion(s) (done either on-site or from aerial photos),
- Identify location of any on-site landing(s) (done either on-site or from aerial photos), and
- Write the timber sale bid specifications, two for each tract offered for sale (e.g., appraisal form, create a site map, calculate volumes, write sale regulations).

To assess whether guidelines impose additional sale preparation costs to forest landowners, field personnel recorded the time spent on the major tasks associated with preparing each of the tracts offered for public auction. Sale preparation time was collected on both field (e.g., cruising the stand to estimate total merchantable volume) and office work (e.g., writing up the bid specifications) commonly associated with preparing a tract for auction. Such tasks were categorized according to whether they were specifically attributable to the guidelines. For each activity, individuals indicated the date(s) when work was performed, the time in hours and minutes required to accomplish the task, and the name(s) of the individual(s) who conducted each activity. All time entries were recorded to the nearest ten-minute interval. Travel time to/from the tract was not recorded on the time sheet.



## Sale Advertisement and Bidding Requirements

Each auction was advertised for at least 30 days. The four timber sale auctions included other nonstudy tracts also being offered for sale after the study tracts were awarded. Sale notices included a cover page describing the study as well as the requirement to bid on both pairs (“with” and “without” guidelines) for each study tract. Each study tract was presented twice in each advertisement; once indicating the specific guidelines to be applied as well as a phrase such as “site-level guidelines do apply” or “guideline version” and the other time indicating “site-level guidelines do not apply” or “nonguideline version.” Each tract within a pair also indicated a statement such as “A bid on this tract requires a bid on Tract No. XY” where XY represented the other tract number within the pair. To reduce confusion, the pairs were listed sequentially in the announcements (e.g., Tract 1 and 2 were the “with” and “without” pair for one study tract). Appendix B contains two Timber Appraisal Forms for one of the study tracts—one including and one excluding the use of guidelines. Appendix C illustrates how auction notices advertised a given study tract twice. Appendix D illustrates the instructions provided to prospective purchasers of study tracts.

An important requirement for this study was that each “bid” on a tract had to include two separate sealed envelopes. One envelope had to contain bid information “with” the application of guidelines and the second information “without” the application of guidelines. An individual from each agency verified the presence of two envelopes (i.e., a pair) for all bids submitted. Any attempt by an individual to submit only one bid envelope for a tract was rejected. Other parameters normally applied by the DNR and SLC when selling timber harvesting rights were also employed within the study (e.g., amount and timing of down payments, utilization standards, method of calculating and collecting payment for timber, penalties for noncompliance with contract provisions), both within each pair and across all tracts offered for sale.

## Assigning Treatments to and Auctioning the Tracts

Prior to the date when bids were opened, the authors assigned harvest treatments to each tract

(i.e., whether it would be sold and harvested “with” or “without” guidelines). This was accomplished by a two-stage randomization process whereby a randomly selected treatment was assigned to a randomly selected tract. Operationally, this meant assigning each tract a unique number, placing those numbers in a hat, flipping a coin to determine “heads” or “tails,” and then drawing a number out of the hat. If the coin landed “heads,” the tract received the “with guidelines” treatment. Otherwise, it was assigned a “without guidelines” treatment. In an effort to provide a relative balance to the number of “with” and “without” guideline tracts, the random selection of harvest treatment was terminated once 14 of the tracts were assigned to one treatment. At that point, the remaining tracts were assigned the other harvest treatment.

The authors did not make available any information from the treatment assignment process until after the bid submission deadline. This eliminated any possibility that a prospective buyer could obtain information about the actual study treatment assignment prior to the public opening of bids. On the date of and immediately prior to each bid opening, the authors sent a memo to the agency’s timber sales supervisor, indicating the treatment assignment for each tract. The timber sale supervisor subsequently “pulled” the tract containing the harvest treatment not selected from the auction such that only the tracts with the assigned treatments were offered for sale. Individual tracts were sold to the highest bidder for the treatment selected. Where no bids were received on a tract, it was reoffered for sale at a later date outside the study process.

As the tracts were offered for sale on three different dates (i.e., November 19 and 22, 2002, for the three DNR area offices followed by the SLC auction on December 19, 2002), it was important to withhold releasing any bidding information until all auctions were completed. The DNR timber sales supervisor sent a memo to key field staff located in the areas where the auctions took place indicating the importance of not releasing study information to anyone until after all auctions had been conducted. The authors also did not provide any study results from the three DNR auctions to SLC personnel prior to the date when the SLC auction was held.

## Acquisition and Analysis of Bid and Sale Set-up Data

After each auction was conducted, the authors were sent a photocopy of all paired bids (both with and without the requirement to use guidelines) received for each tract sold during the auction. Information from those bids was analyzed using Excel to assess differences in bid price (\$/cord) for each paired sale. Aggregate per cord bid prices for each pair of bids submitted on a tract were calculated by weighting bids for each species by their respective merchantable volume in the tract. Only the per cord bid prices of those tree species found in both advertisements for each tract were used in calculating the tract's aggregate per cord bid price with and without guidelines. This procedure was used to make sure the with-without per cord bid prices compared the same species. It also eliminated the possibility of erroneously calculating differing paired stumpage bids when the bidder did not, in fact, discount stumpage when guidelines were required.

The authors also received completed Timber Sale Preparation Time Sheets (Appendix A) for the tracts offered for sale from the cooperating agencies. Where necessary, the individual(s) who completed the time sheets were contacted by the authors to answer questions about items on their forms. Data from these forms were summarized using Excel to assess the extent to which guidelines require more time to prepare a timber sale.

## Survey of Timber Harvesters

The 36 timber harvesters who bid on the study tracts were mailed a two-page questionnaire in spring 2003. The questionnaire requested information about their logging business (e.g., years in business, annual harvest volume, existence of financial records for each tract harvested), how they developed their bids for the study tracts (e.g., sources consulted, tract characteristics, influence of specific guidelines), and perceptions on how different bidding strategies affect who bears the cost of implementing guidelines (Appendix E). Prior to mailing the questionnaire, human subjects approval was granted by the Institutional Review Board at the University of Minnesota. The survey was administered using techniques developed by Dillman (2000).

## Auction Results

### Tracts Offered for Sale

A total of 27 tracts in northern Minnesota were offered for sale as part of this study. All tracts are in Koochiching, Itasca, St. Louis, and Lake counties (Figure 2). Twenty-two of the twenty-seven tracts are on state land administered by the DNR, whereas five tracts are managed by SLC (Table 1). All DNR tracts are in the department's Northeastern administrative region. Land management responsibility for those tracts is administered from six administrative areas within that region. Management responsibility for the five tracts managed by SLC occurs out of the agency's Virginia and Pike Lake administrative areas.

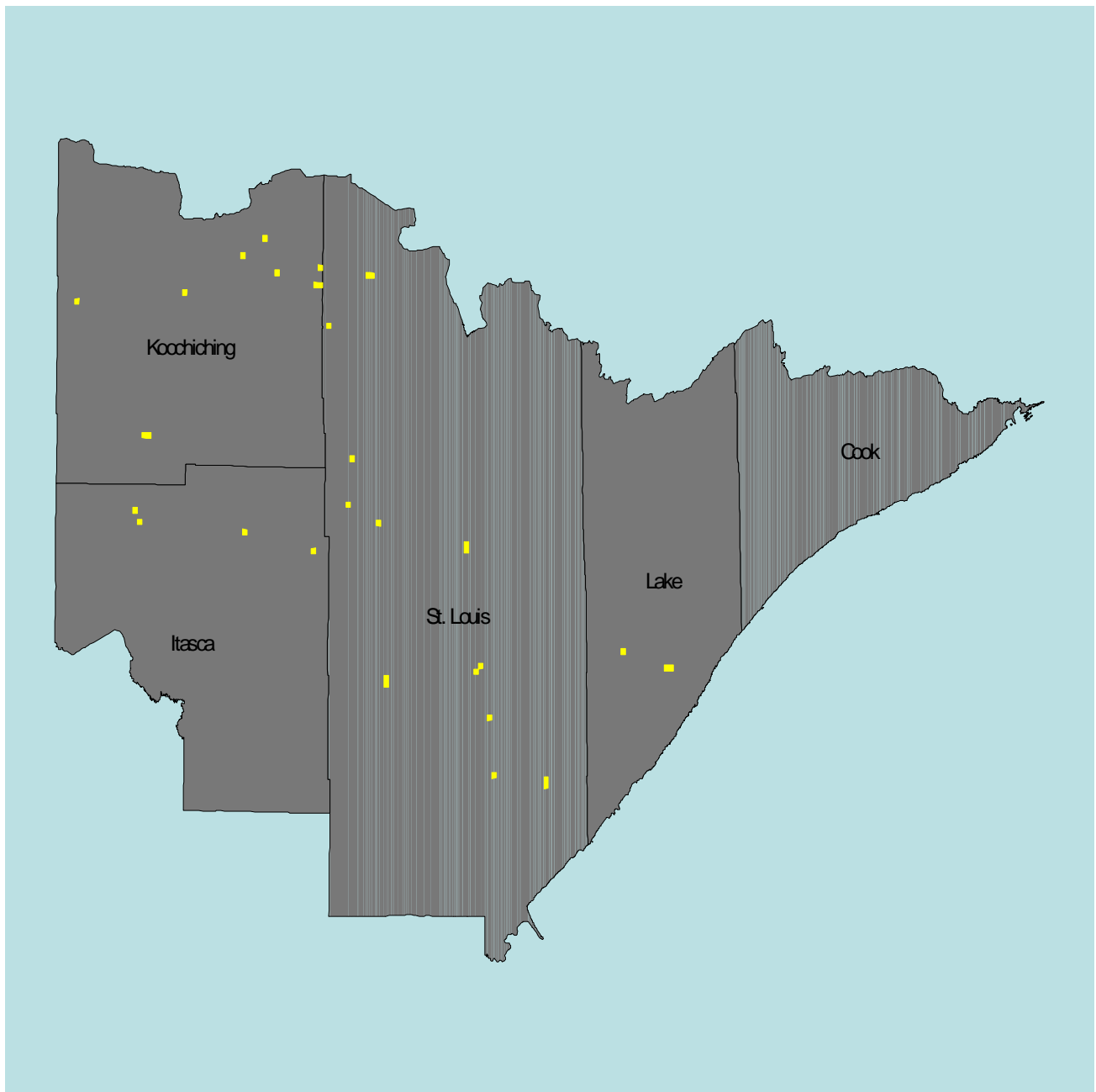
### Characteristics of Tracts Offered for Sale

#### Size

Table 2 identifies several characteristics of the 27 tracts offered for sale. The average size of the study tracts was 23.7 acres, nearly identical to the statewide average timber harvest area of 24 acres in 1996 (Puettmann et al. 1998). Individual tracts ranged in size from 11 to 44 acres, with a fairly even distribution of tract size within this range (Figure 3).

#### Stand Volume and Value

The merchantable volume per acre of timber in the 27 tracts offered for sale without guidelines averaged 29.1 cords, with an appraised value of \$569 per acre (Table 2). The range of tract value was over sevenfold, from less than \$200 to greater than \$1,300 per acre (Figure 4). Merchantable timber volume of individual tracts offered for sale without guidelines ranged from 11 cords to as high as 53 cords per acre (Figure 5). The application of guidelines reduced merchantable stand volume by an average of 2.4 cords per acre, with some tracts reduced as high as 5.5 cords per acre (Table 2). The average appraised value of that merchantable timber left on the site was nearly \$46 per acre when guidelines were incorporated, although individual per acre reduction in tract value was as high as \$112.



**Figure 2.** Location of the 27 study tracts offered for sale.

**Table 1.** Land management responsibility for the 27 study tracts offered for sale.

<b>Agency</b>	<b>Administrative area</b>	<b>Number of tracts used in study</b>
MN Department of Natural Resources	Two Harbors	2
	Hibbing	5
	Tower	1
	Little Fork	5
	Orr	5
	Effie	4
St. Louis County	Virginia	3
	Pike Lake	2
<b>Total</b>		<b>27</b>

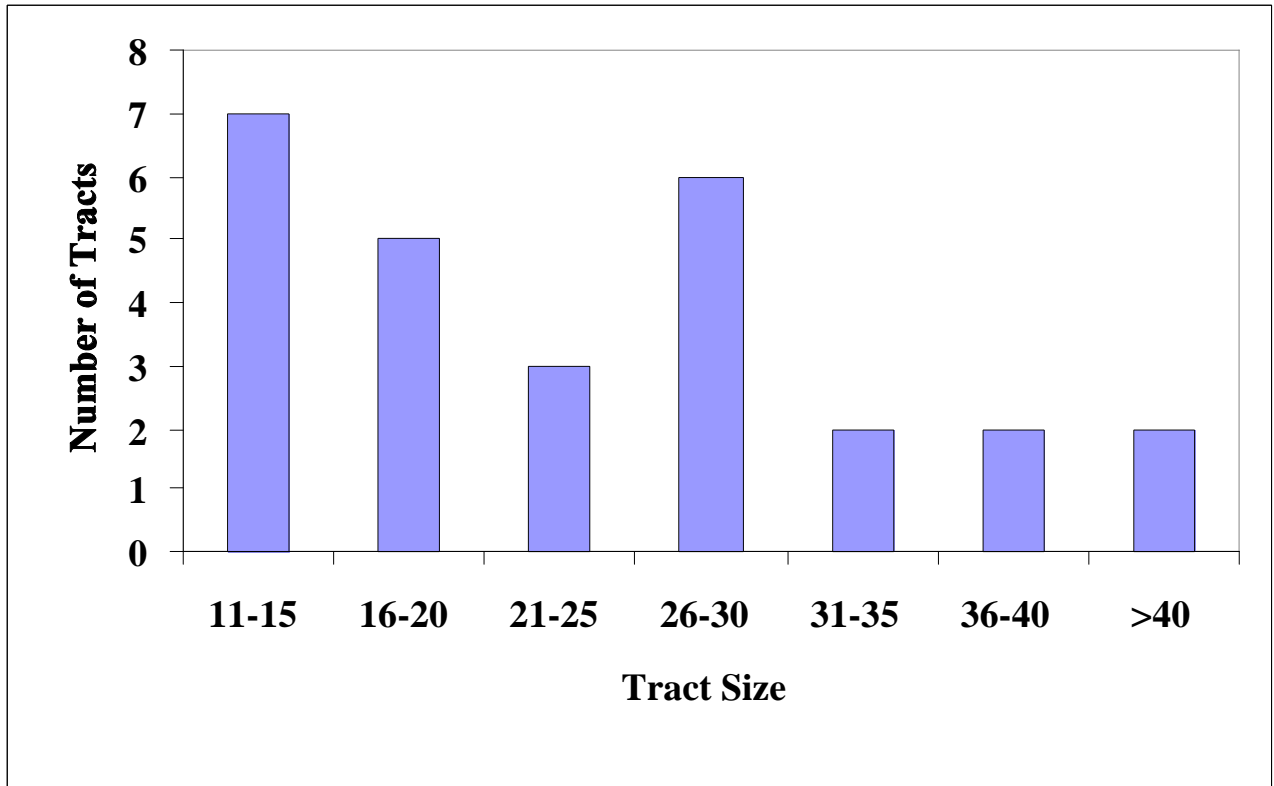


Figure 3. Summary of tract size for the 27 study tracts offered for sale (acres).

Table 2. Descriptive statistics for the 27 study tracts offered for sale.

