



Interior MARKET PRICING SYSTEM

Update – 2016

July 1, 2016

Timber Pricing
Branch

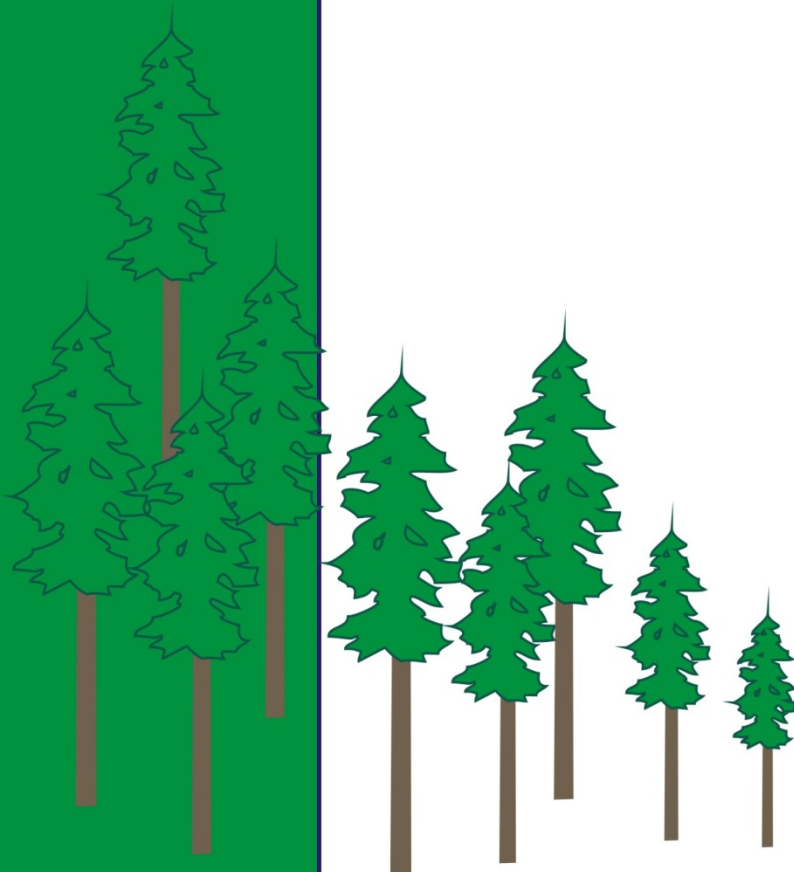


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1. INTRODUCTION

The purpose of this paper is to provide an overview of the July 1, 2016 update to the Interior Market Pricing System (MPS).¹

2. AUCTION DATASET

The new auction dataset used in the update contains winning bids and data from 1309 sales over the 5-year period January 1, 2011 through December 31, 2015.

3. EQUATIONS

The 2015 MPS equations were re-estimated with the new dataset to establish the benchmark equations, shown below. No other changes were made.

¹ This paper is not intended to provide the basis for calculating stumpage rates nor should it be used as guidance for interpreting the legal policies and procedures for calculating stumpage rates, which are contained in the *Interior Appraisal Manual*. The *Interior Appraisal Manual* contains the policies and procedures referred to in Section 105 of the *Forest Act*.

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Estimated Winning Bid Equation

