Minnesota Department of Natural Resources
500 Lafayette Road · Saint Paul, Minnesota · 55155-4037
Office of the Commissioner
651-259-5555

January 20, 2010

The Honorable Bill G. Ingebrigtsen, Chair
Senate Environment and Natural Resources Committee
Capitol Building, Room 303
St. Paul, MN 55155-1606

The Honorable Denny McNamara, Chair
House Environment, Energy, and Natural Resources Policy and Finance Committee
375 State Office Building
St. Paul, MN 55155

Subject: Report on Appraised Value Timber Sales

In accordance with Minnesota 2009 Session Law, Chapter 176, Article 5, Section 1c, attached is a report the provides a comparative evaluation of the efficiency and effectiveness of state timber sales scaling methods.

Please contact Dave Epperly, Director, Division of Forestry, (651) 259-5289 with questions and comments relevant to this report.

Sincerely,

Tom Landwehr
Commissioner

cc: Dave Schad, DNR Deputy Commissioner
Laurie Martinson, DNR Assistant Commissioner
Bob Meier, DNR Assistant Commissioner
Denise Anderson, DNR Chief Financial Officer
Dan Mueller, Senate Fiscal Analyst
Jim Reinholdz, House Fiscal Analyst
Legislative Library (2 copies)

Optimal State Timber Sales Scaling Methods

Report to the House and Senate Natural Resources Policy and Finance Committees and Divisions
January 19, 2011

Prepared by:
Donald L. Deckard, Ph.D.
State Forest Economist
DNR – Division of Forestry

Gaylord P. Paulson
Timber Sales Program Coordinator
DNR – Division of Forestry

George W. Deegan
Forest Mensurationist
DNR – Resource Assessment

The authors gratefully acknowledge the helpful comments of:
Michael A. Kilgore, Professor, University of Minnesota, Department of Forest Resources
Tim O'Hara, Vice President of Forest Policy, Minnesota Forest Industries

Legislative Compliance

This report was prepared to meet the legislative requirement of Minn. 2009 Session Law, Ch. 176, Article 5, Section 1c.; conduct an evaluation of appraised value timber sales and other state timber sales scaling methods, identify the most efficient and effective method or combination of methods that protect the fiduciary interest of the state, and report findings to house and senate natural resources policy and finance committees and divisions by January 15, 2011.

Minnesota 2009 Session Law, Chapter 176, Article 5 – Forest and Timber Management

Section 1. **APPRAISED VALUE TIMBER SALES; FISCAL YEARS 2010 AND 2011.**
(a) During fiscal years 2010 and 2011, the commissioner of natural resources shall increase the amount of timber products sold from state lands under permits based solely on the appraiser's estimate of the timber volume described in the permit, as provided in Minnesota Statutes, section 90.14, paragraph (c).
(b) The commissioner shall evaluate sales of timber under paragraph (a) and other methods used to sell cut forest products from state lands to identify the method, or combination of methods, that is most efficient and effective in protecting the fiduciary interest of the state, including the permanent school fund.
(c) By January 15, 2011, the commissioner shall report to the house and senate natural resources policy and finance committees and divisions on the findings of the evaluation process completed under paragraph (b).

Cost of Preparation

Pursuant to Minn. Stat. §3.197, the cost of preparing this report was:

Cost Category	Description	Amount
Central Office staff time	Project management, data compilation, data processing, analytics, writing and editing, and coordinating peer review	$4,800
Field staff time	Marginal cost of field staff time spent cruising SOAV time study sales	$8,500
Duplication Cost	$0.40 x 500 pages (25 color copies)	$200
	TOTAL TO PREPARE REPORT	$13,500

Contact: Don Deckard
Phone: (651) 259-5287
Email: donald.deckard@state.mn.us

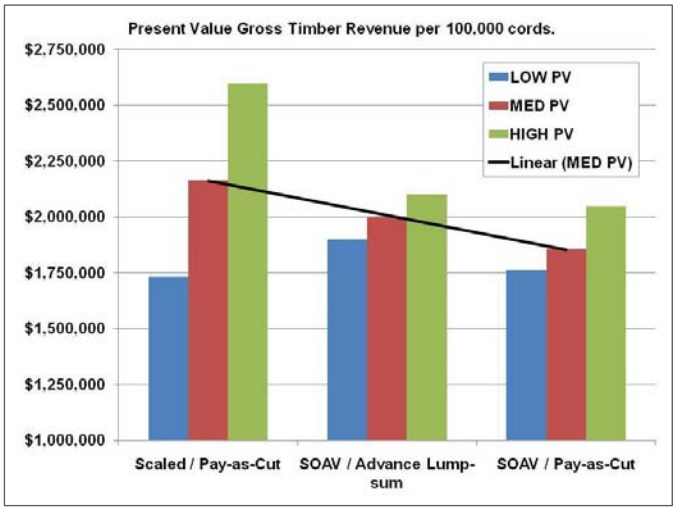
Executive Summary

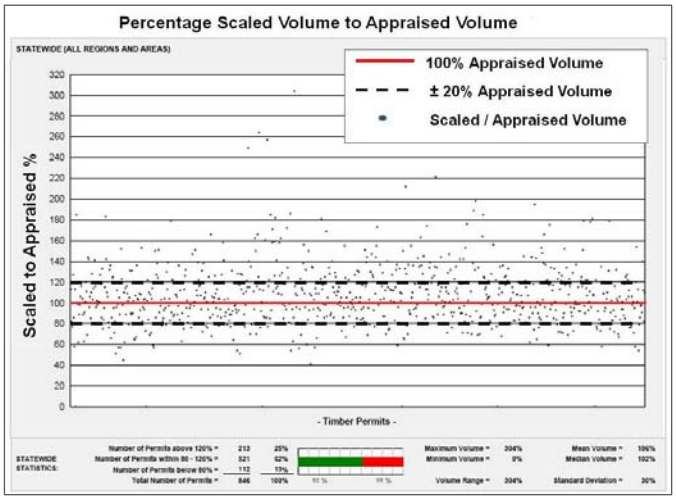
As per the legislative requirement of Minn. 2009 Session Law, Ch. 176, Article 5, Section 1a, the Department of Natural Resources (DNR) established an FY 2010 target of 20% timber sales offered sold-on-appraised-volume (SOAV). Of 1,037 sales offered, 214 were SOAV. As measured by the number of sales offered, the target was met with 20.6% of all sales offered SOAV. This was approximately double the FY09 SOAV number of sales and volume offered.