	Tract Size (acres)	Without guidelines appraised stumpage Value (\$/acre)	Without guidelines merchantable Volume (cords/acre)	With guidelines appraised stumpage Value (\$/acre)	With guidelines merchantable Volume (cords/acre)	Without-with difference appraised stumpage Value (\$/acre)	Without-with difference merchantable Volume (cords/acre)
MEAN	23.7	569.1	29.1	523.5	26.7	45.6	2.4
MEDIAN	21.0	532.4	27.5	483.2	24.6	44.7	2.1
STD DEV	9.6	268.0	11.5	225.7	10.9	30.6	1.4
MAX	44.0	1,312.3	52.9	1,019.4	50.0	111.6	5.5
MIN	11.0	175.3	11.3	193.8	9.4	2.4	0.4
N	27	27	27	27	27	27	27

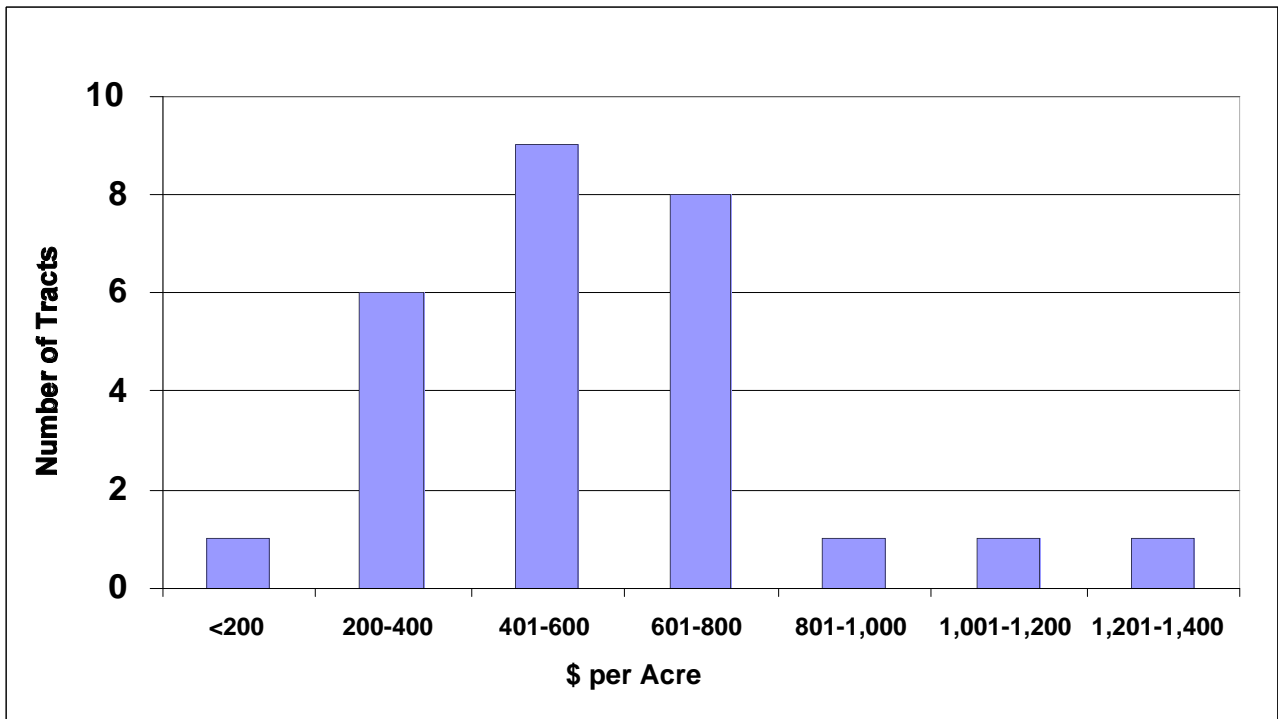


Figure 4. Summary of total merchantable stand value (without guidelines) within the 27 study tracts offered for sale (\$/acre).

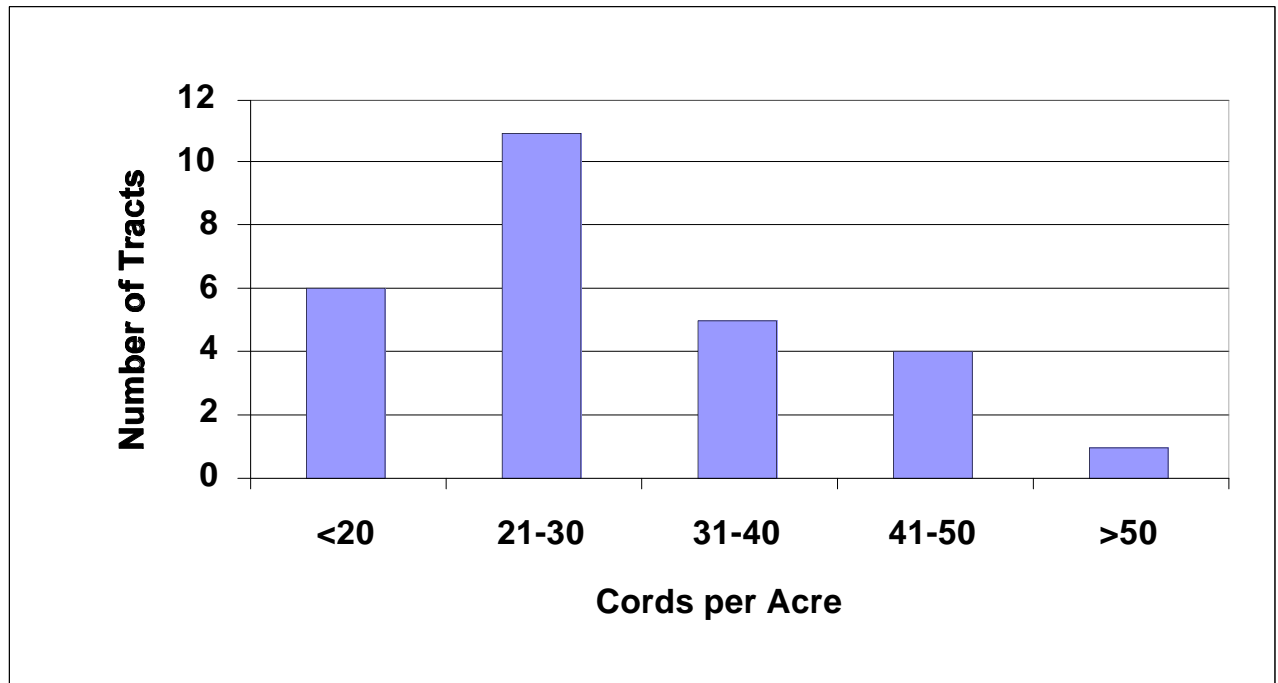


Figure 5. Summary of total merchantable timber volume (without guidelines) within the 27 study tracts offered for sale (cords/acre).

**Stand Composition**

The 27 tracts offered for sale without guidelines had, on average, four different merchantable tree species, with individual tracts ranging from just one to as many as seven merchantable species (Table 3). Aspen was the principal merchantable species found

in the 27 tracts (Figure 6). On average, the “without guidelines” study tracts contained nearly 23 cords per acre of aspen which accounted for 78 percent of the total per acre tract volume. Balsam fir (2.3 cords per acre) and paper birch (1.4 cords per acre) were the next most prevalent merchantable tree

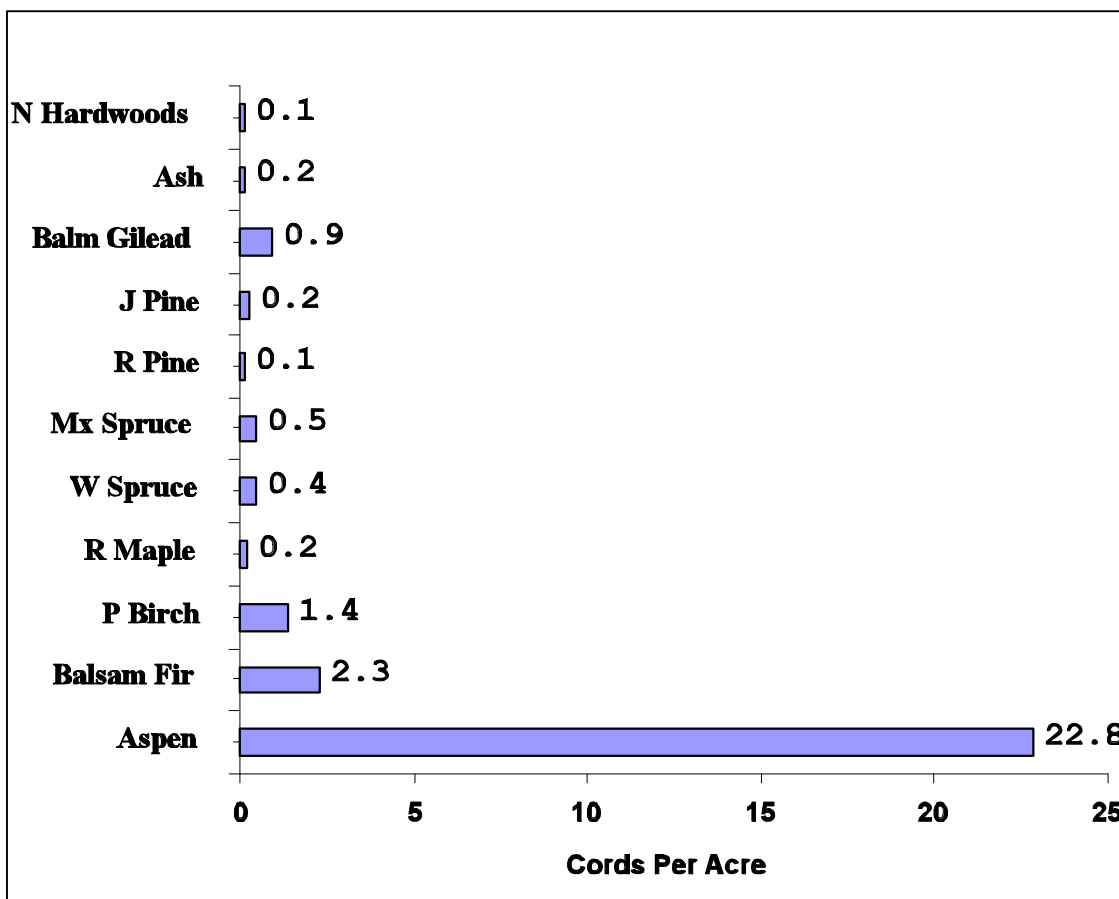
species found on the study tracts. All other merchantable species averaged less than a cord per acre.

**Table 3.** Number of merchantable species within the 27 study tracts offered for sale (without guidelines).

Number of merchantable species within tract	Number of tracts
1	2
2	2
3	6
4	9
5	6
6	1
7	1

Harvest Treatment Assigned

Table 4 indicates the harvest treatments randomly assigned to the 27 tracts offered for sale. Half of the 22 DNR tracts were assigned the sale specification that required use of guidelines—the other half were assigned “without” the requirement to use guidelines. On the five study tracts managed by SLC, three were assigned “with” guideline harvest treatments.



**Figure 6.** Summary of average merchantable volume (without guidelines) by species within the 27 study tracts offered for sale (cords/acre).

**Table 4.** Distribution of harvesting treatments among the 27 study tracts offered for sale.

Land management agency	Administrative area	# Tracts assigned guideline treatments	# Tracts assigned no guideline treatments
MN Department of Natural Resources	Two Harbors	1	1
	Hibbing	4	1
	Tower	0	1
	Little Fork	1	4
	Orr	3	2
	Effie	2	2
St. Louis County	Virginia	2	1
	Pike Lake	1	1
<b>Total</b>		<b>14</b>	<b>13</b>

**Bidding Activity**

Thirty-six different timber harvesters submitted a total of 80 paired bids on 23 tracts that were sold. The number of paired bids received per tract ranged from one to seven (Table 5). Of the four tracts that received no bids, three were offered by the SLC and one by the DNR. The most common number of paired bids submitted per tract was two—eight tracts received this number of paired bids. Four tracts received three paired bids each, the second most frequent number of paired bids submitted.

**Table 5.** Distribution of bids across the 27 study tracts offered for sale.

Number of paired bids submitted	Number of tracts
0	4
1	2
2	8
3	4
4	2
5	2
6	3
7	2
<b>Total</b>	<b>27</b>

Table 6 indicates the number of paired bids submitted per timber harvester. The number of paired bids per prospective buyer ranged from 1 to 10. Nearly half of all timber harvesters submitting bids did so on only one tract. Twelve timber harvesters submitted two paired bids. Together, timber harvesters who submitted one or two paired bids account for 81 percent of the participating timber harvesters. Three timber harvesters submitted three paired bids and two timber harvesters submitted six paired bids. One timber harvester each submitted eight and ten paired bids.

**Table 6.** Number of paired bids submitted per timber harvester within the 23 study tracts sold.

Number of paired bids submitted	Number of timber harvesters
1	17
2	12
3	3
4	0
5	0
6	2
7	0
8	1
9	0
10	1
<b>Total</b>	<b>36</b>

**Bids Received**

Mean Bid Difference

Table 7 summarizes the 80 paired bids submitted on the 23 tracts that sold. The maximum willingness to pay for stumpage was, on average, \$2.66 per cord lower when guidelines were required as part of the timber sale specifications. This amounted to a 10.1 percent discount over bids on the same tracts when guidelines were not specified. A paired two-sample student's t-test indicates the with and without guideline bids are significantly different from each other ( $p < .01$ )—timber harvesters were distinguishing the presence of timber harvesting guidelines when determining their willingness to pay for stumpage. These results suggest bidders were passing additional guideline-related costs on to landowners in the form of lower stumpage prices at an average rate of \$2.66 per cord.

It is important to note that \$2.66 per cord is NOT the cost associated with implementing Minnesota's timber harvesting guidelines. The

study did not seek to determine the additional cost guidelines impose to timber harvesters during the timber harvesting operation. A significant conclusion that can be drawn from the study is that the imposition of timber harvesting guidelines resulted in timber harvesters transferring costs to forest landowners in the form of lower stumpage bid prices that, on average amount to \$2.66 per cord.

#### Range in Bid Discounts

The amount stumpage bids changed when guidelines were required on the timber sale ranged from an increase in stumpage value of \$1.05 per cord or a 5 percent premium to harvest with guidelines (subsequent to the bidding, this timber harvester contacted us to confirm he purposefully bid more for the guideline sale because of a change in specie mix) to reductions in willingness to pay as high as \$10.45 per cord or 38 percent below the “without” treatment per cord bid (Table 7 and Figure 7). Sixty-eight of the 80 paired bids (85 percent) had bid differences that were 20 percent or less (Table 8). Of that total, twenty bids (25 percent) did not differentiate their bid based on whether guidelines were required as a condition of the timber harvest. Six bids (7.5 percent) were discounted between 21-25 percent when guidelines were required. Discounts of between 26-30, 31-35, and 36-40 percent were made on two paired bids each. This wide range in paired bid differences suggests that there is a broad range of factors that influence a timber harvester’s perception of guideline implementation costs such as proficiency in implementing the guidelines, business and organizational policies and practices, and site and timber sale characteristics.

#### Bid Differences by Tract Size

Did a timber harvester’s bid for stumpage with and without the requirement to apply timber harvesting guidelines depend on the size of the

tract? To answer that question, with and without guideline bids were examined in the context of tract size as measured by total tract acres, total appraised tract value without guidelines, and volume per acre without guidelines. No statistically significant relationship was found to exist ( $p > .05$ ) between any of these tract size variables and with-without guideline bid differences. Additionally, the degree of correlation between these variables and per cord bid difference among each pair is modest (maximum  $r = .26$ ) (Figures 8, 9, and 10). The results suggest that the magnitude of discount that timber harvesters assigned to stumpage bids when guidelines were required was not significantly influenced by the number of tract acres, total appraised tract value, or appraised volume per acre.