² Variable	2015 Equation		¹ Benchmark Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	3.924738	16.12446	4.653433	16.70605
Constant	8.010398	4.075526	17.74652	6.876004
Real Stand Selling Price	0.199396	8.870234	0.132415	5.141023
Cedar Fraction * (1 - Cedar Decay Fraction) * (1 – Zone 6)	13.08726	2.924057	9.261253	2.116891
HemBal Fraction	-6.907073	-5.279347	-11.27379	-7.457253
Larch Fraction + Yellow Pine Fraction	-5.254702	-1.983534	-6.648019	-2.364712
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-4.767119	-2.284386	-7.687730	-5.021126
Cable Yarding	-13.69855	-11.02807	-12.74677	-9.438077
LN(Volume/1000)	0.871630	4.521861	1.067903	5.285261
Decay Fraction	-20.31622	-4.326746	-26.31378	-3.957303
Fire Damaged Fraction	-8.319698	-3.597722	-3.658605	-1.382393
LN (Volume per Tree)	3.776852	8.378435	5.502716	8.821263
Volume per Hectare	0.004971	2.067810	0.001233	0.387642
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.090347	-12.21274	-1.150033	-10.82000
Zone 9	-4.366803	-7.292188	-6.128170	-9.218769
Deciduous Fraction	-8.915075	-3.902107	-10.32497	-4.634769
Cruise Based * (1 – RG35)	-4.506163	-7.113684	-5.389680	-8.268355
Cruise Based * (RG35)	-5.223666	-11.97857	-5.757640	-10.45138
Decked Fraction	34.74072	2.728463	39.35795	2.855244
Ground Skid Slope Squared (15-50)	-0.004903	-3.233063	-0.006345	-3.255271
2011 Auctions	2.491357	6.544849	n/a	n/a
2012 Auctions	4.133419	8.733717	2.005517	4.256970
2013 Auctions	5.030823	7.571774	4.387721	6.166426
2014 Auctions	6.378405	7.630386	6.809103	7.487416
2015 Auctions	n/a	n/a	9.481595	11.50943
Grey Fraction	-0.868056	-4.950982	-1.198410	-6.782405
Adjusted R ²	0.762461		0.753602	

¹2015 Equation using Updated Auction Set

²LN means the natural logarithm

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Number of Bidders Equation

Variable	2015 Equation		¹ Benchmark Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.060408	23.85836	0.054071	26.54188
Constant	-0.636928	-9.172693	-0.518459	-7.854326
2011 Auctions	0.003211	0.078016	n/a	n/a
2012 Auctions	-0.172023	-4.188007	-0.161572	-4.103039
2013 Auctions	-0.412015	-9.496835	-0.368334	-9.479033
2014 Auctions	-0.563187	-12.76312	-0.548566	-13.76459
2015 Auctions	n/a	n/a	-0.627406	-15.34925
Cruise Based * (1 – (RG35))	0.355234	6.320825	0.389297	7.549009
Cruise Based * (RG35)	0.476321	12.52385	0.511616	14.48834
District Average Number of Bidders	0.168910	9.739657	0.142616	7.760964
Partial Cut Fraction	-1.135744	-3.370085	-0.621568	-1.655206
Slope	-0.006042	-4.942258	-0.003371	-2.978449
First and Second Quarter Auctions	0.099512	3.994412	0.049969	2.124318
Highway Haul	0.110019	3.043054	0.110756	3.395329
Adjusted R ²	0.515516		0.520020	

¹2015 Equation using Updated Auction Set

New variables were tested to see if they would improve the statistics, compared to the benchmark equations. Likewise, variables that were no longer significant were removed. The final data set contains 1309 auction sales.

The final equations, compared to the Benchmark Equations, are shown below.

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Estimated Winning Bid Equation