Summary recommendation: NO ARBITRARY INCREASE IN SOAV paid-as-cut. Allow DNR to continue to use the full range of timber sale, bid, scale, and payment options available, at the discretion of the Commissioner, in order to provide the most efficient and effective combination of methods to protect the fiduciary interests of the state.

- The median (MED) net present value (NPV) of scaled sales was estimated at $1.4 million per 100,000 cords, 1.5 times greater than the MED NPV of $0.9 million per 100,000 cords for sampled sales sold SOAV paid-as-cut.
- Purchaser's discount SOAV bids by at least 5%-15% compared to scaled sales to account for the financial risk of volume under-run, the result being 14% lower present value (PV) gross timber revenue than comparable pay-as-cut scaled sales.
- Total cost to the state for SOAV paid-as-cut was 20% greater than the total cost of scaled sales requiring 12 FTEs per 100,000 cords as compared to 10 FTEs per 100,000 cords.

The focus of this evaluation was on comparing the efficiency and effectiveness of SOAV sales sold pay-as-cut to scaled sales sold pay-as-cut. Key measures of scale methods efficiency and fiscal effectiveness were financial risk and cost efficiency.





Appraisal Accuracy – Regardless of appraisal method employed, all appraisals of standing timber volume are estimates as opposed to absolute values. In practice, foresters employ a sampling technique or mark and measure 100% of trees to establish tree counts and volume estimates. There are many variations of each basic approach. In all cases, actual volume removed rarely equals appraised volume. Of the 846 DNR administered scaled sales completed since July 1, 2009, 521 sales (62%) were within the established scaled sale standard of ±20% volume estimate error. Some 213 sales (25%) cut out greater than 120% of appraised volume (overrun) and 112 sales (13%) cut out less than 80% of appraised volume (under-run).

Financial Risk – Under the scaled sale system, neither the seller nor purchaser bears any direct volume risk because payment is based on the volume of cut products scaled. However, under the SOAV system, the seller bears the risk of volume overrun and the purchaser bears the risk of volume under-run. Holding all other things equal, an SOAV purchaser will most likely discount their auction bid price to adjust for the probability of a volume under-run. In addition to purchaser's risk adverse bidding behavior, the present value (PV) of the seller's gross timber revenue is impacted by timing of payment. Advance lump-sum payment provides immediate revenue and transfers some of the sale carrying costs to the purchaser.

The importance of meeting SOAV volume appraisal standards cannot be overstated because the appraised volume estimate is the basis for sale payment. When a seller's appraised volumes are deemed to be unreliable by purchasers, the marketing system breaks down because measurable risk becomes uncertainty. This creates an unacceptable situation for both seller and purchaser.

Cost Efficiency – The FY 2010 scaled sales population was the "baseline" for appraisal accuracy and total cost comparisons (n=702). The primary cost tradeoff was between time spent on timber volume appraisal (sample cruising) and time spent on scaling administration (matching and processing load tickets). As of December 1, 2010, the DNR time study was 25% complete with three (3) sales of twelve (12) harvested. Hence, reportable time study results were limited to timber cruising. Time data for other timber related work tasks was sourced from a previously conducted DNR survey. On average, SOAV cruise time was twice the scaled sale baseline at 1.4 hours per acre versus 0.72 hours per acre. Only 56% of SOAV study sales met the ±10% error standard. Analysis of the cruise data indicated cruise time and costs would need to increase by 2.5 to 3 times baseline in order to consistently meet the SOAV appraisal accuracy standard.

Volume appraisal (timber cruise) time requirements by sale and cruise type.

Item	Scale Type	Sales (n=)	Sample Cruise Type	Acres Appraised	Plot Count	Plots/ Acre	Cruise Hours	Cruise Hrs/Acre	% Sales Appraised to Stndrd
Baseline	SCALED	702	Ocular Est.	46000e	46000e	1.0	33177	0.72	62%
Control	SCALED	3	Measured	70	93	1.3	60.5	0.86	100%
Treatment	SOAV	9	Measured	320	640	2.0	443.5	1.40	56%

Baseline - All DNR scaled sales cruised by ocular estimate closed from July 1, 2009 to June 30, 2010.
Control - Scaled sales identified prior to appraisal to cruise at ≥1 plot per acre intensity with trees measured.
Treatment - SOAV sales identified prior to appraisal to cruise at ≥2 plots per acre intensity with all trees measured.

Staffing & Budget – Given a fixed timber offer target of 800,000 cords per year with a baseline 80 FTEs required, a shift to 100% SOAV would require an additional 28 FTEs (total 108 FTEs) during the 3-year transition period required to complete existing scaled sales, then level off at about 96 FTEs or 16 FTEs greater than scaled sales require for the same volume offered.

Comparative annual DoF timber program workload distribution.

Work Task	90% Scaled Ocular Est. ±40% Accuracy Expense (%) (BASELINE)	Net FTEs (BASELINE)	90% Scaled Measured ±20% Accuracy Expense (%)	Net Change FTEs from BASELINE	100% SOAV Measured ±10% Accuracy Expense (%)	Net Change FTEs from BASELINE
Appraisal / Cruising	**20%**	**16**	**25%**	**+4**	**55%**	**+28**
Sale Layout	30%	24	30%	0	30%	0
Sale Admin	25%	20	25%	0	25% / 20%	0 / **-4**
Scaling Admin	15%	12	15%	0	15% / 5%	0 / **-8**
CO Supv.	10%	8	10%	0	10%	0
Column Sum	**100%(a)**	**80**	**105%**	**+4**	**135% / 120%**	**+28 / +16**

(a)Based on 80 timber FTEs with target offer volume = 800,000 cords.

Table of Contents

List of Tables and Figures

1. Introduction

1.1 Background

Minn. Stat. Chapter 90, the State Timber Act, is the primary statue governing the Minnesota Department of Natural Resources (DNR) Timber Sales and Scaling Program, administered by the Division of Forestry (DoF). Under this statute, DoF is delegated by the Commissioner of the DNR to:

- manage the sale of forest products on all forest lands under Departmental control, and
- administer and supervise the sale of timber on non-DNR state lands.