#### Influence of Bidding Activity Per Tract on With-Without Bid Differences

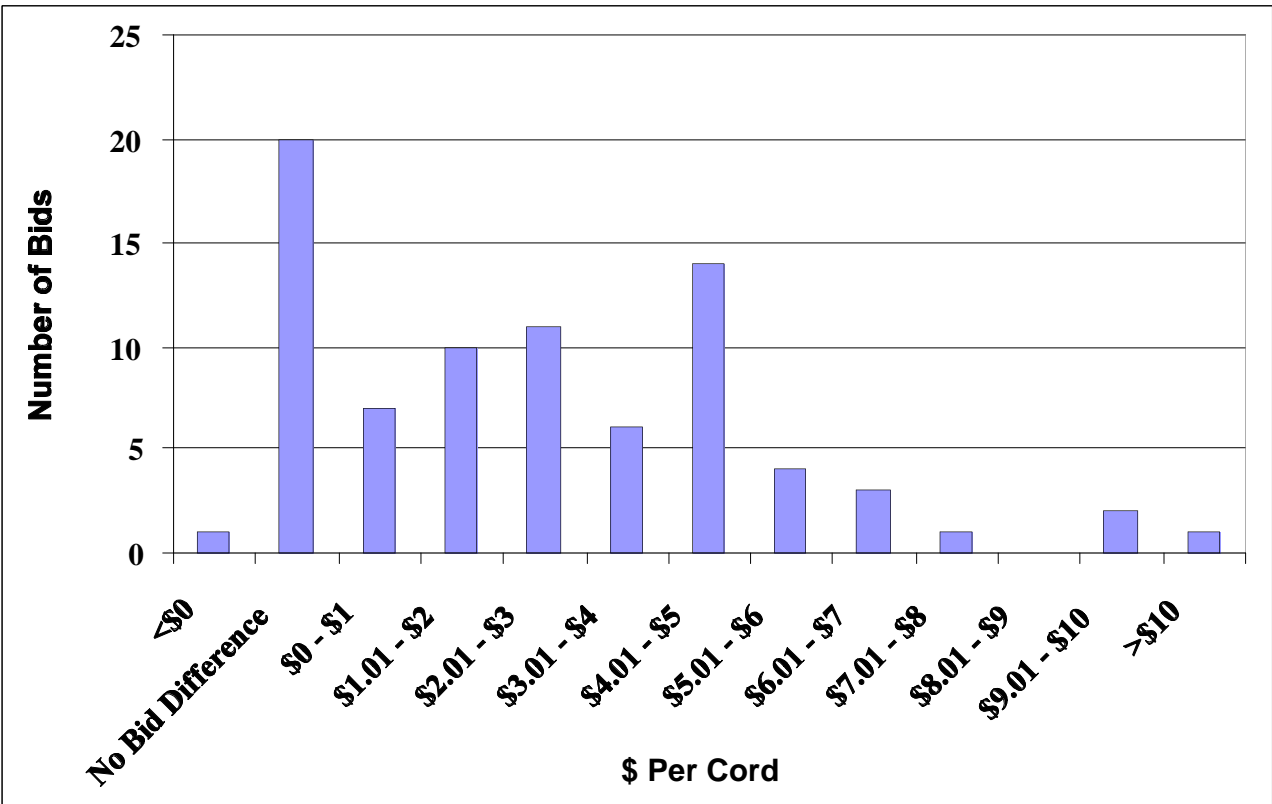
Information on the number of paired bids submitted on each tract was not made publicly available until the time the bids were opened and tracts awarded. Follow-up discussion with agency personnel managing the auctions confirmed requests for this information were not made. Nonetheless, general knowledge of bidder interest in a particular tract may have existed among timber harvesters.

To assess the influence bid activity had on bidding behavior for a particular tract, the difference in paired bids with and without the requirement to use guidelines was compared to the number of paired bids submitted on that tract. Presumably, a priori knowledge about the level of competition for a particular tract could result in a small difference in paired bids when bidding is extensive. Conversely, minimal demand for a tract might lead timber harvesters to more heavily discount with guideline bids in an attempt to pass these costs to landowners. Figure 11 indicates the mean with-without bid difference by number of bids

**Table 7.** Summary of the paired bids submitted within the 23 study tracts sold.

	<b>Without guidelines bid (\$/cord)</b>	<b>With guidelines bid (\$/cord)</b>	<b>“With” guidelines bid difference (\$/cord)</b>	<b>“With” guidelines bid discount (percent)</b>
MEAN	\$27.22	\$24.56	\$2.66	-10.1%
MEDIAN	\$27.48	\$24.10	\$2.25	-8.2%
STD DEV	\$4.82	\$5.65	\$2.55	9.9%
MAXIMUM	\$16.92	\$12.24	-\$1.05	-38.4%
MINIMUM	\$41.15	\$41.15	\$10.45	5.0%
N	80	80	80	80

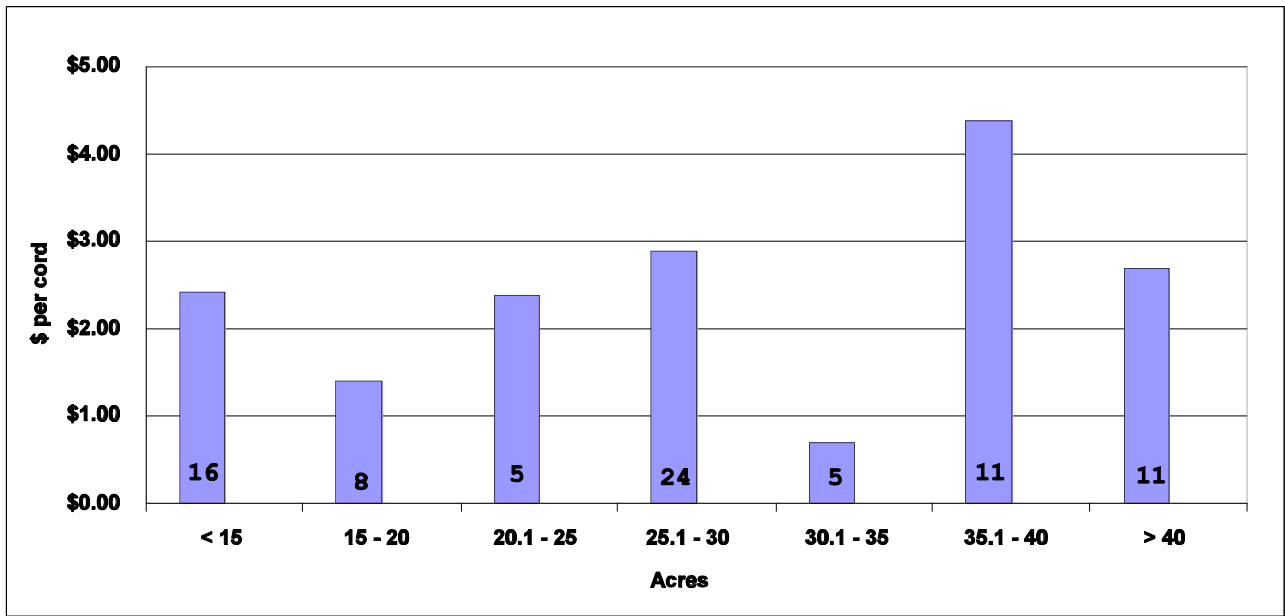




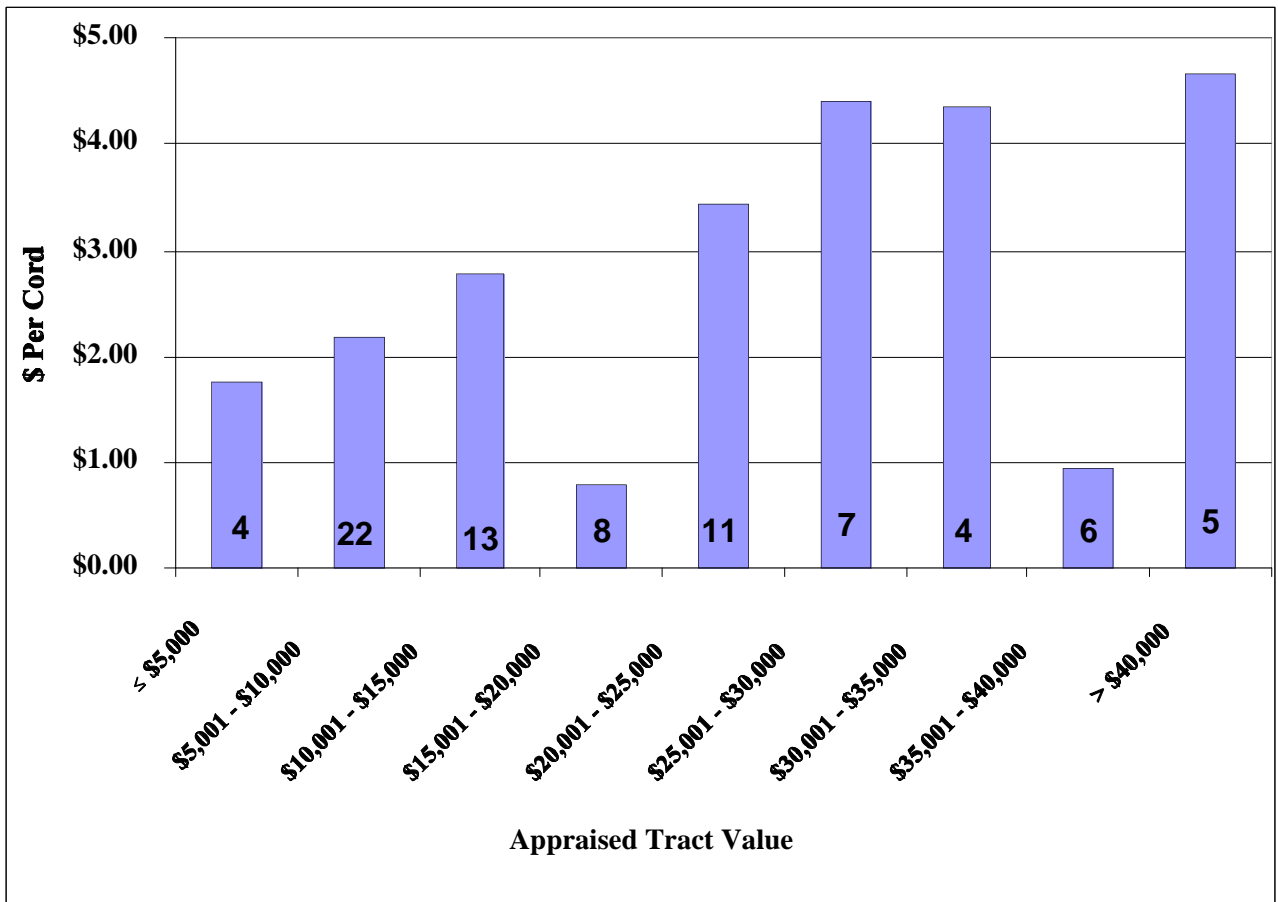
**Figure 7.** Discount in willingness to pay for stumpage when guidelines were required below bid values when guidelines were not required for the 80 paired bids submitted on the 23 study tracts sold (\$/cord).

**Table 8.** Paired bid differences for the 80 paired bids submitted on the 23 study tracts sold.

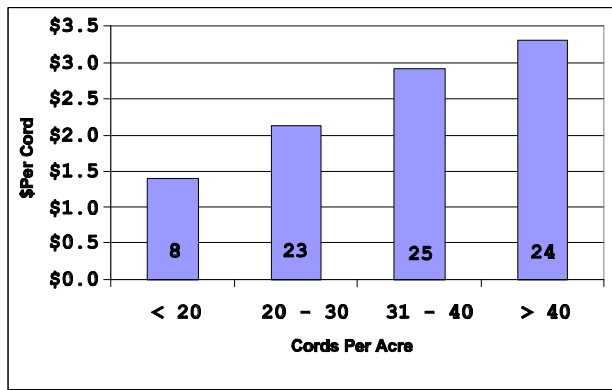
With versus without guideline bids (% discount)	Number of paired bids	Percent of total
> 0%	1	1.25%
No Bid Difference	20	25.00%
<5% Smaller	10	12.50%
6-10% Smaller	14	17.50%
11-15% Smaller	12	15.00%
16-20% Smaller	11	13.75%
21-25% Smaller	6	7.50%
26-30% Smaller	2	2.50%
31-35% Smaller	2	2.50%
36-40% Smaller	2	2.50%
<b>TOTAL:</b>	<b>80</b>	<b>100.00%</b>



**Figure 8.** Summary of the difference in bid price (\$/cord) in “with” and “without” guideline paired bids by tract size (acres) among the 23 study tracts sold. Number inside bar indicates number of paired bids.



**Figure 9.** Summary of the difference in bid price (\$/cord) for “with” and “without” guideline paired bids among the 23 tracts sold by appraised tract value. Number inside bar indicates number of paired bids.

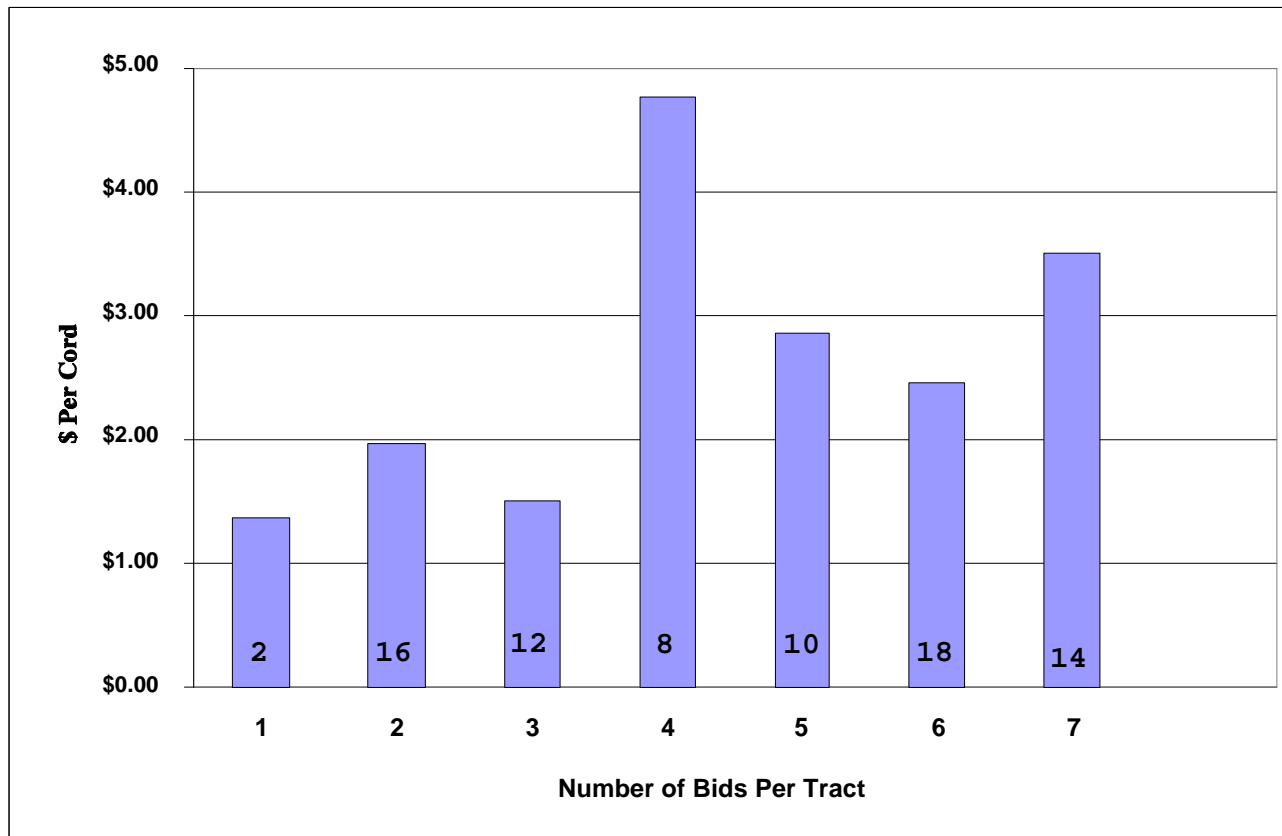


**Figure 10.** Summary of the difference in bid price (\$/cord) for “with” and “without” guideline paired bids among the 23 study tracts sold by stand volume (cords/acre). Number inside bar indicates number of paired bids received.

submitted on an individual tract. Correlation between these two variables is quite weak ( $r=.19$ ) and no statistically-significant relationship exists between bid difference and number of bids submitted per tract ( $p>.05$ ), suggesting the number of paired bids received on a tract had little influence on bid discounts offered when guidelines were required for the tract.

#### Winning Versus Losing Bids

Was the difference in willingness to pay (per cord) for timber distinct among the winning bids as compared to bids that were unsuccessful? The per cord bid difference for the 23 winning bids averaged \$1.80, whereas the mean bid difference for the



**Figure 11.** Summary of the difference in bid price (\$/cord) by the number of paired bids submitted per tract among the 23 study tracts sold. Number inside bar indicates number of paired bids received.

remaining 57 paired bids was \$3.00 per cord ( $p<.05$ ); a \$1.20 per cord difference. Caution should be used in interpreting these results, however, as the harvest treatment selected for each tract determined, in four instances, the winning bid. In these cases, the tract’s winning bid would have

been awarded to another bidder had the harvest treatment selection for that tract been different. If that had happened, the mean difference in paired bid values between the two groups (i.e., winning versus losing bids) would have been only \$0.96 per cord (although still significantly different at  $p=.05$ ).