² Variable	¹ Benchmark Equation		2016 Final Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	4.653433	16.70605	6.032858	16.70605
Constant	17.74652	6.876004	23.00715	6.876004
Real Stand Selling Price	0.132415	5.141023	0.132415	5.141023
Cedar Fraction * (1 - Cedar Decay Fraction) * (1 – Zone 6)	9.261253	2.116891	12.00658	2.116891
HemBal Fraction	-11.27379	-7.457253	-14.61571	-7.457253
Larch Fraction + Yellow Pine Fraction	-6.648019	-2.364712	-8.618703	-2.364712
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-7.687730	-5.021126	-9.966618	-5.021126
Cable Yarding	-12.74677	-9.438077	-16.52532	-9.438077
LN(Volume/1000)	1.067903	5.285261	1.384464	5.285261
Decay Fraction	-26.31378	-3.957303	-34.11403	-3.957303
Fire Damaged Fraction	-3.658605	-1.382393	-4.743132	-1.382393
LN (Volume per Tree)	5.502716	8.821263	7.133896	8.821263
Volume per Hectare	0.001233	0.387642	0.001599	0.387642
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.150033	-10.82000	-1.490939	-10.82000
Zone 9	-6.128170	-9.218769	-7.944755	-9.218769
Deciduous Fraction	-10.32497	-4.634769	-13.38562	-4.634769
Cruise Based * (1 – RG35)	-5.389680	-8.268355	-6.987352	-8.268355
Cruise Based * (RG35)	-5.757640	-10.45138	-7.464388	-10.45138
Decked Fraction	39.35795	2.855244	51.02490	2.855244
Ground Skid Slope Squared (15-50)	-0.006345	-3.255271	-0.008225	-3.255271
2012 Auctions	2.005517	4.256970	2.600016	4.256970
2013 Auctions	4.387721	6.166426	5.688381	6.166426
2014 Auctions	6.809103	7.487416	8.827538	7.487416
2015 Auctions	9.481595	11.50943	12.29224	11.50943
Grey Fraction	-1.198410	-6.782405	-1.553657	-6.782405
Adjusted R ²	0.753602	0.753602		

¹2015 Equation using Updated Auction Set

²LN means the natural logarithm

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Number of Bidders Equation

Variable	¹ Benchmark Equation		2015 Final Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.054071	26.54188	0.041707	28.57105
Constant	-0.518459	-7.854326	-0.518459	-7.340789
2012 Auctions	-0.161572	-4.103039	-0.161572	-4.078646
2013 Auctions	-0.368334	-9.479033	-0.368334	-9.641104
2014 Auctions	-0.548566	-13.76459	-0.548566	-13.19020
2015 Auctions	-0.627406	-15.34925	-0.627406	-15.84774
Cruise Based * (1 – (RG35))	0.389297	7.549009	0.389297	7.273312
Cruise Based * (RG35)	0.511616	14.48834	0.511616	13.83661
District Average Number of Bidders	0.142616	7.760964	0.142616	7.528449
Partial Cut Fraction	-0.621568	-1.655206	-0.621568	-2.084092
Slope	-0.003371	-2.978449	-0.003371	-2.822624
First and Second Quarter Auctions	0.049969	2.124318	0.049969	2.118669
Highway Haul	0.110756	3.395329	0.110756	3.213283
Adjusted R ²	0.520020		0.520020	

¹2015 Equation using Updated Auction Set

To implement the new equation in the *Interior Appraisal Manual*, the two equations are reduced to one MPS equation. This is done by substituting the Number of Bidders equation into the Estimated Winning Bid Equation (and thereby eliminating the variable: LN (Number of Bidders)). See Appendix 1 for detailed statistics on the estimated winning bid and number of bidders equations and variable definitions.

Note: The list of variables has not changed between the benchmark and the final regressions but the coefficients have. The list of variables has not changed because none of the new variables tested were found to improve the model. The coefficients have changed because the CPI base year was updated. The coefficients appear to be higher but when the real estimated winning bid is inflated by a lower CPI factor, there is no net effect on final estimated winning bid.

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4. SPECIFIED OPERATIONS

The auction dataset used to develop the MPS equation is comprised of 1309 auctions. There are some harvesting situations that are not accounted for in the data and equation, and therefore a specified operation cost estimate may be used for these situations in the calculation of stumpage rates.

The specified operations are shown below and described in Appendix 2.