DNR plays a prominent role in the state's timber economy. Since FY 2008, timber volume harvested from state managed land has averaged 784,500 cords per year, a 26 percent market share of annual statewide all-ownership harvest volume.[1] In FY 2010, DNR sold 857 sales totaling 767,700 cords including biomass and harvested 794,700 cords including biomass with timber receipts of $18.9 million (Table 1).

Table 1. Summary DNR timber sales statistics.

Fiscal Year	Number Sales	Volume Sold (cords)	Volume Harvested (cords)	Timber Receipts
2010	857	767,700	794,700	$18.9 million
2009	940	956,600	744,000	$19.6 million
2008	1,182	1,143,500	814,700	$25.3 million

Volumes sold and harvested include optional biomass and added timber as of June 30 end of fiscal year.

1.2 Appraised Value Timber Sales Offered

Scaled sales, the primary method used by DNR for determining payment for timber sold and harvested, have been questioned as to relative efficiency and effectiveness in protecting the state's interests. This report presents an evaluation of state timber sales scaling methods and alternatives with emphasis on comparing scaled sales to sales sold SOAV. A critical concept underlying the comparison is appraised volume accuracy.

As directed by the legislative requirement of Minn. 2009 Session Law, Ch. 176, Article 5, Section 1a, DNR established an FY 2010 target of 20% timber sales offered sold-on-appraised-value (SOAV). The FY10 SOAV target was two times FY09 actual. Of 1,037 sales offered, 214 were SOAV. As measured by number of sales offered, the SOAV target was met with 20.6% of all sales offered SOAV. Some 13% of all sales volume was offered SOAV with 9% of all sales volume sold SOAV (Table 2). This was approximately double FY 2009 number of sales and volume offered SOAV.

[1] DNR estimates derived from 2008 USFS FIA commercial timber land acreage by ownership data and DNR compiled statewide all-ownership harvest estimates for 2008, 2009, and 2010.

Table 2. FY 2010 DNR SOAV offers by forestry area.

	Percent Volume Offered as SOAV			Percent of Sales Offered as SOAV			
Area / Region	**Total Volume Offered**	**SOAV Volume Offered**	**Percent SOAV by Volume**	**Regular Auctions**	**Intermediate Auctions**	**Informal Sales**	**Overall SOAV Percent**
Bemidji	22,707	2,364	10%	17%	15%	57%	22%
Blackduck	50,700	3,041	6%	0%	17%	75%	16%
Warroad	64,292	3,795	6%	10%	8%	69%	26%
Baudette	105,542	4,465	4%	0%	4%	83%	15%
Brainerd	47,807	9,870	21%	15%	27%	38%	25%
Park Rapids	67,823	2,237	3%	19%	3%	67%	14%
Detroit Lakes	5,896	751	13%	0%	8%	100%	31%
TOTAL NW Region	**364,767**	**26,523**	**7%**	**10%**	**11%**	**69%**	**20%**
Deer River	56,478	8,779	16%	18%	17%	14%	17%
Aitkin	83,414	15,718	19%	6%	35%	0%	27%
Hibbing	52,494	9,660	18%	13%	24%	21%	20%
Orr	49,269	3,945	8%	12%	6%	0%	8%
Tower	50,916	1,503	3%	4%	4%	0%	3%
Cloquet	19,086	3,659	19%	8%	0%	14%	7%
Two Harbors	50,112	7,171	14%	12%	11%	8%	11%
Littlefork	74,180	11,096	15%	11%	0%	20%	7%
TOTAL NE	**435,949**	**61,531**	**14%**	**11%**	**17%**	**12%**	**14%**
Little Falls	19,629	7,232	37%	42%	36%	100%	50%
Lake City	2,981	1,621	54%	50%	0%	71%	59%
Rochester	3,592	3,499	97%	93%	0%	100%	94%
Sandstone	57,803	9,641	17%	59%	0%	100%	40%
Cambridge	5,305	3,935	74%	60%	0%	0%	60%
TOTAL CR	**89,310**	**25,928**	**29%**	**63%**	**18%**	**87%**	**56%**
STATEWIDE	**890,026**	**113,982**	**13%**	**20%**	**14%**	**44%**	**21%**

Compiled by Gaylord Paulson, November 2010. Volume in cord equivalents includes optional biomass and added timber.

1.3 Sale, Bid, Scale, and Payment Methods

To achieve program goals and meet statutory requirements, DNR sells wood using selected combinations of the following methods:

Sale Type

- Informal – non-bid over-the-counter with maximum 500 cords.
- Intermediate Auction – limited to qualified small firm bidders (≤ 30 employees) with maximum sale volume of 3,000 cords.
- Regular Auction – open to all qualified bidders with maximum volume of 6,000 cords; volume limit can be exceeded with special permissions.

Bid Type

- No Bid - over-the-counter, purchaser pays appraised price.
- Ascending Oral Auction – bidders may make multiple ascending bids starting at or above the established reserve price.
- First-Price Sealed Bid – qualified bidders submit a single written bid at or above the established reserve price.

Scale Type

- Consumer – payment is based on volume delivered to and scaled by wood using facilities under formal consumer scaling agreements
- Sold on Appraised Volume (SOAV) – payment is based on appraiser's volume estimate; also referred to as sold-on-area-estimate.
- State Scaled – payment based on physical measurement by state scaler; application is for cut products going to wood using facilities without an approved state scaling agreement.
- Standing Timber - payment based on appraised volume by a state appraiser; typically used for partially completed or uncut permits.

Payment Type

- Advance Lump Sum – 100% of appraised value of sale is paid at time of purchase; application limited by statute to informal sales and required by policy.
- Pay-as-Cut – DNR requires 15% down payment at time of purchase with acceptable form of security equal to 100% appraised value prior to start of harvest operations; final payment or refund made after all wood is cut and scaled.

The primary combination of sale and scale methods utilized by DNR is auction/scaled. In FY 2010, some 97% of sales were offered at auction and 91% of wood harvested was scaled. The detailed breakdown of sale, bid, scale, and payment type combinations was as follows (Table 3):

Table 3. Summary of DNR sale, bid, scale, and payment types.

Sale Type	Number of Sales	Vol. Sold (M cords)	Bid Type	Scale Type (% by # Sales)	Payment Type (% by Volume)
Informal	155	24.9	No Bid	44% SOAV 56% Scaled	44% Advance Lump Sum 56% Pay-as-Cut
Intermediate Auction	437	329.0	75% Oral Bid 25% Sealed Bid	14% SOAV 86% Scaled	100% Pay-as-Cut
Regular Auction	265	413.8	75% Oral Bid 25% Sealed Bid	20% SOAV 79% Scaled	100% Pay-as-Cut
Sale Totals	857	767.7			

Derived from: Paulson, Gaylord. Division of Forestry Timber Sales Program Performance Report, FY2010 through June 30, 2010 and related documents.