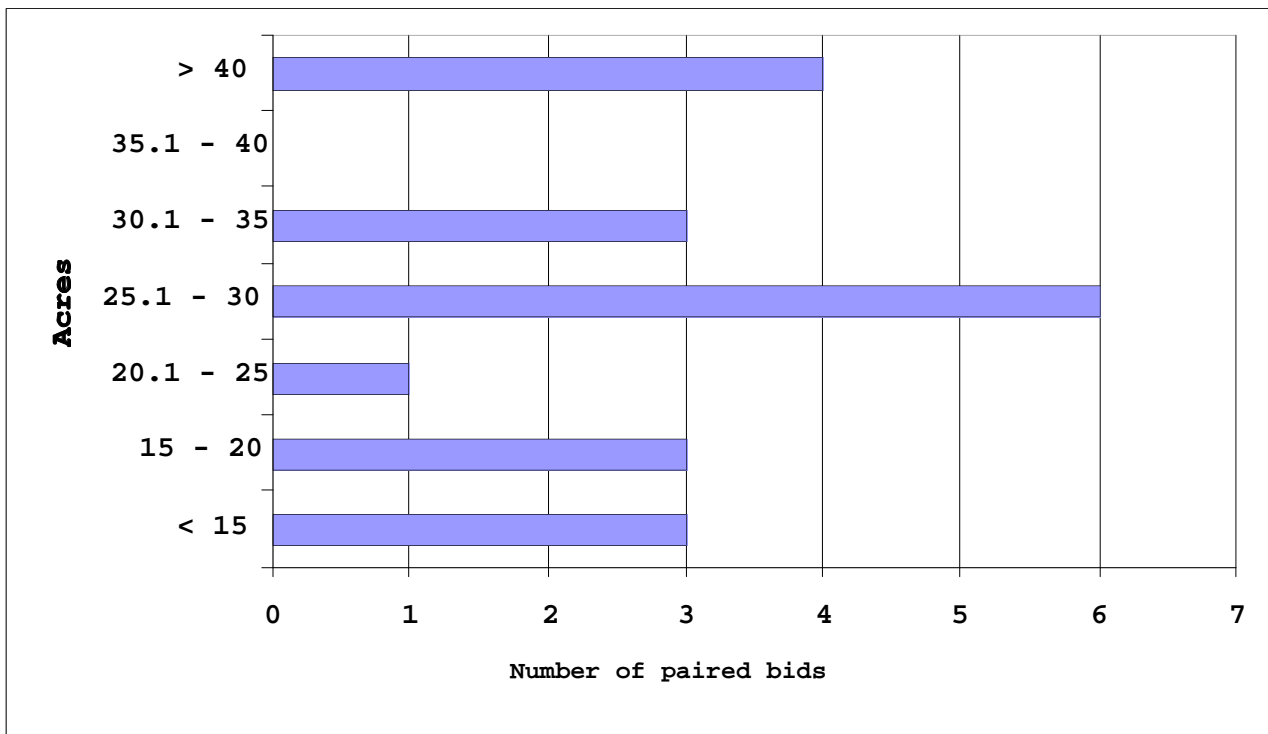
### Paired Bids with No Bid Difference

Twenty paired bids (25 percent of all paired bids received) did not differentiate a willingness to pay for stumpage based on the requirement to use guidelines when harvesting timber. As a group, these 20 represent the largest single category of paired bids submitted. The individuals who submitted these bids were not transferring any guideline-related costs they may incur to forest landowners in the form of lower stumpage prices. Of interest is assessing whether the tracts and/or bidders had common characteristics that might help explain this bidding behavior.

#### Tract Characteristics

No distinct patterns are evident in the characteristics of tracts where bidders did not differentiate a willingness to pay for the guidelines. Paired bids with no difference in the per cord price

were submitted across the entire range of tract size receiving bids, from the smallest (12 acres) to the largest (44 acres) of the study's tracts (Figure 12). The "no difference" paired bids were also not confined to tracts with specific stocking characteristics. Half of such paired bids were submitted on tracts with 11 to 30 cords per acre merchantable timber volume, and half on tracts with stocking levels ranging from 31 to 54 cords per acre. The total number of bids received per tract where at least one of the paired bids showed no bid difference ranged from as few as one to as many as seven (Table 9). Seven (35 percent) of the 20 "no difference paired bids" submitted were for tracts receiving bids from six individuals. A fourth of the no difference paired bids were submitted for tracts that received bids from two individuals. Four (20 percent) paired bids with no per cord difference were submitted for tracts where the total number of paired bids equaled three.



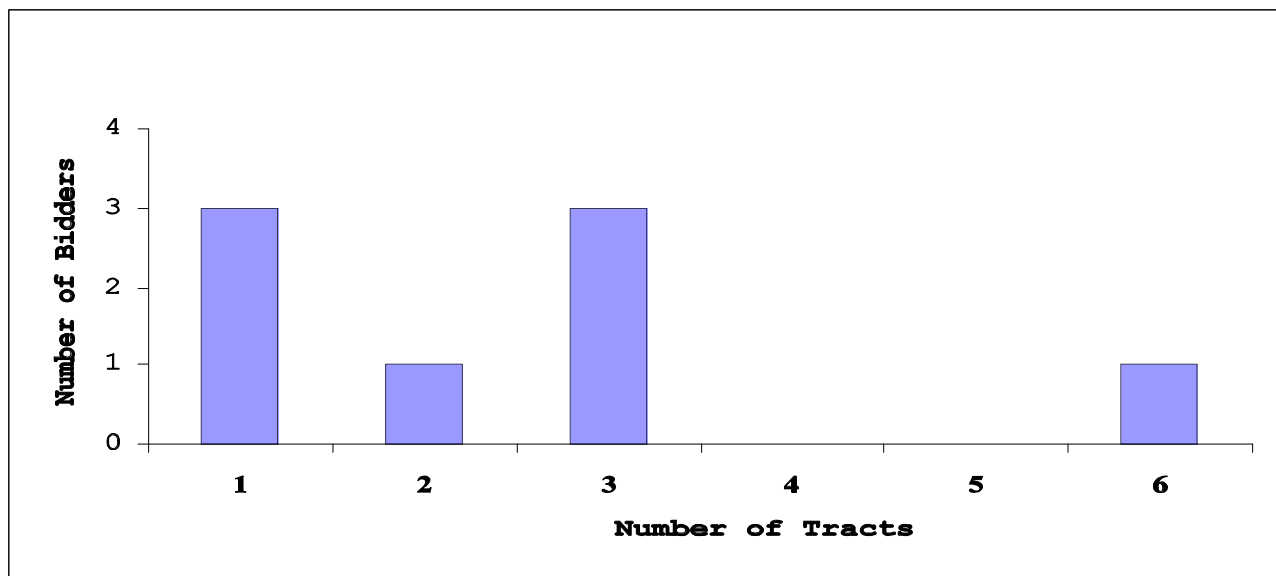
**Figure 12.** Summary of the bids by tract size (acres) where there was no difference between paired "with" and "without" guideline bids for the 23 study tracts sold.

**Table 9.** Distribution of tracts bid on by individuals submitting zero-difference bid pairs.

Paired bids received/tract	Number of tracts receiving \$0 discount bids
1	1
2	5
3	4
4	0
5	2
6	7
7	1

### Bidder Characteristics

Individuals submitting paired bids with equal per cord value bid on as few as one to as many as six tracts (Figure 13). Interestingly, every individual who did not differentiate their per cord bid price with and without guidelines did so on all study tracts on which they submitted bids. This bidding consistency suggests these individuals did not perceive additional guideline-related timber harvesting costs or were unable or unwilling to pass any such costs along to forest landowners across a range of harvest sites.



**Figure 13.** Summary of the number of tracts bid by individuals submitting no difference between paired “with” and “without” guideline bids for the 23 study tracts sold by number of bids received.

### Predisposition to be the Winning Bid

Did those bidders who did not discount stumpage bids end up purchasing a greater percentage of study tracts than bidders who differentiated stumpage? Of the 23 tracts receiving one or more paired bids, 15 (65 percent) had at least one paired bid with no difference in per cord stumpage value. Nine of these 15 tracts (60 percent) were awarded to bids containing no difference in with-without guideline stumpage bids. Three of the 15 tracts received two or more paired bids with no difference in per cord value. For these three tracts, these no difference pairs of bids represented 50 to 100 percent of all paired bids submitted on that tract, and ended up being the winning bid for that tract. The prevalence of multiple equal value paired

bids on these three tracts suggests the tracts may contain certain characteristics that tend to minimize the cost of implementing the guidelines used in this study.

### Efforts to Reduce Strategic Bidding

The potential existed to have study results biased by strategic bidding behavior. Care was taken in designing the study to reduce the likelihood that timber harvesters would submit bids in an attempt to influence study outcomes. While not completely controllable, elements of the study that discouraged timber harvesters from submitting bids that are not reflective of their true willingness to pay for timber stumpage included:

- *Bidding was not hypothetical.* All 27 tracts offered for sale were sold to the highest bidder for the harvest treatment selected. Presumably, bidders interested in demonstrating that guideline-related timber harvesting costs are not being passed on to forest landowners would have submitted paired bids of equal value per cord. The risk of such a strategy is that a bidder may have ended up purchasing stumpage at a higher price than would otherwise be paid if the tract had been sold with the requirement to use guidelines. Thus, one might expect paired bids on a tract with equal per cord price to be lower than paired bids with a price differential. Such a strategy would be an attempt to minimize the likelihood that the bidder is awarded the tract at a price higher than they would otherwise be willing to pay when guidelines are required.

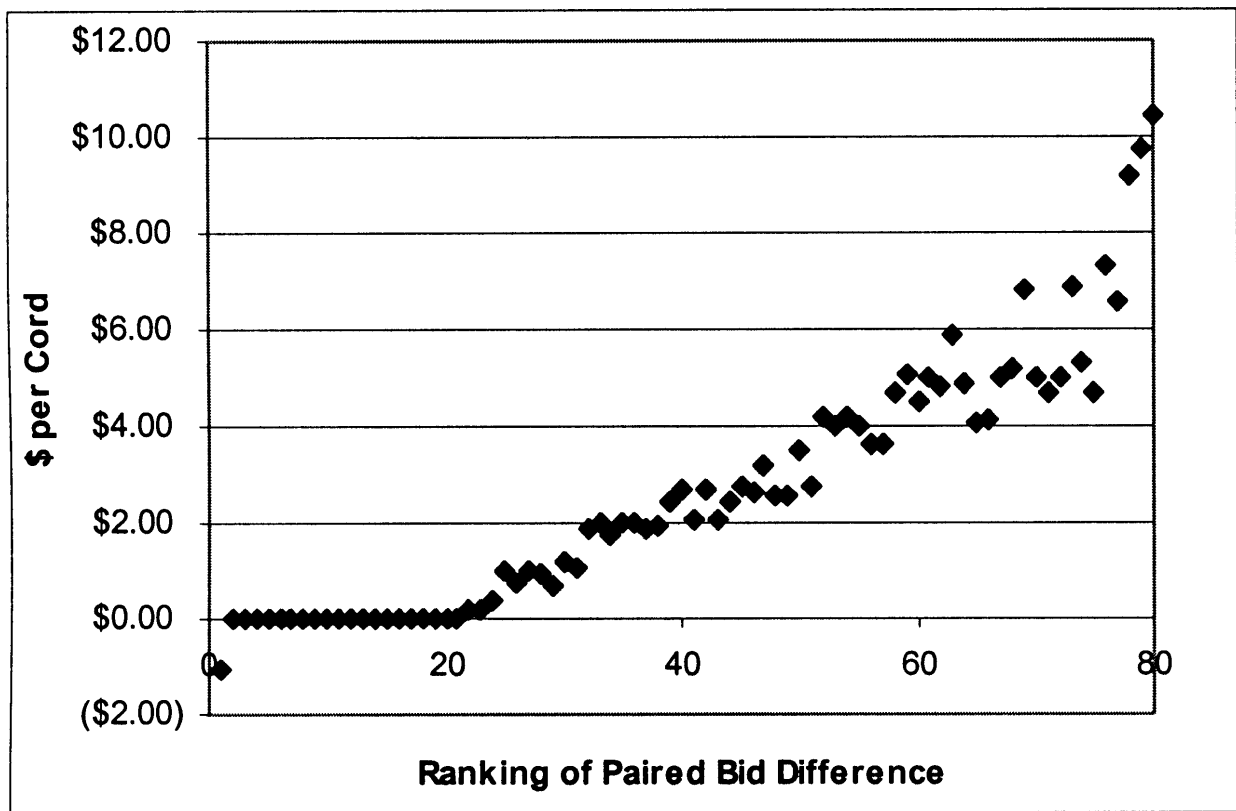
Analysis of submitted paired bids indicates just the opposite. The “with guideline” portion of paired bids with equal value averaged more than \$5 higher than the average “with guideline” bid when paired bids were different (average of \$28.60 and \$23.13 per cord, respectively). The results suggest timber harvesters’ bids that did not differentiate stumpage bids based on the requirement to use guidelines were, indeed, competitive. In fact, nine of the 15 tracts receiving at least one paired bid with no difference in price were awarded to bidders who did not differentiate stumpage bids based on the requirement to apply guidelines.

- *Timber auctions used a sealed bid format.* The study’s sealed bid format provided timber harvesters the opportunity to bid only once on each study tract. All bids were submitted in writing and bidders were presumably unaware of the level of bidding activity on a particular tract. Further, timber harvesters bidding on multiple tracts did not have knowledge of prior bidding success when subsequent bids were submitted. These factors all should have elicited a timber harvester’s true willingness to pay for the stumpage. This is in contrast to tracts sold at an oral auction where bids on specific tracts can be substantially influenced by prior bidding success, the

level of bidding activity, and knowledge of other bidding parties.

- *Harvest treatments for each study tract had an equal probability of selection, and treatment assignments were not made known until after the bidding period closed.* All public notices advertising the sale of the 27 tracts stated the harvest treatments would be randomly selected with an equal probability assigned to each treatment. The study investigators made treatment selections only after the conclusion of each tract’s bidding period. Land management agency personnel were informed of the treatments assigned to each tract just prior to awarding the sales. Thus, paired bids were submitted without a priori knowledge by prospective buyers of harvest treatment assignments and, presumably, reflected an unbiased estimate of willingness to pay for each tract with and without the requirement to apply the guidelines.

Figure 14 illustrates the cost per cord difference among each bid pair for the 80 paired bids submitted. With the exception of the paired bids of equal value, the distribution appears relatively even across the entire range of bid differences, suggesting the perceived effect of guidelines on the cost of harvesting timber was quite variable among bidders. Factors likely influencing this perception among individual timber harvesters include physical attributes of the harvest site, the operator’s proficiency applying the guidelines and production efficiency, and type of harvesting equipment used. Whether the preponderance of no difference in paired bids is a function of timber harvester’s perception that guidelines have minimal impact on harvesting costs, an unwillingness to pass guideline-related costs to forest landowners in the form of lower stumpage prices, or strategic bidding behavior is not known.



**Figure 14.** Distribution of differences in bid prices for paired bids (\$/cord) within the 23 study tracts sold.

### Guideline-related Costs of Timber Sale Set-up

Data associated with the agency’s time required to prepare each tract for public auction was collected on all 27 tracts offered for sale. Data on one tract was deleted from the analysis because it was deemed to be incomplete. Total nonguideline and guideline sale set-up time required to prepare the 26 tracts is summarized in Table 10. On average, agencies spent just less than 13 hours to prepare a tract “without” guidelines vs. almost 20 hours (a 54 percent increase) when guidelines were included as part of the sale provisions. Total sale set-up time for individual tracts with guidelines ranged from just less than five to nearly 45 hours, with additional preparation time attributed specifically to guidelines as low as 2.51 and as much as 17.5 hours.