Specified Operations	Current Adjustment	Update July 1, 2016
1. Rail Haul	Appraisal Manual	Appraisal Manual
2. Barge/Ferry	Appraisal Manual	Appraisal Manual
3. Dump, Boom, Tow, Dewater and Reload	Appraisal Manual	Appraisal Manual
4. Camp Costs	$\$3.61/m^3$ if rail Remote camps: $\$3.66/m^3$ All other camps: $\$1.35/m^3$	$\$3.92/m^3$ if rail Remote camps: $\$3.37/m^3$ All other camps: Formula Based on CAMPV (Appraisal Manual)
5. Skyline Yarding	$\$4.34/m^3$	$\$4.07/m^3$
6. Horse Logging	$\$8.67/m^3$	$\$8.67/m^3$
7. Market Logger Specified Operations Cost	$\$0.08/m^3$	$\$0.07/m^3$ Combined in Final Tenure Obligation Adjustment
8. Helicopter	$\$88.59/m^3$	$\$95.64/m^3$

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5. TENURE OBLIGATION ADJUSTMENTS

As outlined in the Interior Tenure Obligations Adjustment paper (dated June 5, 2006), the adjustments are based on licensee data submitted in the Interior Log Cost Report.

The tenure obligation adjustments are shown below.

Tenure Obligation	Current Adjustment	Update July 1, 2016
Total Administration Cost	2012/13 Cost Base	2013/14 Cost Base
Development Cost	2012/13 Cost Base	2013/14 Cost Base
Total Road Management Cost	2012/13 Cost Base	2013/14 Cost Base
Market Logger Development Cost	\$1.30/m ³	\$1.30/m ³
Total Silviculture Cost	2012/13 Cost Base	2013/14 Cost Base
Return to Forest Management	1.031	1.035
Low Grade Percent Adjustment	Mark Specific 1/(1-%low grade/100)	Mark Specific 1/(1-%low grade/100)

6. SUMMARY

The new final equation, specified operations and tenure obligation adjustments will be used in the MPS for the Interior, starting July 1, 2016.

APPENDIX 1

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FINAL ESTIMATED WINNING BID

Dependent Variable: BID*141.7/CPI

Method: Least Squares

Date: 05/03/16 Time: 13:43

Sample: 1 2436 IF LIVE_IN=1

Included observations: 1309

White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	23.00715	3.346006	6.876004	0.0000
LN (Number of Bidders)	6.032858	0.361118	16.70605	0.0000
Real Stand Selling Price	0.132415	0.025757	5.141023	0.0000
Cedar Fraction * (1 - Cedar Decay Fraction) * (1 - Zone 6)	12.00658	5.671801	2.116891	0.0345
HemBal Fraction	-14.61571	1.959932	-7.457253	0.0000
Larch Fraction + Yellow Pine Fraction	-8.618703	3.644715	-2.364712	0.0182
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-9.966618	1.984937	-5.021126	0.0000
Cable Yarding	-16.52532	1.750920	-9.438077	0.0000
LN(Volume/1000)	1.384464	0.261948	5.285261	0.0000
Decay Fraction	-34.11403	8.620525	-3.957303	0.0001
Fire Damaged Fraction	-4.743132	3.431101	-1.382393	0.1671
LN (Volume per Tree)	7.133896	0.808716	8.821263	0.0000
Volume per Hectare	0.001599	0.004125	0.387642	0.6983
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.490939	0.137795	-10.82000	0.0000
Zone 9	-7.944755	0.861802	-9.218769	0.0000
Deciduous Fraction	-13.38562	2.888088	-4.634769	0.0000
Cruise Based * (1 – RG35)	-6.987352	0.845072	-8.268355	0.0000
Cruise Based * (RG35)	-7.464388	0.714201	-10.45138	0.0000
Grey Fraction	-1.553657	0.229072	-6.782405	0.0000
Decked Fraction	51.02490	17.87059	2.855244	0.0044
Ground Skid Slope Squared (15-50)	-0.008225	0.002527	-3.255271	0.0012
2012 Auctions	2.600016	0.610767	4.256970	0.0000
2013 Auctions	5.688381	0.922476	6.166426	0.0000
2014 Auctions	8.827538	1.178983	7.487416	0.0000
2015 Auctions	12.29224	1.068015	11.50943	0.0000
R-squared	0.758124	Mean dependent var		24.29555
Adjusted R-squared	0.753602	S.D. dependent var		14.13599