The primary combination of sale/scale methods utilized by DNR is auction/scaled. In FY 2010, some 97% of sales were offered at auction and 91% of wood harvested was scaled. Of a total 794,751 cord equivalents harvested, 83% was consumer scaled, 8% was state scaled, and 9% was SOAV.

1.4 Evaluation Metrics

Key measures of sale/scale methods efficiency and fiscal effectiveness were financial risk and cost efficiency. These measures are driven by and inseparable from appraisal accuracy standards, staffing requirements, and budget issues.

1.4.1 Appraisal Accuracy

Regardless of appraisal method employed, all appraisals of standing timber volume and value are estimates as opposed to absolute values. In practice, foresters either employ a sampling technique or mark and measure 100% of trees to be harvested in order to estimate sale volumes and values. There are many variations of each basic approach. In all cases, actual volume removed rarely equals appraised volume.

Appraisal accuracy is a function of the inherent stand variability, volume estimation technique used, sampling intensity, and sample measurement precision. In general, increasing volume appraisal accuracy requires increasing sampling intensity and measurement precision which in turn equates to more staff time spent conducting volume appraisals.

Volume appraisal methods utilized by DNR include:

1. Variable radius or fixed radius sample plots with ocular estimates for diameter and height; a few trees are measured to check the precision of ocular estimates. Depending on stand variability and cruise intensity, expected error is ±15% to ±40%.
2. Variable radius or fixed radius sample plots with all trees measured to the nearest 1/10 inch and at least one tree per plot measured for merchantable height. Depending on stand variability and cruise intensity, expected error is ±5% to ±20%.
3. 100% marked; each individual tree to be sold is measured and marked with paint; tree volumes are estimated using standard yield tables. Expected error is ±2% to ±5%.

Current DNR statistical standards for volume appraisals by scale method are as follows:[2]

- Scaled standard is **±**20%, Confidence Interval = 80%
- SOAV standard is **±**10%, Confidence Interval = 80%

1.4.2 Financial Risk

In the context of selling and purchasing timber, financial risk with respect to volume is the statistical probability of a sale volume under-run or overrun where an under-run means actual volume removed is less than the appraised estimate and overrun means the actual volume and value removed is greater than the appraised estimate. This risk is only incurred when selling and purchasing wood SOAV.

In a mail survey conducted by University of Minnesota, Department of Forest Resources as part of an assessment of Lake States timber sale policies, loggers and DNR foresters were asked to provide their perspective about the use of consumer scale and SOAV methods for paying for purchased stumpage. Loggers were asked to evaluate how consumer scaling affects bid preparation time, financial risk, and bidding competition. More than three-fourths of the responding loggers felt SOAV methods require more bid preparation time than stumpage sold on

[2] Source: Minnesota DNR. 2007. Timber Sales and Scaling Manual.

a consumer scale basis. Some 72% of loggers indicated SOAV methods pose greater financial risk to them as compared to stumpage sold on consumer scale.[3]

A related financial risk not directly tied to appraised volume is unit value or unit price risk. Market prices for specific species and products fluctuate over time. Given that DNR sells the vast majority of its wood on 3 year permits, the probability that market values will change over a permit cycle is high. Unit value risk is not a function of scale method and not addressed in the report.

1.4.3 Cost Efficiency

For this analysis, cost efficiency was defined as full-time-equivalent (FTE) hours per volume unit sold scaled and total FTE hours per volume unit SOAV. A small sample time study was developed to evaluate the primary tradeoff of cruise time versus time spent on scaling administration.

1.4.4 Staffing & Budget

The DNR timber program incurred budget cuts and staffing reductions in FY 2008, FY 2009, and FY 2010 with more expected going forward. In FY 2008, there were 101 FTEs charged to timber (activity code 3210). In FY 2010, timber FTEs declined to 92. Based on current information, including state offered retirement buyouts effective December 21, 2010, the FY 2011 estimate is about 80 timber FTEs. The potential impacts of budget cuts and associated staffing reductions were evaluated on the basis of total capacity to offer timber sales and average volume offered per timber program FTE.

[3] Brown, Ross, M. Kilgore, C. Blinn, J. Coggins, and C. Pfender. 2010. Assessing State Timber Sale Policies, Programs and Stumpage Price Drivers. Staff Paper #209. St. Paul, MN: University of Minnesota, Department of Forest Resources. DNR and loggers refer to Minnesota, Michigan, and Wisconsin region in context of this policy assessment survey.

2. Data and Methods

2.1 State Timber Sales Information

DNR's timber sales database was used as the primary source of "baseline" timber sales information. The baseline was defined as all scaled sales closed in FY 2010. Standard analytic techniques and statistical analyses were utilized.

2.2 DNR SOAV Time Study

To supplement "baseline" timber sales information, a time study was developed to provide detailed cost information for timber program staff payroll hours charged by work task. Initially, the study was designed to track timber staff hours spent from sale appraisal through final closing. Conceptually, the study used a Latin Square approach with 1 control and 3 treatments. Four potential sales with similar physical characteristics were identified in each Forestry Administrative Region. Region 1 sales were jack pine regeneration harvests, Region 2 sales were aspen regeneration harvests, and Region 3 sales were mixed hardwoods regeneration harvests. The control sales were scaled and the treatments were SOAV. For the SOAV time study, timber program payroll time coding was divided into the following work task categories and assigned unique project codes:

1. Cruising
On-site cruise and travel time
Gathering and recording field plot data
Individual tree cruising/marking
Data file preparation and sale volume estimate

2. Check Cruise
On-site cruise and travel time
Gathering and recording plot data
Preliminary data file preparation and formatting

3. Other Appraisal and Layout Work
Boundary marking/GPS work
Prescription worksheet
Ecological Classification System (ECS) Inventory
Assessing cultural, riparian, insect & disease, leave trees, etc.
Creating TSM cutting blocks and appraisals
Other in field or office work done prior to offering sale

4. Sale Supervision
On-site review of operations
All drive time to and from sale
Communications with operators and permit holders
Administering alternate landings
Assessing liquidated damages or penalties
Selling added timber
Lock box installation
Does NOT include collecting scale tickets

5. Scaling Administration
Collection of scale tickets
Scale ticket reconciliation
Scale approvals in TSM
TSM data entry

6. Other Sale Administration Tasks
Notice of sale, permit approvals, surveillance, invoicing, scaling extensions, closing sale

As per internal decision, sample size was limited to 12 sales due to: (i) no legislatively appropriated funding, (ii) the anticipated marginal costs of cruising to SOAV standards, and (iii) existing field staff shortages in many forestry administrative areas. Preliminary estimates of the number of cruise plots needed to meet appraisal standards for each sale type were made based on historical information. As implemented, timber cruise intensity averaged 1.3 measured plots per acre for scaled sales and 2.0 measured plots per acre for SOAV sales (Table 4).