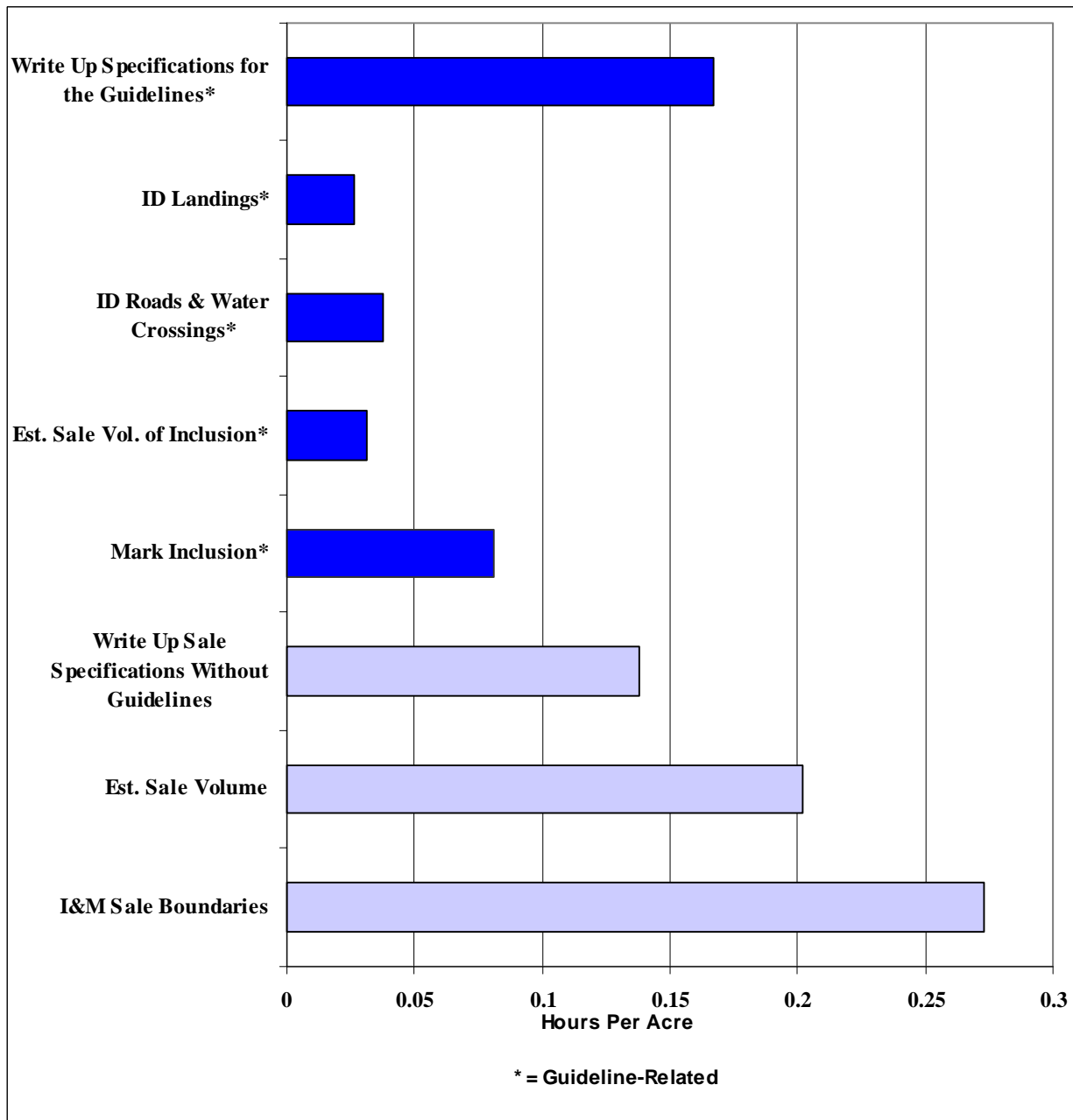
When evaluated on a per acre basis, the set-up time required to prepare a tract for auction with guidelines was significantly greater than when no guidelines were required ( $p < .01$ ). Total time required to prepare a tract for harvest that included guidelines averaged slightly less than one hour (56 minutes) per acre. This compares to the average

time of 36 minutes per acre to prepare a tract for auction when guidelines were not specified. At the margin, timber harvesting guidelines added an average 0.34 hours per acre—a 57 percent increase over timber sale preparation costs absent guidelines. When the guidelines were included, the total time to prepare individual tracts for auction ranged from 0.29 to 2.35 hours per acre, with the additional time attributed specifically to guidelines as low as 0.1 to as high as 0.92 hours per acre (Table 10).

Figure 15 indicates the average per acre set-up time associated with each of the major tasks on the 26 tracts in which detailed information was available. The first five set-up tasks listed in the figure (i.e., writing up sale specifications, identify landing locations, identify roads and water crossing locations, estimating the sale volume within the inclusion, and marking the inclusion) are associated with incorporating the guidelines. Half of all guideline-related sale preparation time (0.17 out of 0.34 hours per acre) was incurred in writing the sale specifications needed to advertise the tract for auction. Writing up the timber sale specifications to include guidelines increased the amount of time required to perform this task from 0.14 hours per

**Table 10.** Summary statistics of sale set-up time with and without guidelines.

	Hours per tract			Hours per acre		
	Nonguideline related time	Guideline related time	Total time	Nonguideline related time	Guideline related time	Total time
MEAN	12.89	7.01	19.89	0.60	0.34	0.94
STD DEV	6.68	3.93	9.65	0.37	0.22	0.57
MAX	27.22	17.50	44.72	1.58	0.92	2.35
MIN	2.42	2.51	4.93	0.14	0.10	0.29
N	26	26	26	26	26	26



**Figure 15.** Summary of time, by activity, to set up the 26 study tracts for sale (hours/acre).

acre (without guidelines) to 0.31 hours per acre (with guidelines). The other guideline-associated sale set-up tasks (i.e., identifying the placement of

landings, roads and water crossings, and marking and estimating timber volume in the inclusion) each were found to impose minimal additional sale set-up



time. In aggregate, these tasks added 0.17 hours per acre to the time required to prepare the sale for auction. Of these, marking and cruising the inclusion added the most time, on average 0.12 hours (seven minutes) per acre, whereas the marginal time spent identifying the placement of skid trails, water crossings, and landings averaged only 0.07 (four minutes) per acre across the 26 tracts.

### DNR and SLC Comparisons

The average time required for SLC to prepare study tracts for auction was roughly double the time needed for DNR study tracts, averaging 1.5 hours and 0.8 hours per acre, respectively (Table 11). Interestingly, the relationship between total guideline- and nonguideline-related time for the two agencies was strikingly similar. For both agencies, the time required to incorporate the guidelines into timber sales increased total sale preparation time by approximately 60 percent. Although the number of SLC tracts used in the study was limited (useable data on sale preparation time was only available on four SLC tracts), the differences in sale set-up time between the two agencies are substantial. The results suggest the procedures used by individual agencies to incorporate timber harvesting guidelines in timber sales can differ markedly.

### Financial Cost to Forest Landowners

The study demonstrated forest landowners are incurring additional financial costs when implementing Minnesota’s timber harvesting guidelines. Assuming the study tracts are representative of timber harvesting and guideline implementation practices found in Minnesota, the state’s timber harvesters are passing, on average,

\$2.66 per cord to landowners in the form of reduced stumpage prices when guidelines are incorporated into timber sales (Table 7). That average amounts to a 10.1 percent reduction in stumpage revenues.

- Considering the average reduction in willingness to pay for stumpage offered by timber harvesters when guidelines are required during harvest and stand volume per acre within the study tracts, forest landowners lost an average of **\$71.02 per acre** in timber revenue when guidelines were required (\$2.66 per acre x 26.7 cords/acre) (Table 12).
- In addition, the use of guidelines decreased merchantable timber available for harvest by an average of 2.4 cords per acre (Table 2). At an average “without” guideline stumpage bid of \$27.22 per cord across the study tracts (Table 7), the value of residual trees left on the site when guidelines were incorporated into the design of the timber sale averaged **\$65.33 per acre** (Table 12) (2.4 cords per acre x \$27.22 per cord).
- The process of planning and setting up any timber sale requires personnel time both in the office and in-the-field. That time required to prepare a tract for sale expanded by more than 50 percent (20 minutes) when guidelines were incorporated into a timber sale (Table 10). Assuming an opportunity cost of \$20 per hour, the additional cost of preparing a tract for sale when incorporating Minnesota’s timber harvesting guidelines averaged **\$6.80 per acre** (Table 12) (0.34 hours per acre x \$20 per hour). If there were additional costs to landowners associated with timber sale administration and sale closure, which were not documented in this study, they would need to be considered before a total cost to landowners could be calculated.

**Table 11.** Comparison of sale set-up time between Minnesota Department of Natural Resources and St. Louis County Land Department for 26 study tracts (hours/acre).

Agency	Number of tracts offered for sale	Nonguideline related time	Guideline related time	Total sale set-up time
MN Department of Natural Resources	22	0.5	0.3	0.8
S. Louis County Land Department	4	0.9	0.6	1.5

**Table 12.** Average financial cost to forest landowners using Minnesota’s timber harvesting guidelines based on study tracts (\$/acre).

	Reduced price for timber sold	Value of residual trees	Opportunity cost of additional sale set-up time	Total
Average Cost Per Acre	\$71.02	\$65.33	\$6.80	<b>\$143.15</b>

Collectively, the per acre financial cost of implementing timber harvesting guidelines into Minnesota timber sales as expressed by reduced stumpage revenue, decreased revenue due to reducing the amount of merchantable timber sold, and additional sale set-up time averaged \$143.15 for the study tracts (Table 12).

## Survey of Bidder Characteristics, Strategies, and Perceptions

Thirty-three of the 36 timber harvesters bidding on the study tracts returned the questionnaire (a 92 percent response rate) which accounted for 93 percent of the paired bids submitted on the 23 study tracts. All returned questionnaires were complete and deemed useable in the study.

### Experience and Production

The timber harvesters who responded to the survey were very experienced, averaging 27 years in the logging business (Table 13). This average is four years greater than the state average number of years of experience reported by timber harvesters in 1996 (Puettmann et al. 1998). None of the respondents had been logging less than nine years, and two had been logging for at least 50 years. Individuals responding to the survey harvested, on average, approximately 14,000 cords annually—substantially above the statewide average production level of 5,000 cords reported in 1996 (Puettmann et al. 1998) (Table 14). The range in annual wood production among respondents was substantial, from 250 to 60,000 cords. All but seven respondents indicated annual production levels less than 20,000 cords. Collectively, the 33 timber harvesters responding to the survey produced 462,400 cords or 13 percent of the state’s estimated total wood production in 2002 (Minnesota Department of Natural Resources 2003).

### Record-Keeping

Only 21 percent (n=7) of the respondents indicated that they maintain separate financial records for each tract they harvest. Analysis of financial record-keeping tendencies indicates that these timber harvesters have been in business nearly 4.5 years less, on average, than timber harvesters who indicated they do not keep financial records of

each tract harvested (Figure 16). The average annual production in 2002 was nearly identical for timber harvesters who maintained individual tract records and for those who did not (13,460 versus 14,160 cords per year, respectively).

**Table 13.** Experience of responding timber harvesters who submitted paired bids on the 23 study tracts.

Number of survey respondents	Number of years in business
1	<10
7	10-19
10	20-29
9	30-39
4	40-49
2	>50
AVERAGE	27
MAXIMUM	51
MINIMUM	9

**Table 14.** Annual timber production of responding timber harvesters who submitted paired bids on the 23 study tracts.

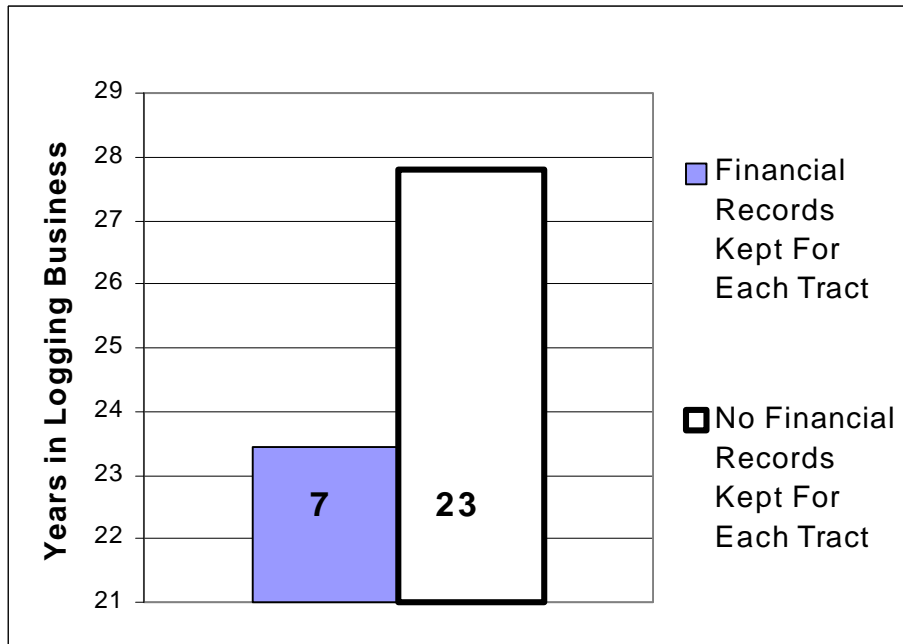
Number of survey respondents	2002 timber production (cords)
15	<10,000
11	10,000-19,999
3	20,000-29,999
0	30,000-39,999
3	40,000-49,999
1	>49,999
AVERAGE	14,012
MAXIMUM	60,000
MINIMUM	250

### Sources Consulted When Developing Bids

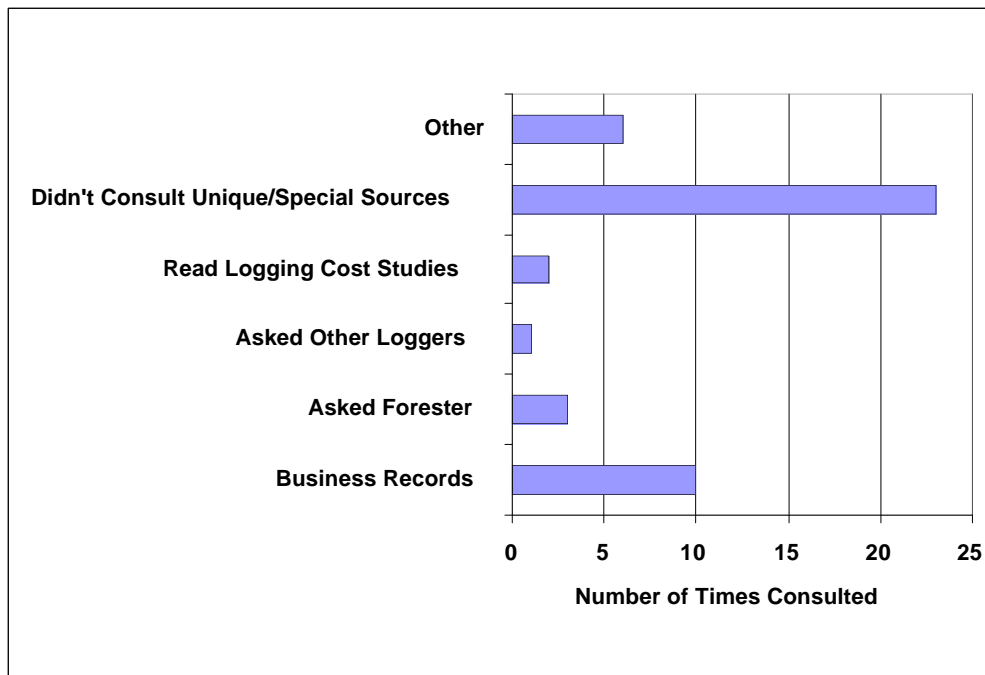
We asked timber harvesters who bid on the guideline study tracts to identify what sources were consulted in developing their paired bids. Seven of ten (n=23) responding timber harvesters indicated they did not consult any unique or special sources to develop their paired bids (Figure 17). Of those sources that were consulted, general business records of logging production costs was the most frequent, cited by ten timber harvesters. Three bidders asked the forester who set up the sale for ideas on how to bid, whereas one asked other timber harvesters how they planned to develop their paired bids. Two timber harvesters considered previous reports that documented the impact of guidelines on

logging costs to assist in developing their with-  
without guideline bids. Other sources mentioned by  
timber harvesters included basing their bids on

previous experience (three timber harvesters cited  
this), personally looking at the tract to see how  
guidelines affected the sale (e.g., skidding distance)



**Figure 16.** Average years of experience in the logging industry for survey respondents who maintain financial records on each tract harvested versus average years experience for those timber harvesters who do not maintain separate financial records for each tract harvested (number indicates number of respondents).