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FINAL NUMBER OF BIDDERS

Dependent Variable: LOG_NB
 Method: Least Squares
 Date: 05/03/16 Time: 13:44
 Sample: 1 2436 IF LIVE_IN=1
 Included observations: 1309

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-0.518459	0.070627	-7.340789	0.0000
Forecast Real Winning Bid	0.041707	0.001460	28.57105	0.0000
Cruise Based * (1 – (RG35))	0.389297	0.053524	7.273312	0.0000
Cruise Based * (RG35)	0.511616	0.036976	13.83661	0.0000
2012 Auctions	-0.161572	0.039614	-4.078646	0.0000
2013 Auctions	-0.368334	0.038205	-9.641104	0.0000
2014 Auctions	-0.548566	0.041589	-13.19020	0.0000
2015 Auctions	-0.627406	0.039590	-15.84774	0.0000
Partial Cut Fraction	-0.621568	0.298244	-2.084092	0.0373
Slope	-0.003371	0.001194	-2.822624	0.0048
First and Second Quarter Auctions	0.049969	0.023585	2.118669	0.0343
Highway Haul	0.110756	0.034468	3.213283	0.0013
District Average Number of Bidders	0.142616	0.018944	7.528449	0.0000
R-squared	0.524423	Mean dependent var		0.850697
Adjusted R-squared	0.520020	S.D. dependent var		0.605816

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VARIABLES AND DEFINITIONS FOR EQUATIONS

Variable	Definition
2011 Auctions	If the auction sold in 2011, then AUC 2011 =1.
2012 Auctions	If the auction sold in 2012, then AUC 2012 =1.
2013 Auctions	If the auction sold in 2013, then AUC 2013 =1.
2014 Auctions	If the auction sold in 2014, then AUC 2014 =1.
2015 Auctions	If the auction sold in 2014, then AUC 2015 =1.
Cable Yard Fraction	Fraction of harvest method volume that is appraised as overhead cable yarding (includes Skyline <600m horizontal).
Cable Yarding	Cable Yard Fraction – from 2011, 2012 or 2013 or 2014 auctions.
Cedar Decay Fraction	Cedar decay (%) from the appraisal summary report/100.
Cedar Fraction	Fraction of total net coniferous volume that is cedar.
Constant	Fixed value.
Cruise Based	1 if cruise based, 0 if scale based.
CYCLE	Hauling round trip cycle time (Primary CT (hrs) + Secondary CT (hrs)). See sections 3.5.1 and 3.5.2 of the Interior Appraisal Manual.
CYCLE_INC6	CYCLE – 6.0 hours. If <0, then 0.
Decay Fraction	Prorated coniferous species decay % (from appraisal summary report) / 100.
Deciduous Fraction	Fraction of the total net cruise volume that is the total net deciduous volume
Decked Fraction	Fraction of cutting authority volume that has been decked and/or partially harvested in the timber sale licence. Cutting authority volume = total net cruise volume + volume of decked/partially harvested timber + right-of-way volume.
District Average Number of Bidders	Average number of bidders for the district, in which the cutting authority area is located (see Table 3-2, section 3.3 Appraisal Manual).
District DRM or DMH	See ‘Dry Belt’
Dry Belt	Dry Belt = 1 if the cutting authority volume is located in the Rocky Mountain (DRM) or 100 Mile House (DMH) Forest Districts. Otherwise, Dry Belt is the fraction of the Net Merchantable Area of the cutting authority that is located in Dry Belt Douglas Fir Zones as per the table in the <i>Cruising Manual</i> . If the BEC