Table 4. DNR SOAV time study sales summary.

NW REGION 1			Sale			Acres	Plot
Permit #	Area#	Area_Name	Type	Sold Date	FIM Stand #(s)	Appraised	Count
X012228	121	Warroad	SCALED	6/7/2010	t16037w1040700	13.0	31
X012076	111	Bemidji	SOAV	3/25/2010	t14334w1080046	21.4	50
X012106	131	Baudette	SOAV	6/7/2010	t15935w1070276	46.0	99
B011178	142	Backus/Brainerd	SOAV	5/18/2010	t13632w1310069	19.0	76
"same"					t13632w1310070	6.0	included

NE REGION 2			Sale			Acres	Plot
Permit #	Area#		Type		FIM Stand #(s)	Appraised	Count
X012101	234	Hibbing	SCALED	3/30/2010	t06322w1360382	25.2	30
X012099	221	Deer River	SOAV	3/30/2010	t06226w1100041	51.0	92
"same"					t06226w1100043	4.0	included
X012090	232/244	Aitkin/Sandstone	SOAV	3/30/2010	t04522w1290089	20.0	50
B011170	241	Orr	SOAV	3/30/2010	t06722w1330500	21.0	52

CR REGION 3			Sale			Acres	Plot
Permit #	Area#		Type		FIM Stand #(s)	Appraised	Count
X012289	244	Sandstone	SCALED	6/9/2010	t04516w1060028	33.3	32
B011357	312	Little Falls	SOAV	9/23/20110	t04126w1010009	35.0	71
B011210	244	Sandstone	SOAV	6/9/2010	t04516w1210679	38.5	60
B011202	244	Sandstone	SOAV	6/9/2010	t04020w1240063	45.8	90

Table Notes:
FIM is DNR's forest inventory database containing over 200,000 forest stands, each with a unique identification number.

2.3 Staffing & Budget

Staffing and budget information was secured from a variety of internal sources. Standard analytic techniques were applied.

3. Findings

3.1 Appraisal Accuracy

In practice, DNR foresters utilize a sampling method to appraise the volume of almost all scaled sales. The appraisal accuracy of scaled sales is monitored by comparing actual volume harvested and scaled to the appraisal volume estimate. For FY 2010 and the first 5 months of FY 2011, a total of 846 scaled sale timber permits were completed. Of the 846 completed scaled sales, 521 sales (62%) were within the established scaled sale standard of ±20% volume estimate error (Figure 1). Some 213 sales (25%) cut out greater than 120% of appraised volume (overrun) and 112 sales (13% cut out less than 80% of appraised volume (under-run). Overall, the weighted average ratio of scaled volume to appraised volume was 106% (overrun) and the median overrun was 102%. Of note, the vast majority of sales were sample cruised using ocular estimates of diameter and height.