**Figure 17.** Types and frequency of sources used by responding timber harvesters in developing paired bids on the 23 study tracts.

(mentioned by two timber harvesters), examining information on the tract provided by the forester in the timber sale appraisal form (one respondent), and “just doing our own calculating” (one respondent).

### Visiting the Tract Prior to Bidding and Awareness of Bidding Activity

A surprising finding of the survey was the frequency by which timber harvesters personally inspected the tracts they bid on. Only half of all bidders actually visited the tract prior to submitting the paired bids for that tract (Table 15). This finding suggests many timber harvesters rely heavily to exclusively on information about the tract as contained in the agency’s timber appraisal report in formulating their bids for the stumpage. When asked about general knowledge of bidding activity on the study tracts at the time paired bids were submitted, all but two (94 percent) indicated they were unaware of how many other bids had been submitted. This latter finding confirms our premise that the sealed bid method used to auction the study tracts produced paired bids whose values were not dependent on the level of bidding activity for that tract.

**Table 15.** Percent of responding timber harvesters bidding on the 23 study tracts who, prior to submitting paired bids, visited the tract; knew the level of bidding activity.

	Visited tract prior to submitting bids (percent)	Knowledge of other bidders prior to submitting bids (percent)
Yes	50	6
No	50	94

### Factors Influencing With-Without Guideline Stumpage Bids

#### Site-Specific Tract Factors

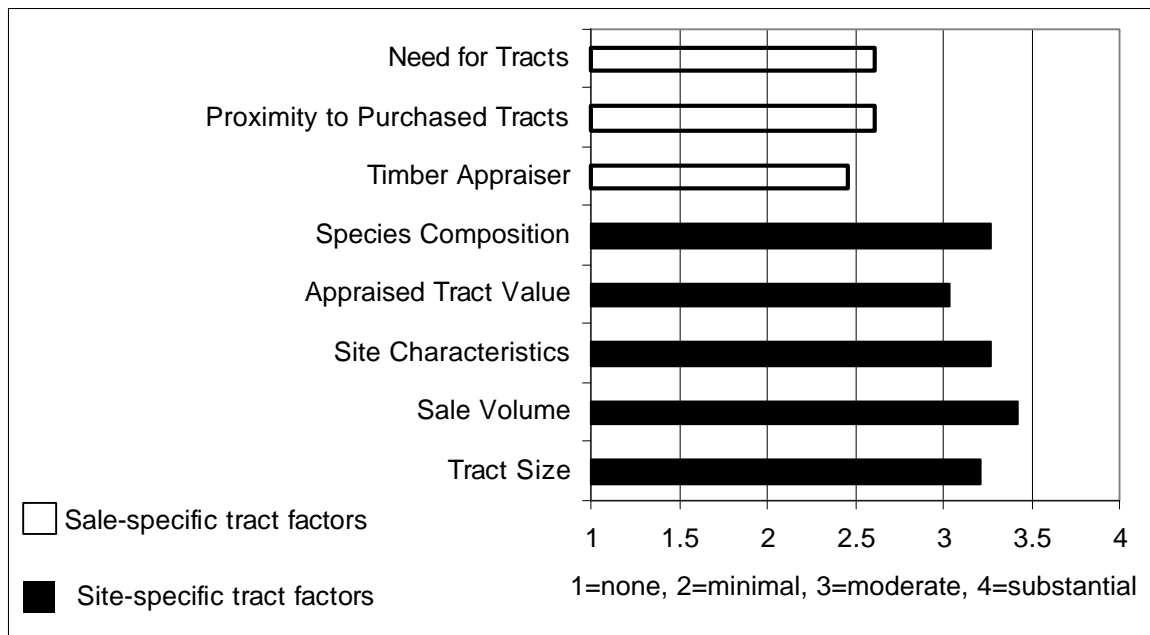
We asked bidders to rate a number of tract-specific factors thought to influence the bids submitted on the study tracts. Respondents were given four response categories to express the degree to which a given factor influenced their bids—substantial, moderate, minimal, and none. Of those tract variables, total volume of merchantable timber on the tract was the most influential in shaping a timber harvester’s bid on the study tracts, receiving an average rating of 3.42 (4 = substantial influence; 1 = no influence) (Table 16 and Figure 18). Specific site characteristics of the tract and species composition were the second highest rated influences, each receiving a mean rating of 3.27. The size of the tract also had more than a moderate influence on the bids submitted on the study tracts, averaging 3.21. All site-specific tract factors were perceived to have, on average, at least a moderate influence on bidding.

#### Sale-Specific Tract Factors

Sale-specific tract variables evaluated for their affect on stumpage bids on the study tracts included who appraised the tract, the location of the tract in proximity to other existing stumpage tracts held by the timber harvester, and the timber harvester’s current inventory of purchased tracts. None of these three factors influenced stumpage bids to the degree of the site-specific factors (Table 16 and Figure 18). Of the three sale-specific variables evaluated, the tract’s proximity to other timber sales owned by the bidder and the bidder’s inventory of purchased tracts were considered to have the greatest influence in developing stumpage bids (mean score of 2.61

**Table 16.** Summary statistics: influence of site- and sale-specific tract factors on the development of paired bids submitted on the 23 study tracts (1 = none, 2 = minimal, 3 = moderate, 4 = substantial).

	Site-specific factors					Sale-specific factors		
	Tract size	Sale volume	Site characteristics	Appraised value	Species composition	Timber appraiser	Proximity to other sales	Need for tracts
Average	3.21	3.42	3.27	3.03	3.27	2.45	2.61	2.61
Maximum	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Minimum	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
S. Deviation	0.65	0.66	0.76	0.85	0.88	1.06	1.03	1.03
Count	33	33	33	33	33	33	33	33



**Figure 18.** Influence of site- and sale-specific tract factors on the development of paired bids submitted on the 23 study tracts (mean rating).

each). Knowledge of the forester who set up the timber sale was least influential to the timber harvesters in developing their bids on the study tracts (2.45).

### Guidelines

Applying the same rating scale used to assess the influence of site- and sale-specific tract factors on stumpage bids, we asked timber harvesters to indicate how each of the six guidelines used in the study influenced their bidding behavior on the study tracts. Guidelines that required the timber harvester to leave residual trees on site (e.g., at least six trees per acre greater than six inches diameter breast height in patches or scattered throughout the study site; no less than 50 percent of the merchantable volume within the marked inclusion which is equal to 10 percent of the harvest area) were reported to have the greatest influence on with-without guideline stumpage bids (Table 17, Figure 19). Retaining leave trees in patches or individual trees received a mean score of 2.97, whereas bidders rated selective harvesting within the inclusion boundary as 2.94. Leaving snags (dead trees) standing was considered least influential in developing stumpage bids with and without the use of guidelines. None of the guidelines were reported to have, on average, at least a moderate influence on bidding.

### Comparing Tract Factors and Guidelines

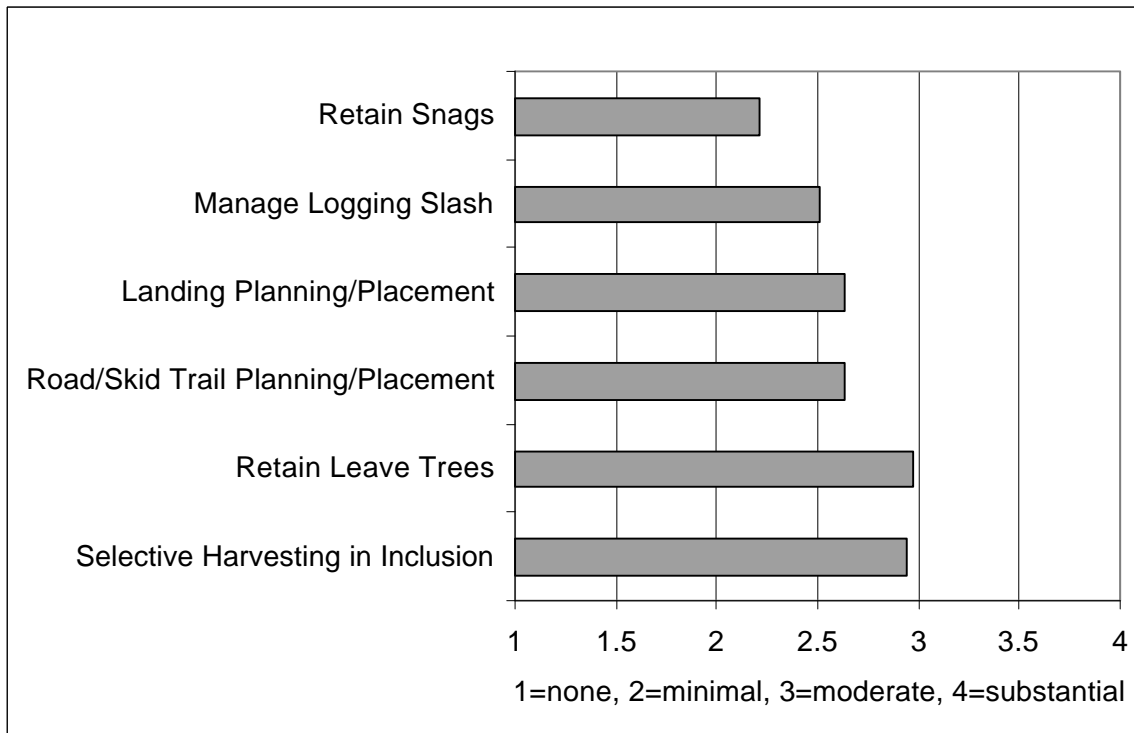
Figure 20 contrasts the mean scores for the tract factors and guidelines examined in the survey. To generalize, a tract’s physical characteristics were perceived to have a greater overall influence on the development of paired bids than did specific guidelines. The average ratings of influence for all five of the tract’s site characteristics were higher than any of the six guidelines, implying a tract’s characteristics factored more prominently in determining the willingness to pay for stumpage than did guidelines. Ratings for the three sale-specific tract factors were less than any of a tract’s physical characteristics, and within the range of influence guidelines were found to have on stumpage bids.

### Timber Harvester’s Perception of Who Bears the Cost of Guidelines

The practices or restrictions recommended in Minnesota timber harvesting guidelines can increase the marginal cost of timber harvesting in a variety of ways. These increased costs can be in the form of additional material purchases (e.g., culverts, road crossing and erosion control structures), decreased productivity per acre (e.g., leaving merchantable trees for wildlife and visual purposes), decreased volume removed per tract (e.g., additional move costs or stumpage requirements to meet contract

**Table 17.** Summary statistics: influence of guidelines on the development of paired bids submitted on the 23 study tracts (1 = none, 2 = minimal, 3 = moderate, 4 = substantial).

	Harvesting in inclusion	Leave trees	Road/skid trail placement	Landing placement	Logging slash	Retain snags
Average	2.94	2.97	2.64	2.64	2.52	2.21
Maximum	4.00	4.00	4.00	4.00	4.00	4.00
Minimum	1.00	1.00	1.00	1.00	1.00	1.00
S. Deviation	1.00	0.85	0.93	0.93	0.80	0.89
Count	33	33	33	33	33	33



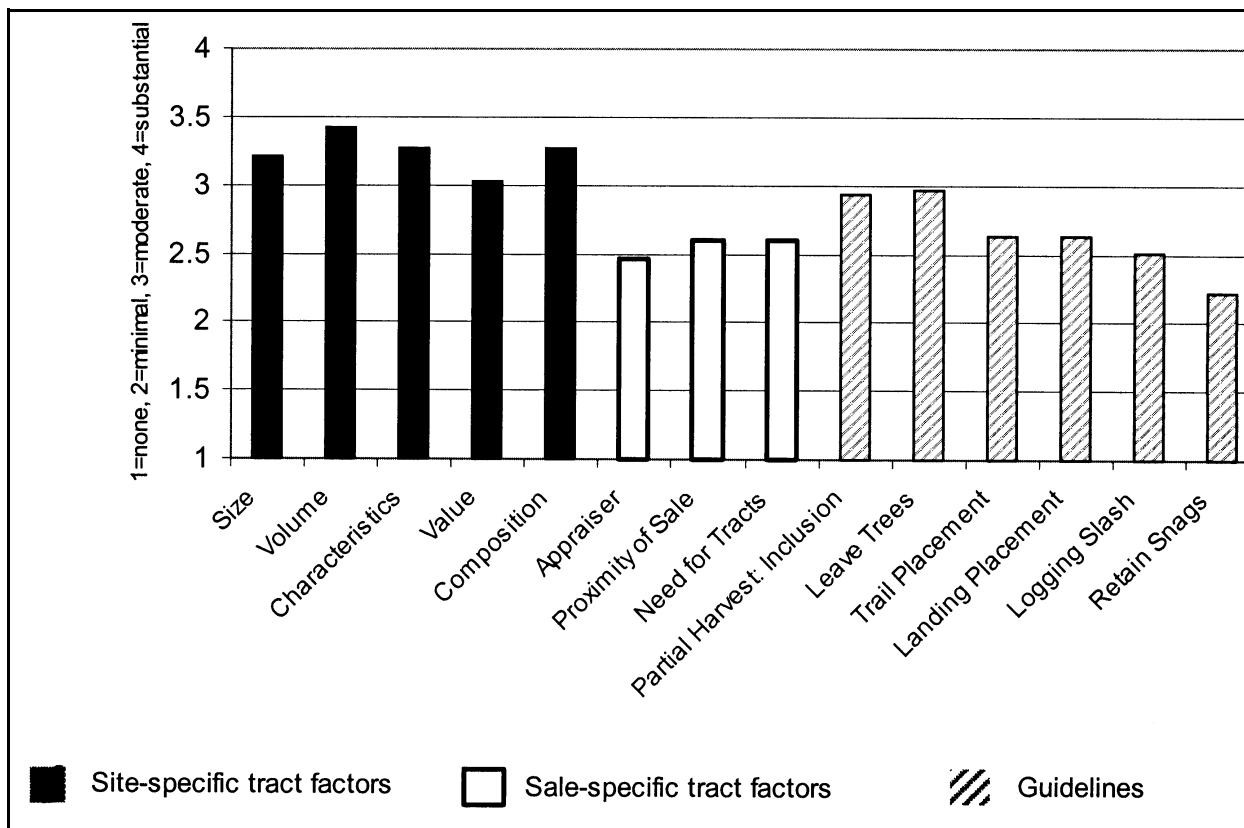
**Figure 19.** Influence of guidelines on the development of paired bids submitted on the 23 study tracts (mean rating).

obligations) additional planning time (e.g., pre-harvest consultation with a forester), and increased variable operating cost per unit harvested (e.g., alternative road and skid trail patterns).

Economic theory suggests these additional costs are shared with forest landowners to the extent timber harvesters differentiate their willingness to pay for stumpage when guidelines are required. Any difference in per cord bids with and without the requirement to use guidelines represent that portion (possibly all) of the perceived additional harvesting costs transferred from a timber harvester to a forest landowner in the form of lower willingness to pay for stumpage. Stumpage bids with and without guidelines that are of equal value per cord indicate

timber harvesters are not passing any guideline-related costs on to forest landowners. We asked timber harvesters who they thought bears the cost of implementing guidelines under different bidding scenarios. Overall, the bidder's perception of how differences in with-without guideline bids impacted the incidence of any guideline-related costs was quite variable.

When bidders were asked who bears the cost for implementing guidelines when there is no difference in the paired bid for a given tract, 58 percent felt it was the timber harvester, 29 percent believed both the timber harvester and landowner were sharing the cost, and 13 percent thought the burden fell solely on the forest landowner (Table 18).



**Figure 20.** Influence of tract factors and guidelines on the development of paired bids submitted on the 23 study tracts (mean rating).

**Table 18.** Timber harvester perception of who bears the cost of implementing timber harvesting guidelines when with- and without guideline bids are similar and different.