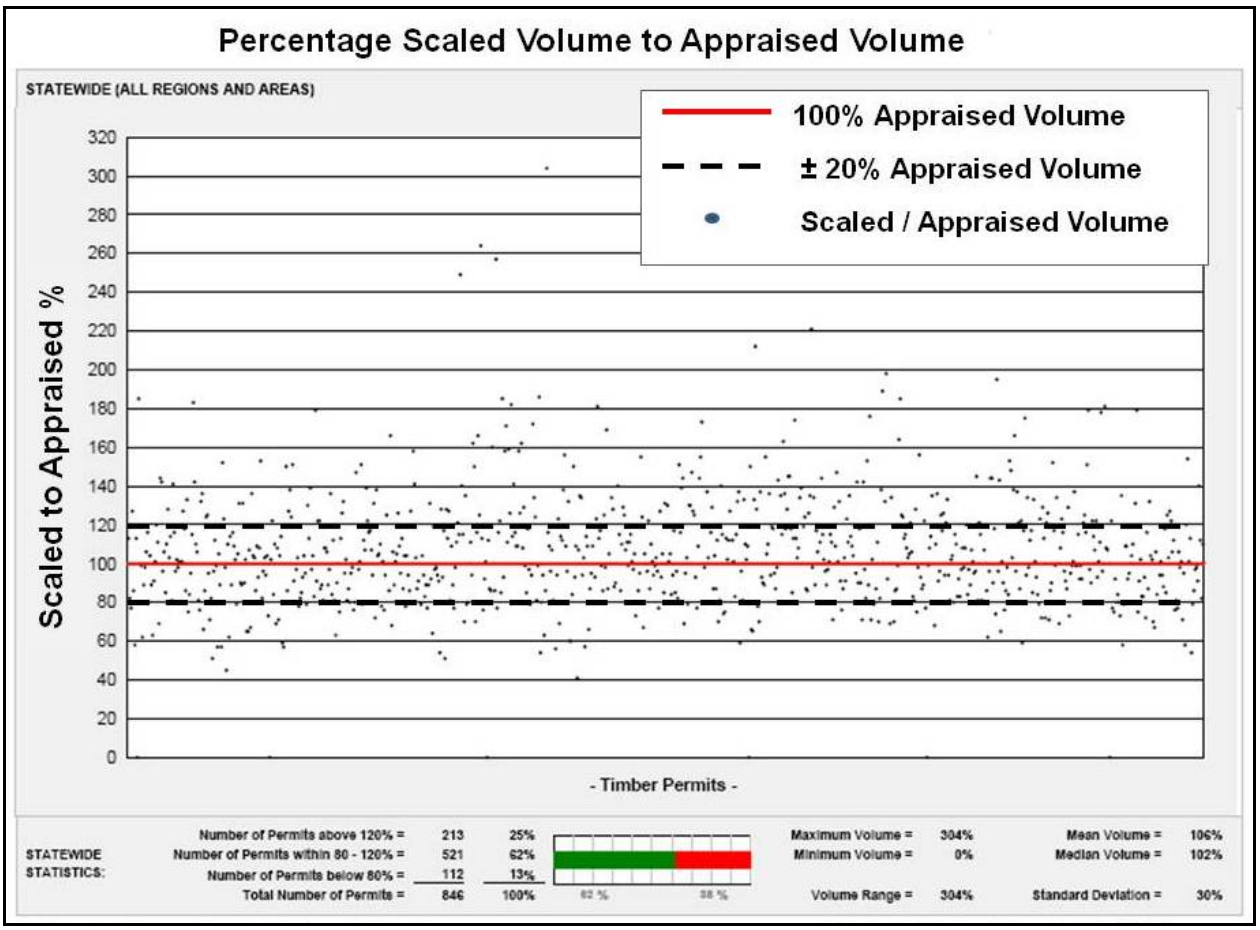


Figure 1. Scaled volume to appraised volume statistics for DNR timber permits closed July 1, 2009 through November 30, 2010.

Of the 846 completed scaled sales, 521 sales (62%) were within the established scaled sale standard of ± 20% volume estimate error. Some 213 sales (25%) cut out greater than 120% of appraised volume (overrun) and 112 sales (13% cut out less than 80% of appraised volume (under-run).

While comparison of scaled volume to the appraisal volume estimate is routinely used by DNR as a measure of appraised volume accuracy, it is an imperfect measure because the appraisal is completed at a fixed point-in-time that lags actual harvest by an average 36 months. Timber stand dynamics dictate that volumes change over time, either increasing or decreasing. The expectation is that harvest volumes will vary from appraised volumes to some degree regardless of the statistical accuracy of the appraisal volume estimate.

As an alternative measure of appraised volume accuracy, statistical measures were estimated for a sample of SOAV and scaled sales identified for the time study. For the SOAV time study sales, the Confidence Interval (C.I.) was increased from [C.I. = 80%] to [C.I. = 90%] to align more closely with generally accepted practices. Sampling intensity for SOAV volume appraisals averaged 2.0 measured plots per sale acre while sampling intensity for scaled sale volume appraisals averaged 1.3 measured plots per sale acre (Table 5).

Table 5. Summary statistics for SOAV time study sales.

SOAV SALES									
Area	241	142	221	232	131	111	312	244	244
Permit #	B011170	B011178	X012099	X012090	X012106	X012076	B011357	B011210	B011202
Acres	21	38	55	20	46	20	35	38.5	46
# Plots	52	76	92	50	99	50	71	60	90
Mean Cds/Acre	37.4	21.4	19.3	32.8	33.4	14.7	30.4	27.81	28.41
Std. Dev.	21.47	11.44	13.55	13.5	10.9	11.84	15.14	9.07	14.85
S.E.	2.98	1.31	1.41	1.91	1.09	1.675	1.81	1.17	1.57
T-Value	1.68	1.67	1.66	1.3	1.67	1.68	1.68	1.67	1.66
Error @ 90% C.I.	5.0	2.2	2.35	2.48	1.82	2.81	3.04	1.96	2.61
% Error @ 90% C.I.	**13.40%**	**10.25%**	**12.20%**	**7.60%**	**5.40%**	**19.20%**	**10.04%**	**7.03%**	**9.18%**
Est. Plots Required for 90% CI, 10% A.E.	93	80	137	8	30	184	71	30	75
CV	57.40%	53.55%	70.30%	41.10%	32.60%	80.70%	49.80%	32.60%	52.30%
Additional Plots Required	41	4	45	0	0	134	0	0	0

SCALED SALES			
Area	234	244	121
Permit Number	X012101	X012289	X012228
Acres	25	33	12
# Plots	30	32	31
BAF	20	10	10
Mean Cds/Acre	19.8	29.97	23.3
Std. Dev.	8.3	11.00	13.9
S.E.	1.52	1.42	2.5
T Value	1.7	1.31	1.31
Error @ 80% C.I.	2.59	1.86	3.28
% Error @ 80% C.I.	**13.03%**	**6.21%**	**14.06%**
Est. Plots Required for 80% CI, 20% A.E.	25	8	16
CV	42%	36.70%	59.60%
Additional Plots Required	0	0	0

Empirical evidence clearly indicated sampling intensity would need to be in the 2.5 to 3 plots per acre range and precision (measured trees as opposed to ocular estimates) would need to be increased for sample cruised SOAV sales to consistently meet appraisal accuracy standards.

The ±10% [C.I. = 90%] appraisal accuracy standard was met for five (5) of the nine (9) or 56% of the SOAV sales. The ±20% [C.I. = 80%] appraisal accuracy standard was met for all three (3) or 100% of the scaled sales. Empirical evidence suggests sampling intensity would need to be in the 2.5 to 3 plots per acre range and precision (measured trees as opposed to ocular estimates) would need to be increased for sample cruised SOAV sales to consistently meet ±10% appraisal accuracy standards.

3.2 Financial Risk

Under the scaled sale system, neither the seller nor purchaser bears any direct volume risk because payment is based on the volume of cut products scaled. However, under the SOAV system, the seller bears the risk of volume overrun and the purchaser bears the risk of volume under-run. Even though, the seller is obligated to ensure appraisal volume estimates are within acceptable standards, the SOAV purchaser will most likely discount the auction bid price to adjust for the perceived probability of a volume under-run (Figure 2).

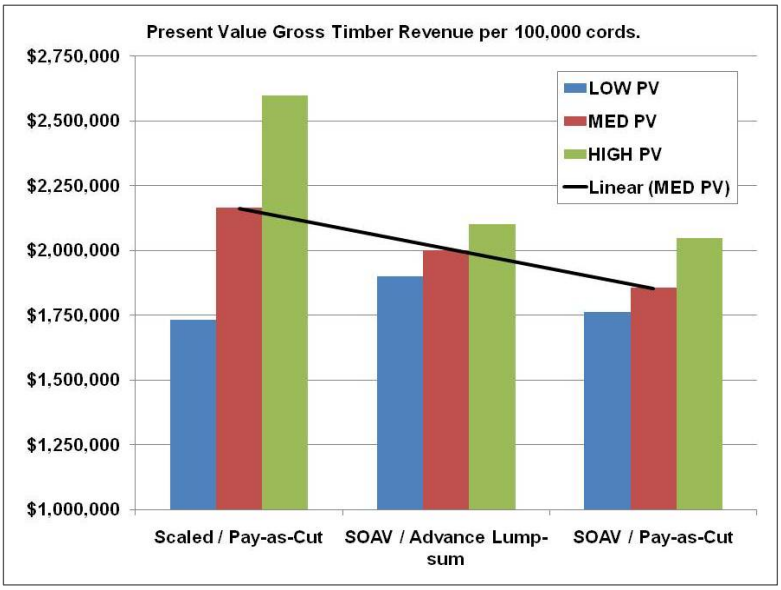


Figure 2. Expected present value of seller's gross timber revenue by scale and payment method.

Expected PV revenue parameters and assumptions:
SOAV bids discounted by 5% to 15% compared to scaled bids
Average selling price scaled = $22 per cord
Average selling price SOAV = $20 per cord
Pay-as-cut sales 15% down payment with balance at time of harvest
SOAV appraisal standard met within ±10% error
Scaled appraisal standard met within ±20% error
Average volume/value growth = 2% per year
Average sale volume overrun = 6%
Average time from sale to harvest = 2.8 years
Interest rate paid on FMIA balance = 2% per year
Real discount rate (i) = 3%

In addition to risk adverse bidding behavior, the present value of the seller's gross timber revenue is impacted by timing of payment. Advance lump-sum payment provides for immediate use of revenue while payment by the pay-as-cut method delays realized revenue. Of note, DNR is limited by statute to using the advance lump-sum payment method for sales with an appraised volume ≤ 500 cords. By volume, only 2% of all DNR timber sales are sold using the advance lump-sum payment method.

Scaled sales paid-as-cut have the highest expected present value to the state because payment for actual volume scaled, including any volume greater than appraised (overrun), is guaranteed and there is no bid price hedging by the purchaser for the risk or uncertainty of volume under-run.

Scaled sales paid-as-cut have the highest expected present value to the state because payment for actual volume scaled, including any volume greater than appraised, is guaranteed and there is no bid price hedging by the purchaser for the risk of volume under-run. SOAV sales with advance

lump-sum payment have a higher present value for the seller than SOAV sales sold pay-as-cut because full payment is received at the time of sale rather than at some point in the future.

A qualifying condition to this finding is that SOAV appraisal standards are met at the specified confidence interval. If the seller's SOAV appraised volume estimates are deemed to be unreliable by prospective purchasers, the marketing system breaks down and revenue expectations become unpredictable. This creates an unacceptable situation for both seller and purchaser. For example, if SOAV appraisal standards were only met for only 56% of sales versus the standard 90% of sales, purchasers would most likely adjust their bidding behaviors using whatever means available including prior experience with individual appraiser's accuracy bias.

3.3 Cost Efficiency

Cost efficiency was evaluated by comparing the total cost of scaled sales paid-as-cut to the total cost of SOAV paid-as-cut. The primary tradeoff was between time spent on timber volume appraisal (cruising) and time spent on scaling administration (matching and processing load tickets). A combination of baseline timber sales data, time study data, and direct survey information was utilized to develop total sale cost estimates.

The FY 2010 scaled sales population was the "baseline" for appraisal accuracy and cost comparisons. As of December 1, 2010, the DNR time study was 25% complete with three (3) sales of twelve (12) harvested. Hence, reportable time study results were limited to timber cruising. Time data for other timber work tasks was sourced from a previously conducted DNR survey.[4] The FY10 baseline (n=702) scaled sales required 0.72 hours staff time per acre with appraisal standards met for 62% of the sales. Study control scaled sales (n=3), cruise intensity was 1.3 plots per acre and required 0.86 hours staff time per acre with appraisal standards met on 100% of the sales. Study SOAV cruise intensity was 2.0 plots per acre and required 1.4 hours staff time per appraised acre with appraisal standards met on 56% of the sales (Table 6). Results of the DNR time study were comparable to the results of a similar study done on USDA Forest Service timber sales where tree measurement (SOAV) sales were found to require about twice the cruise/mark/layout time as scaled sales (0.63 hours per thousand board foot (MBF) versus 0.30 hours per MBF).[5]

Table 6. Volume appraisal (timber cruise) time requirements by sale and cruise type.

Item	Scale Type	Sales (n=)	Cruise Type	Acres Appraised	Plot Count	Plots/ Acre	Cruise Hours	Cruise Hrs/Acre	% Sales Appraised to Stndrd
Baseline	SCALED	702	Ocular Est.	46000e	46000e	1.0	33177	0.72	62%
Control	SCALED	3	Measured	70	93	1.3	60.5	0.86	100%
Treatment	SOAV	9	Measured	320	640	2.0	443.5	1.40	56%

Table Notes:
Baseline - All DNR scaled sales cruised by ocular estimate closed from July 1, 2009 to June 30, 2010.
Control - Scaled sales identified prior to appraisal to cruise at ≥1 plot per acre intensity with trees measured.
Treatment - SOAV sales identified prior to appraisal to cruise at ≥2 plots per acre intensity with all trees measured.

[4] Deckard, Donald L. 2009. Survey of DNR Forestry Timber Program Staff Time by Task. St. Paul, MN: Minnesota DNR, Division of Forestry. Unpublished data.
[5] Rynearson, Gary C. et.al. 1997. A Nationwide Study Comparing Tree Measurement and Scaled Sale Methods for Selling United States Forest Service Timber. USFS Contract# 53-82FT-6-11. Eureka, CA: Natural Resources Management Corporation.

3.4 Staffing & Budget

A shift from 90% scaled sales to 100% sold-on-appraised-volume (SOAV) would require meeting the existing SOAV appraisal volume accuracy standard of ± 10% error as compared to the scaled sale standard of ± 20% error. To consistently meet the SOAV appraisal volume accuracy standards, average timber cruise intensity would most likely need to increase from an average 1 plot per acre to at least 2.5 plots per acre and shift from ocular estimate to measured sample. As a result, time spent cruising would increase from 20% of baseline timber program direct costs (16 FTEs) to an estimated 55% of baseline timber program direct costs (44 FTEs) (Table 7).