Perception of who bears the cost of guidelines	Paired bid	
	Little-to-no difference (percent)	Large difference (percent)
Timber harvester	58	39
Landowner	13	22
Both timber harvester and landowner	29	39

When given the scenario that a bid for stumpage when guidelines are required is significantly lower than stumpage bids for that same tract when guidelines are not required, 39 percent felt timber harvesters bear the costs (Table 18). An equal number of respondents felt the cost of guidelines was shared among timber harvesters and landowners. Only 22 percent believed the landowner was solely bearing the cost of guidelines under the scenario where stumpage bids with and without guidelines have a large difference in value.

### Summary Observations of Bidder Characteristics, Strategies, and Perceptions

The survey revealed a number of important findings about how timber harvesters approach the development of stumpage bids when guidelines are required, as well as how various factors influence their bidding behavior. These findings include:

- Greater than three of four responding timber harvesters do not keep detailed financial records on each tract they harvest, making it difficult for individual operators to quantify how various tract characteristics and use of specific guidelines will impact per unit logging costs.

- Most responding timber harvesters did not consult any special or unique sources in developing their paired bids on the study tracts, suggesting the availability of additional information may not be very important in determining the cost of implementing guidelines.
- Only half the responding timber harvesters visited the tract prior to submitting sealed bids for the stumpage. This finding indicates many timber harvesters rely heavily to exclusively on information about the tract contained in the agency's timber appraisal report in formulating their bids for the stumpage. It also may suggest that personally visiting each site represents a substantial cost to many stumpage purchasers relative to the additional benefits they might gain by visiting the tract.
- Of the site-specific tract factors evaluated, the total volume of merchantable timber in a timber sale was perceived to have the greatest influence on stumpage bids. This finding suggests the importance of being able to minimize the marginal increase in per unit production costs imposed by guidelines by spreading these costs over a large quantity of timber harvested.
- Knowing who the forester was who set up the timber sale, the location of the sale in proximity to other tracts held, and the bidder's inventory of tracts all had less than a moderate influence on stumpage bids.
- The influence of specific guidelines on bidding behavior was also modest. None of the six guidelines evaluated in our study generated an average score of three, meaning they had less than a moderate influence on the bids developed for the study tracts.
- In comparing site-and sale-specific tract factors and guidelines, a tract's physical characteristics were perceived to have a greater overall influence on the development of paired bids than did specific guidelines. The average ratings of influence for all five of the tract's site characteristics were higher than any of the six guidelines, implying a tract's characteristics factored more prominently in determining the willingness to pay for stumpage than did guidelines.
- The perception of who bears the cost of implementing guidelines among timber harvesters and forest landowners is quite variable among the individuals who bid on the

study tracts. Nearly 40 percent of the respondents felt that the timber harvester bore the cost of guidelines when there is a large difference in stumpage prices due to the inclusion of guidelines on a timber sale (i.e., the landowner was not incurring those reduced stumpage values).

## Implication of Study Findings

The ecological benefits of implementing timber harvesting guidelines have been well documented. They include healthy and resilient forests, greater diversity of biological resources, increased forest productivity, reduced soil erosion, clean water, enhanced fisheries and wildlife habitat, and improved visual appeal of timber harvesting operations. Elusive, however, has been a description and quantification of the tradeoffs associated with applying these practices, particularly to those who own the land or harvest the timber. This study has, for the first time, attempted to empirically quantify the financial cost to forest landowners who apply Minnesota's timber harvesting guidelines. The study found that implementing guidelines has an average financial cost to forest landowners of \$143 per acre as represented by reduced stumpage prices, foregone value of trees left on-site, and additional time incorporating guidelines into timber sale specifications. Assuming the tracts used in the study are representative of Minnesota's timber sales and associated harvesting practices, the benefits of guidelines need to be worth, on average, at least \$143 per acre for their use to be justified on economic grounds.

While the types and magnitude of guideline-derived benefits are not appreciably different on public and private forests, the extent to which they are recognized by their respective owners varies considerably. The benefits produced on public forests from the application of timber harvesting guidelines may easily justify their cost as these lands are managed for the production of both market and nonmarket goods and services. However, the extent to which these same benefits are recognized by private forest landowners as exceeding their cost of implementation is unclear. While privately owned forests are rarely managed for maximum financial return, the perceived net value associated with various management practices such as guidelines will influence landowner land



management decisions. To the extent private forest landowners recognize the collective economic and environmental benefits of guidelines for being greater than their cost, guidelines will be incorporated in timber harvesting activities. Absent benefits of this magnitude, financial support in the form of incentives and/or compensation may be needed if landowners are to routinely apply the guidelines on a voluntary basis.

### Range of Possible Policy Tools

With a public policy objective being the widespread application of voluntary timber harvesting guidelines, an important consideration becomes identifying an effective and efficient means of encouraging forest landowners to adopt these practices. Government commonly uses a wide range of policy tools by which to influence the behavior of landowners and resulting management of their forests. They include benign intervention such as providing information, education, and training to inform forest landowners about the guidelines; economic incentives such as tax policy or cost-sharing programs to encourage the application of specific practices; and aggressive control of forest resource use through regulation and government ownership. Information on the “right mix” of such strategies that will result in use of the guidelines by forest landowners is not always available and straightforward.

### MFRC Study of Policy Tool Use, Effectiveness, and Efficiency

Previous research supported by the Minnesota Forest Resources Council may be helpful in identifying effective approaches for encouraging forest landowners to use timber harvesting practices that accommodate ecological, environmental, and aesthetic considerations. As part of a larger study to assess the financial effects associated with implementing Minnesota’s timber harvesting and forest management guidelines, forestry administrators in all states and provinces were surveyed to assess the use, effectiveness, and efficiency of public policy tools. It was reported that states and provinces use a variety of policy tools to encourage forest landowners to apply timber harvesting guidelines (Kilgore and Blinn 2003). The reported effectiveness and efficiency of those tools varied considerably. Of the 51 forestry administrators who responded to the survey, the

most common approaches used to encourage forest landowners to apply timber harvesting guidelines were technical assistance (47 states/provinces), education (46 states/provinces), and cost-share programs (28 states/provinces) (Kilgore and Blinn 2003). Collectively, these three policy tools accounted for 88 percent of all state and provincial programs directed at encouraging forest landowners to use guidelines. The remaining 12 percent was roughly split between grants (nine states), premium prices for products (three states), and preferential access to contracts and loans (two states each) when landowners are determined to be in compliance with the guidelines.

Kilgore and Blinn (2003) reported that technical assistance programs are considered the most effective policy tool for encouraging forest landowners to apply timber harvesting guidelines with a mean rank of 3.18 (1 = low effectiveness; 4 = high effectiveness). Effectiveness was defined as a measure of how well a policy tool is achieving its intended objective or outcome with regard to guideline implementation. Cost-share and education programs, two additional strategies commonly used to encourage landowner use of state guidelines received a mean score of 3.00 and 2.89, respectively. Respondents suggested that sustained and adequate funding can be significant barriers to long-term program effectiveness. The nine states with grant programs for forest landowners gave the programs a mean effectiveness score of 2.70. While not used extensively, price premiums and preferential access to contracts had effectiveness ratings of 2.50—only modestly effective at increasing guideline use among landowners. Both states with landowner loan programs rated them as having low effectiveness (1.00) (Kilgore and Blinn 2003).

The efficiency of different programs can be assessed through an evaluation of the extent to which program benefits exceed costs. Using a scale of 1 to 4 (1 indicates that the investment greatly exceeds the payoff, whereas 4 indicates the level of the payoff greatly exceeds the investment), forestry agency administrators felt technical assistance programs yielded the greatest return of all approaches used to encourage forest landowners to apply timber harvesting guidelines, with a mean score of 3.36. This approach was also considered the most effective in securing increased landowner use of timber harvesting guidelines. Education programs were the second highest rated approach in

terms of efficiency with a score of 3.14, although it ranked third overall in terms of effectiveness in influencing landowner behavior about using guidelines. Cost-share programs, which were considered the second most effective policy tool, ranked third in terms of efficiency (rating of 3.00). The two states with landowner loan programs considered the benefits from such programs as less than the investment (efficiency rating of 1.00) (Kilgore and Blinn 2003).

Discussion with state forestry officials suggested that tax incentives and cost-share programs are a new and emerging tools for encouraging application of forest management guidelines by forest landowners (Kilgore and Blinn 2003). These programs provide financial incentives to landowners to compensate them for benefits of applying guidelines that largely accrue to society (e.g., clean water, visual quality, protection of cultural resources) but have no direct benefit to the landowner (e.g., installation of water diversions, selection harvesting in a riparian management zone). As guidelines largely provide societal benefits, public funding of tax incentives and cost-share programs may increase in the future.

### Example Forest Landowner Assistance Program

An example of a state program designed to recognize the contributions private forest landowners make to the protection of riparian wildlife habitat and assist private forest landowners in carrying out practices that protect this habitat is Washington's Forestry Riparian Easement Program. This private forest cost-share program is administered through the Washington Department of Natural Resources (<http://www.wa.gov/dnr/sflo/frep/#>). It is part of Washington's Small Forest Landowner Office which serves as a resource and focal point for small forest landowner concerns and policies (<http://www.wa.gov/dnr/sflo/>). Recognizing the public value of leaving timber in riparian areas, the Forestry Riparian Easement Program partially compensates eligible small forest landowners in exchange for a 50-year easement on "qualifying timber." This is timber the landowner is required to leave unharvested as a result of new forest practices rules protecting Washington's forests and fish. Landowners cannot cut or remove the qualifying timber during the easement period. The landowner still owns the property and retains full access, but

has "leased" the trees and their associated riparian function to the state. Due to the program's popularity, landowner demand for easement funding currently exceeds available resources.

### Program Design Considerations

The timber harvester bidding behavior revealed through this study sheds considerable light on the extent to which any perceived cost of applying timber harvesting guidelines are, in fact, being passed on to forest landowners in the form of lower stumpage prices. This information will be extremely useful in the design of policies and programs aimed at encouraging widespread use of the guidelines among forest landowners.

While it is convenient to focus on a single number (i.e., \$2.66 per cord) as the stumpage revenue loss forest landowners incur when using timber harvesting guidelines, such a focus can be misleading. The discount in stumpage prices offered by timber harvesters facing perceived increased harvesting costs as a result of guidelines varied considerably, ranging from a slight premium to nearly a 40 percent discount. Further, fully one-quarter of all bids submitted through this study did not discount stumpage bids when faced with the requirement to apply guidelines during the harvest operation.

Similarly, while the guidelines increased agency timber sale preparation time on average 20 minutes (approximately 50 percent increase), the additional time incurred by forest land managers in preparing timber sales when guidelines are included ranged from a few minutes to nearly an hour per acre.

The study also found that tract characteristics were more important than guidelines in influencing a timber harvester's bid for stumpage. Consequently, timber sale design may be effective in mitigating some of the additional costs associated with implementing guidelines.

Clearly, the impact of guidelines on harvest costs, the value of merchantable wood left on the site, and timber sale set-up time is influenced by many variables. These include individual proficiency in using the guidelines, business and organizational policies and practices, site and timber sale characteristics, and overall market conditions. The volume and value of merchantable wood left on site and the sale set-up time also varied. To the extent possible, this variability needs to be considered in the design of strategies to mitigate

adverse financial effects of timber harvesting guidelines on forest landowners.

## Future Research Needs

This study has quantified the extent to which forest landowners bear any preharvest cost for implementing Minnesota's timber harvesting guidelines in terms of reduced stumpage prices, foregone timber revenue, and additional time spent preparing a tract for sale. The study did NOT, however, identify the magnitude of the total costs resulting from implementation of the guidelines. That is, it does not provide information about the total costs incurred by timber harvesters during the harvest operation itself, or by the landowner as a part of administering the timber sale while it is ongoing and later closing the sale. While this study has made significant strides toward quantifying some of the additional financial costs associated with implementing Minnesota's timber harvesting guidelines, additional studies are needed to complete the assessment. Each of these additional needs is described below.

### *Assessing Timber Harvesting Costs.*

Tracking the total costs for timber harvesters is a daunting task, given the range of operators (e.g., low vs. high volume producers), equipment mix (e.g., differences in felling machines, skidders, and forwarders), operating conditions (e.g., topography, stand density, season), prescriptions (e.g., selection harvesting vs. clearcutting), and needs for guidelines on-site (e.g., riparian management zones, leave trees, stream crossings) across the state. While time study data collection with stopwatches has been a commonly applied approach for assessing differences in costs and productivity, it is both labor and time intensive. As such, it is difficult to sample the full range of factors which impact logging. New metering and sampling technology that now allow researchers to study a number of operators over the course of several months might be one lower-cost method of collecting useful information. An advantage of using such equipment is the possibility of collecting data over a broad range of factors such as site conditions, operators, and season of harvest. Employing this technology would enable an assessment of the impact Minnesota's guidelines have on timber harvesting productivity and associated variable operating costs.

*Further Study of Landowner Costs.* This study documents the extent to which timber harvesting guidelines impose additional set-up time to forest landowners when preparing timber tracts for sale. Unknown is the extent to which landowners incur additional costs during the administration of a timber sale that incorporates guidelines such as meeting with the stumpage buyer to discuss contract terms, reviewing ongoing harvest operations, and closing the timber sale. Once these costs are quantified, a survey of foresters could identify unique and/or cost-effective ways for dealing with additional time requirements for implementing guidelines during the timber sale design, administration, and closing processes

*Quantifying Landowner Perception of Guideline Benefits.* Our understanding of the financial costs to forest landowners who choose to implement Minnesota's timber harvesting guidelines has been strengthened considerably by the data generated from this study. Knowing the magnitude of guideline costs to landowners increases our ability to assess tradeoffs associated with the application of these practices. While the types of benefits guidelines provide are fairly well documented (e.g., protection of water quality, plant and animal species and their habitats), the magnitude by which these benefits accrue is not well understood. Empirical studies of guideline benefits (e.g., effectiveness monitoring, surveys of landowners and the public) would help resource managers and policy makers better understand the net value attributed to the use of timber harvesting guidelines.

## Authors

The authors are, respectively, Assistant Professor and Professor/Extension Specialist, Department of Forest Resources, College of Natural Resources, University of Minnesota, St. Paul, MN.

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Louis County Land Department and their staff for conducting the on-the-ground work associated with setting up the 27 study tracts for sale. Appreciation is also expressed to the timber harvesters who participated in this study.

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## Appendix A–Timber Sale Administration Time Sheet

# Timber Sale Administration Time Sheet

<b>Sale Identification Number</b>	<b>County</b>
<b>St. Louis County Land Dept. Office</b>	<b>Township/Range/Section</b>

Use this form to record the time spent performing each activity listed below. Use a separate form for each timber sale that is part of the guideline economic study. All entries should include only the **ACTUAL TIME** spent conducting the activity. Do not include travel time.

**\*\*\* NOTE: All time entries should be rounded to the nearest 10 minutes. \*\*\***

ACTIVITY	DATE(S)	TIME SPENT ON ACTIVITY		INDIVIDUAL(S) CONDUCTING TASK
		Hours	Minutes	
<b>Identifying &amp; Marking Sale Boundaries.</b>				
<b>Estimating Sale Volume.</b> (e.g. cruising time)				
<b>Guideline-Related Activities</b>				
<b>Planning &amp; Marking the Boundary of the 10% Partial Harvest Inclusion.</b>  <i>NOTE: Do not mark individual trees within the 10% inclusion. This should be an unmarked thinning where the operator selects the trees for harvest with forester direction.</i>				
<b>Estimating Sale Volume Within Inclusion</b>				
<b>Identifying Placement of Access Road(s), water crossings and Water Diversion(s).</b> (on-site or from photos)				
<b>Identifying the Location of Landing(s).</b> (on-site or from photos)				
<b>Timber Sale Specifications Write-Up</b>				
<b>Timber Sale Bid Specifications -- 2 for each tract.</b> (e.g., appraisal form; creating site map, calculating volumes, writing regs., etc.)	<b>Without Guidelines</b>			
<i>NOTE: The "Without Guidelines" sale bid specifications should be written up first.</i>	<b>With Guidelines</b>			

**Comments:**

**Return the completed form to:**

Mike Kilgore  
 Dept. of Forest Resources, University of Minnesota  
 115 Green Hall, 1530 Cleveland Ave N, St. Paul, MN 55108  
 Phone: 612-624-6298    FAX: 612-625-5212    E-mail: [mkilgore@umn.edu](mailto:mkilgore@umn.edu)

## Appendix B—Sample DNR Timber Appraisal Reports

**WITH GUIDELINES  
TIMBER APPRAISAL REPORT**

NA-02136-05  
(Part B) 8/00



Permittee	State Forest 28 - Koochiching		Sale Type Intermediate	RAD 261	Permit Number
Legal Description SESW, W1/2SE1/4	Section 14	Township 069	Range 24W	County 36 - Kooch	Permit Date

**CUTTING REGULATIONS**

| - Reserve Area - No cutting      |||| - Permit Area  
 000 - Natural Boundary Line      XXX - Reserve Line - Blue Paint  
 ||| - Selective Harvest Area - 50% of merchantable volume to be removed during harvest. Avoid damaging leave trees.  
 An on-site meeting with the Forest Officer must occur prior to starting sale.  
 Reserve 6-10 scattered leave trees per acre greater than 6" dbh throughout the permit area.  
 Keep felled trees within permit area.  
 Leave dead trees standing where safety permits.  
 Winter access only on frozen ground.  
 Access roads and landing must be approved by Forester prior to clearing.  
 Harvest operations will be halted if rutting occurs.