Given a fixed timber offer target of 800,000 cords per year with a baseline 80 FTEs required, a shift to 100% SOAV would require an additional 28 FTEs (total 108 FTEs) during the 3-year transition period required to complete existing scaled sales, then level off at about 96 FTEs or 16 FTEs greater than scaled sales require for the same volume offered. Staffing requirements for SOAV appraisal and cruising would increase by 28 FTEs as compared to the scaled sales baseline while scaling administration staff time would decrease by an estimated 8 FTEs and sale administration staff time would decrease by an estimated 4 FTEs as compared to the scaled sales baseline.

Table 7. Comparative annual DoF timber program workload distribution.

Work Task	90% Scaled Ocular Est. ±40% Accuracy Expense (%) (BASELINE)	Net FTEs (BASELINE)	90% Scaled Measured ±20% Accuracy Expense (%)	Net Change FTEs from BASELINE	100% SOAV Measured ±10% Accuracy Expense (%)	Net Change FTEs from BASELINE
Appraisal / Cruising	**20%**	**16**	**25%**	**+4**	**55%**	**+28**
Sale Layout	30%	24	30%	0	30%	0
Sale Admin	25%	20	25%	0	25% / 20%	0 / -4
Scaling Admin	15%	12	15%	0	15% / 5%	0 / -8
CO Supv.	10%	8	10%	0	10%	0
Column Sum	**100%(a)**	**80**	**105%**	**+4**	**135% / 120%**	**+28 / +16**

(a)Based on 80 timber FTEs with target offer volume = 800,000 cords.

Given a fixed timber offer target of 800,000 cords per year with a baseline 80 FTEs, a shift to 100% SOAV would require an additional 28 FTEs (total 108 FTEs) during the 3-year transition period required to complete existing scaled sales, then level off at about 96 FTEs in the long run or 16 FTEs greater than scaled sales require for the same volume offered.

The final consideration on timber program staffing is budget. Since, FY 2008 DNR has reduced the Forest Management Investment Account (FMIA) portion of the DoF operating budget from $16 million per year to $11 million per year. This cut was partially offset with a special General Fund appropriation of $2 million per year for FY 2010-11 only. Including the state's early retirement incentive package, effective December 21, 2010, DoF was down an estimated 70 FTEs as compared to FY 2008. The full impact on timber program staffing and ability to offer and properly administer timber sales was unknown at the time this report was prepared.

3.5 Discounted Cash Flow Analysis

Using revenue and expense information presented in this report, the net present value (NPV) of scaled sales was estimated at $1.4 million per 100,000 cords as compared to SOAV NPV of $0.9 million per 100,000 cords under current market conditions. The benefit cost ratio (BCR) for scaled sales was 2.8 versus 2.0 for SOAV (Table 8). While both scale methods produce positive net cash flows, the NPV of scaled sales paid-as-cut was estimated to be 1.5 times greater than the NPV of SOAV paid-as-cut.

Table 8. NPV SOAV versus scaled sales per 100,000 cords.

SOAV Pay-as-Cut				**SCALED Pay-as-Cut**			
Period	Expenses	Revenue	Cash Flow	Period	Expenses	Revenue	Cash Flow
0	-720000	300000	-420000	0	-440000	330000	-110000
1	0	0	0	1	0	0	0
2	0	0	0	2	0	0	0
3	-240000	1700000	1460000	3	-360000	2002000	1642000
NPV			$916,107	NPV			$1,392,663
BCR			2.0	BCR			2.8

Table Notes:

Scaled sale costs at $80,000 and 10,000 cords per FTE; 55% time to sell and 45% time to close.

SOAV costs at $80,000 and 8,330 cords per FTE; 75% time to sell and 25% time to close.

Scaled sale paid-as-cut average bid price = $22 per cord.

SOAV paid-as-cut average bid price = $20 per cord.

Scaled sale average overrun = 6%.

Both SOAV and scaled sales paid-as-cut down payment requirement = 15% of sell price.

NPV = Net Present Value.

BCR = Benefit Cost Ratio.

Real discount rate (i) =3%.

4. Discussion

The focus of this evaluation was on comparing the efficiency and effectiveness of SOAV sales sold pay-as-cut to scaled sales sold pay-as-cut. Empirical analysis provided conclusive evidence that scaled sales have an expected NPV 1.5 times greater than comparable SOAV sales appraised using a sampling method and sold paid-as-cut.

SOAV is appropriate in specialized situations when the appraisal accuracy standard can be met cost effectively. For example, when selling 100% marked grade hardwood sawtimber to consuming mills that pay logging contractors based on ungraded net scale, the benefits of selling SOAV generally outweigh the costs. Another example of using SOAV is its application to minor species in a mixed species sale when the species may be mixed on the same load. However, as compared to scaled sales, SOAV sales require additional controls such as check cruises and check scaling of a minimum 5% sales volume. From the seller's accounting perspective, advance lump-sum payment is preferable to pay-as-cut for SOAV as allowed by statute.

While only 62% of the completed scaled sale population met the appraisal standard of ±20% error, the state did receive full payment for all timber scaled. When selling pay-as-cut, the appraised volume estimate is primarily used for planning purposes and for establishing the amount of down payment required. Hence, acceptable appraisal error for scaled sales is somewhat subjective. Actual scaled sales accuracy, as measured by comparing scaled volume to appraised volume, was estimated to save DNR about 6 FTEs timber staff time as compared to more closely meeting the 80% standard.

Of concern was the fact that only five (5) of the (9) or 56% of SOAV study sales met the appraisal standard of ±10% error by statistical estimation. Considering SOAV, the importance of meeting volume appraisal standards cannot be overstated because the appraised volume estimate is the basis for sale payment. When the seller's appraised volumes are deemed unreliable by purchasers, the timber marketing system breaks down because statistically measurable risk becomes uncertainty. This is an unacceptable situation for both seller and purchaser. Findings illustrated the difficulties and costs of consistently meeting SOAV appraisal standards.

5. Conclusion

Overall, the current mix of DNR timber sales scaling methods appears to be near optimal in terms of generating revenue and minimizing appraisal and scaling related costs. Scaled sales provide the most accurate and fiscally prudent basis for payment as applied to the vast majority of DNR timber sales.

Summary recommendation: NO ARBRITRARY INCREASE IN SOAV paid-as-cut. Allow DNR to continue to use the full range of timber sale, bid, scale, and payment options available, at the discretion of the Commissioner, in order to provide the most efficient and effective combination of methods to protect the fiduciary interest of the state.