**SLASH DISPOSAL REGULATIONS**

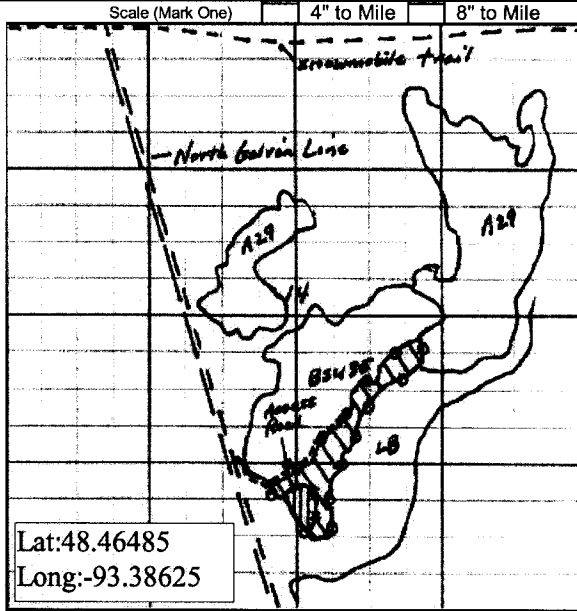
Lop and scatter slash evenly within sale area.  
 All tops and slash brought to landing must be hauled back out and scattered on site.

**REMARKS**

Access across State land.  
 Winter access to permit, 1 3/4 miles south on North Galvin Line on County Road #97.  
 Aspen averages 10" dbh, 6 - 7 sticks. Aspen includes 05% Balm.  
 Location of access road and landings are shown on map.

**FOREST DEVELOPMENT PLANS**

Aspen age is 59 years, SI averages 71.  
 Natural regeneration to Aspen.



Bid + / SOAV *	Species	Product	Cords	MBF	Top Diameter		Appraised Price	Appraised Value	Bid Price	Bid Value					
					4"	8"									
+	Aspen	Pulp and Bolts	340				\$24.00	\$8,160.00							
<b>Pole Sizes</b>		10'	12'	14'	16'	20'	25'	30'	35'	40'					
<b>Pole Prices</b>															
<b>PULP, BOLTS, POLES BREAKDOWN</b>		<b>PRICE (Using PGF)</b>				<b>Acres 12 acres</b>									
Species		% Bolts	% Poles	Pulp	Bolts	Poles	Sec	C. Type	Pres. Code	Acres D/S	P/U P	Section	Land Status	Forty or Lot	% Total Value
Aspen		20%		\$21.00	\$36.00		14	Asp-05	1113	13/12	UP	14	09	SESW	11
												14	09	NWSE	55
												14	09	SWSE	34
<b>Price Adjustment Factor and Additional Remarks:</b>															
Bid Type: 1															
Soil Type(s): sandy soil over clay.															
State Appraiser Signature				ID #	Date										
				0305	12/21/99										
Program Forester Approval				Date											



**WITHOUT GUIDELINES  
TIMBER APPRAISAL REPORT**

NA-02136-05  
(Part B) 8/00



Permittee	State Forest 28 - Koochiching		Sale Type Intermediate	RAD 261	Permit Number
Legal Description SESW, W 1/2SE1/4	Section 14	Township 069	Range 24W	County 36 - Kooch	Permit Date

**CUTTING REGULATIONS**

- Reserve Area - No cutting       - Permit Area  
 000 - Natural Boundary Line      XXX - Reserve Line - Blue Paint  
 An on-site meeting with the Forest Officer must occur prior to starting sale.  
 Keep felled trees within permit area.  
 Winter access only on frozen ground.  
 Access roads and landings must be approved by Forester prior to clearing.  
 Harvest operations will be halted for excessive rutting.

**SLASH DISPOSAL REGULATIONS**

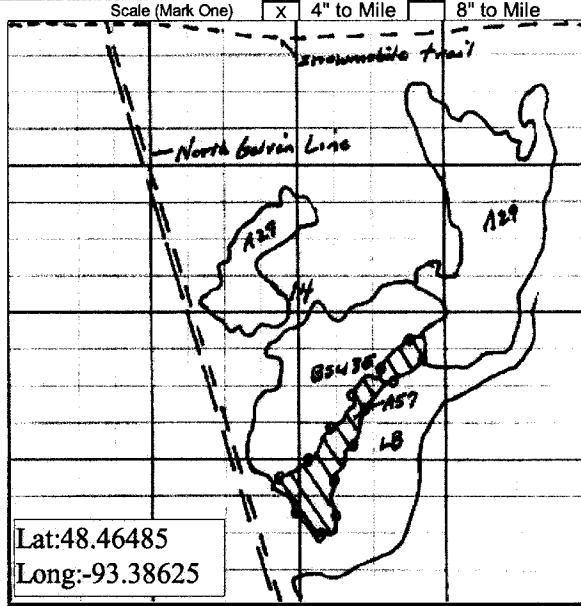
Lop and scatter slash evenly within sale area.  
Pile any slash or tops, if brought to landing.

**REMARKS**

Access across State land.  
 Winter access to permit, 1 3/4 miles south on North Galvin Line from  
 County Road # 97.  
 Aspen averages 10" dbh, 6 - 7 sticks. Aspen includes 05% Balm.

**FOREST DEVELOPMENT PLANS**

Aspen age is 59 years, SI averages 71.  
 Natural regeneration of site back to an aspen type.



Bid + / SOAV*	Species	Product	Cords	MBF	Top Diameter		Appraised Price	Appraised Value	Bid Price	Bid Value
					Pulp	Bolts				
+	Aspen	Pulp and Bolts	375		4"	8"	\$24.00	\$9,000.00		
Pole Sizes		10'	12'	14'	16'	20'	25'	30'	35'	40'
Pole Prices										
Advance Payment		\$1,350		Total Appraised Value		\$9,000.00		Total Bid Value		
PULP, BOLTS, POLES BREAKDOWN			PRICE (Using PGF)			Acres			12 acres.	
Species	% Bolts	% Poles	Pulp	Bolts	Poles	Sec	C. Type	Pres. Code	Acres D/S	P/U P
Aspen	20%		\$21.00	\$36.00		14	Asp-05	1113	13/12	UP
						14			09	SES
						14			09	NWSE
						14			09	SWSE
										11
										55
										34
<b>Price Adjustment Factor and Additional Remarks:</b>										
Bid Type: 2										
Soil Type(s): Sandy over Clay										
State Appraiser Signature				ID #	Date					
				0305	12/31/99					
Program Forester Approval					Date					

## Appendix C—Sample Sale Advertisement

INTERMEDIATE AUCTION - SALE # 1 - November 22, 2002 .

TRACT 11 COUNTY: KOOCHICHING AREA: LITTLEFORK  
 ACRES: 12

Permit # X2558

SESW, NWSE, SWSE of Sec. 14, Twp. 069, Rge. 24W

Species	Product	Pct Bolts	Volume	Unit	Appraised	
					Unit \$Price	\$Value
ASPEN	P/B	20	340.00	CDS	24.00	8160.00
					Total Value = \$8160.00	
					Advance Payment = \$1224.00	

WINTER ACCESS ONLY ON FROZEN GROUND - ACCESS ACROSS STATE LAND.  
 WINTER ACCESS TO PERMIT 1&3/4 MILES SO ON N GALVIN LINE FROM CTY  
 RD 97

WITHIN INCLUSION, CUT/REMOVE UP TO 50% OF THE MERCHANTABLE BASAL  
 AREA.

WITHIN SALE AREA, RETAIN 6-10 TREES/ACRE. 3 YR SALE. KEV  
 OLSON/INTL FL

BID TYPE 1 - TRACT 11. MUST BE BID WITH BID TYPE 1 - TRACT 12.  
 ASPEN INCLUDES 5% BALM OF GILEAD; AVG 6-7 STICKS / 10" DBH

TRACT 12 COUNTY: KOOCHICHING AREA: LITTLEFORK  
 ACRES: 12

Permit # X2559

SESW, NWSE, SWSE of Sec. 14, Twp. 069, Rge. 24W

Species	Product	Pct Bolts	Volume	Unit	Appraised	
					Unit \$Price	\$Value
ASPEN	P/B	20	375.00	CDS	24.00	9000.00
					Total Value = \$9000.00	
					Advance Payment = \$1350.00	

WINTER ACCESS ONLY ON FROZEN GROUND - ACCESS ACROSS STATE LAND  
 WINTER ACCESS TO PERMIT 1&3/4 MILE SO ON N GALVIN LINE FROM CTY RD  
 97

ON-SITE MEETING W/FOREST OFFICER MUST OCCUR PRIOR TO SALE ENTRY.  
 THREE (3) YEAR SALE. KEVIN OLSON / INTL FALLS

BID TYPE 2 - TRACT 12. MUST BE BID WITH BID TYPE 1 - TRACT 11.  
 ASPEN CONTAINS 5% BALM OF GILEAD; AVG 6-7 STICKS / 10" DBH

## Appendix D—Study Site Bidding Instructions



# Saint Louis County

Land Department • 320 West 2nd Street, Room 607, Gov't. Serv. Cntr. • Duluth, MN 55802  
Phone: (218) 726-2606 • Fax: (218) 726-2600

**David J. Epperly**  
Land Commissioner

## Forest Guidelines Study Sites Bidding Instructions

**Mark E. Reed**  
Deputy Land Commissioner

November 20, 2002

Dear Prospective Timber Purchaser,

The St. Louis County Land Department is participating in a study developed for the Minnesota Forest Resource Council to evaluate Site Level Forest Management Guideline implementation costs. As a part of this study, we are offering a select number of tracts that will be a part of this study.

**NOTICE:** There is an unusual bidding procedure for this sealed bid auction. Due to the nature of the study, tracts will be offered in pairs. Both tracts in a pair are the same forest stands (acreage and location), but are offered with different sale regulations. An eligible bid must provide a bid for each tract in a pair, a separate bid for each tract. Through a random selection process, only one tract in each pair will be sold. The highest bidder for that tract will be awarded the sale.

A \$300 bid bond, i.e. personal check, payable to the **St. Louis County Auditor** is required and must be included in the envelope provided for the bid form. One bid bond will cover all tract bids (including the Special Forest Guideline Study Site Tracts) and will be returned if the bids are not the successful bidder. For a successful bidder, the bid bond will be applied to the down payment on the first tract awarded.

Instructions for bidding on pairs of tracts:

- 1) Contact the Area Office as explained on the Notice of Sale and indicate which pair of tracts you are intending to bid.
- 2) The Area Office will mail you the appraisal sheets for each tract in which you expressed interest, as well as bid sheets and bid envelopes for each tract.
- 3) Complete the bid sheet for each tract you wish to bid on. **You must bid on both tracts in a pair for your bid to be accepted.**
- 4) Mail your bid sheets to the Land Commissioners Office in the provided bid envelopes by the closing date. **Each tract must have a separate bid envelope and a bid bond check must be included in one of the bids.** (Checks will be returned for losing bids.)

Please follow the above directions carefully if you intend to bid. If bids are received for only one tract in a pair, they will be returned. If a winning bidder does not submit a bid bond check for \$300, the next highest bidder will be awarded the sale.

Thank you for expressing an interest in bidding on tracts on this sale as a part of the Minnesota Forest Resource Council study of forest management guideline costs. If you have any questions regarding the sealed bid auction, please contact Mark Reed or Mark Weber at 218-726-2606.

Sincerely;

David Epperly

## Appendix E—Stumpage Price Bidding Questionnaire

Survey Identification Number: \_\_\_\_\_ (For mailing purposes only)

### Stumpage Price Bidding Survey

Last fall, you bid on timber tracts offered by the Minnesota Department of Natural Resources or St. Louis County Land Department that were part of a study conducted by the University of Minnesota. The purpose of the study was to assess the extent to which stumpage prices reflect any additional costs associated with Minnesota's timber harvesting and forest management guidelines. This information will help the state better understand the economic impacts associated with implementing the guidelines.

The questions below are intended to help us understand more about the firms who bid on the study tracts sold in November and December 2002, as well as what factors were considered in developing the bids for those tracts. While we have included an identification number on your survey to help us relate survey responses to previous bids on the study tracts, your responses will be kept completely confidential.

#### Information About Your Logging Business

1. How many years have you been in logging?  
\_\_\_\_\_ Years
2. What was your approximate volume produced during 2002?  
\_\_\_\_\_ Cords  
\_\_\_\_\_ Thousand board feet  
\_\_\_\_\_ Tons
3. Does your logging business maintain separate financial records (e.g., information on harvesting costs) for each individual tract you harvest?  
\_\_\_\_\_ Yes  
\_\_\_\_\_ No

#### Information about How You Developed Your Bids for the Study Tracts

4. Which of the following sources did you use to help you develop your paired bids on timber tracts used in the study? (Please check all the sources you used.)  
\_\_\_\_\_ Business records on logging production costs  
\_\_\_\_\_ Asked the forester who set up the sale for ideas on how to bid  
\_\_\_\_\_ Asked other loggers about how they were going to bid  
\_\_\_\_\_ Read or heard about studies that reported the impact of guidelines on logging costs  
\_\_\_\_\_ Didn't consult any special sources to develop my paired bids  
\_\_\_\_\_ Other: \_\_\_\_\_
5. Did you or someone else from your logging business personally visit a tract prior to submitting a set of paired bids for that tract?  
\_\_\_\_\_ Yes  
\_\_\_\_\_ No
6. Did you know how many other bids had been submitted on the tract(s) when your paired bids were submitted?  
\_\_\_\_\_ Yes  
\_\_\_\_\_ No

7. To what extent did the following influence the bids you submitted on the study tracts?

<u>Factors NOT Related to Guidelines</u>	-----Degree of Influence on Bid-----			
	<u>Substantial</u>	<u>Moderate</u>	<u>Minimal</u>	<u>None</u>
Size of tract (acres)	4	3	2	1
Estimated sale volume of tract	4	3	2	1
Specific site characteristics of tract	4	3	2	1
Total appraised value of tract	4	3	2	1
Species composition	4	3	2	1
Person who appraised timber	4	3	2	1
Proximity to other purchased tracts	4	3	2	1
Low inventory of purchased tracts	4	3	2	1
 <u>Factors DIRECTLY Related to Guidelines</u>				
Selective harvesting within inclusion boundary	4	3	2	1
Retaining leave trees (patches or individual trees)	4	3	2	1
Planning/placement of road/skid trails	4	3	2	1
Planning/placement of landings	4	3	2	1
Managing logging slash	4	3	2	1
Retaining snags (dead trees)	4	3	2	1

8. For each bidding scenario below, indicate who you think bears the costs of implementing guidelines.

A. Paired bids have little or no difference in value (i.e., the same price is bid for the stumpage regardless of whether guidelines were required).

- Logger  
 Landowner  
 Both logger and landowner

B. Paired bids have large difference in value (i.e., bids for stumpage when guidelines are required is significantly lower than the bid when guidelines were not required).

- Logger  
 Landowner  
 Both logger and landowner

9. Please provide any additional comments about your participation in bidding on these tracts.

**\*\*\*Please return your completed survey in the self-addressed, stamped envelope by April 21st \*\*\***

Yes, I would like to receive a copy of the study results.