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	<p>zone/subzone combination does <u>not</u> appear in that table, then the following logic must apply:</p> <ul style="list-style-type: none"> - If the subzone is very dry (begins with x) then the zone/subzone combination is Dry Belt. - If the subzone is dry (begins with d) then the zone/subzone combination is Dry Belt only if the BEC zone is IDF, MS or PP. <p>If the subzone is not very dry or dry (does not begin with x or d) then the zone/subzone combination is not Dry Belt.</p>
Fir Fraction + Yellow Pine Fraction	Fraction of total net coniferous volume that is Douglas fir and yellow pine.
Fire Damaged Fraction	Fraction of total net coniferous volume that is fire damaged.
First and Second Quarter Auctions	If the auction sold in January to June, $D_Q1 + Q2 = 1$.
Forecast Real Winning Bid	Estimated winning bid from the estimated winning bid equation
GREY	Fraction of total net coniferous volume that is grey Mountain Pine Beetle attacked lodgepole pine.
Grey Fraction	$GREY * (Award\ Year - 2008 - LAG) * Cruise\ Based * RG35$
Ground Skid Slope Squared (15-50)	See 'GS_Slope' definition in Section 3.3 'Estimated Winning Bid Variables' of the Interior Appraisal Manual for more information.
HemBal Fraction	Fraction of total net coniferous volume that is hemlock and balsam.
Highway Haul	1 if primary haul method is highway, otherwise HWY = 0.
LAG	Lag in years. LAG = 0 if Zone 5 or Zone 6 as defined in Section 3.5 of the Interior Appraisal Manual or Cariboo Chilcotin District or Quesnel District, otherwise LAG = 2.
Larch Fraction + Yellow Pine Fraction	Fraction of total net coniferous volume that is larch and yellow pine.
Partial Cut Fraction	Fraction of the harvest method volume that is appraised as partial cut. $PC = (100 - CAPCUT\%)/100$. See section 4.5 of Appraisal Manual for definition of CAPCUT%. The 80% limit in the definition of CAPCUT in section 4.5 does not apply.

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RBID	Winning bid in 1997 dollars
Real Stand Selling Price	Estimated stand lumber value (\$/m ³) in 1997 dollars. Weighted average of (LRF * Lumber price by coniferous species). See Appraisal Manual section 3.2.
Red + Grey Attack Fraction	Fraction of total net coniferous volume that is red and grey mountain pine beetle attack.
RG35	1 if Total Net Coniferous Volume of timber on the cutting authority area is comprised of 35% or greater red and grey Mountain Pine Beetle attacked Lodgepole pine, otherwise RG35 = 0.
Slope	Cutting authority average slope from the appraisal summary report.
Volume	The zonal volume from Table 3-3 (See Appraisal Manual section 3.3) for the cutting authority unless: <ol style="list-style-type: none"> 1. The cutting authority is a BCTS cutting authority; if so then use the Total Net Coniferous Volume for the cutting authority. 2. The cutting authority is not a BCTS cutting authority and, the sum of all the AAC's for all the licences that the licensee has in the same TSA as the cutting authority being appraised is less than the zonal volume indicated in Table 3-3 for the selling price zone in which the cutting authority is located, if so, then use the greater of: <ul style="list-style-type: none"> - The Total Net Coniferous Volume, or - The sum of the AAC volumes described above
Volume per Hectare	Net coniferous volume per hectare (m ³ /ha)
Volume per Tree	Cutting authority average net volume per tree, from appraisal summary report (m ³).
Zone 6	Skeena selling price zone variable. Zone 6 = 1 if cutting authority is appraised with selling price zone 6, otherwise Zone 6 = 0.
Zone 9	Fort Nelson – Peace selling price zone variable. Zone 9 = 1 if cutting authority is appraised with selling price zone 9, otherwise Zone 9 = 0.

APPENDIX 2

DESCRIPTION OF SPECIFIED OPERATIONS

If sufficient auction data is not available for an activity employed by either BCTS or other licenses, the ministry may, for those identified situations, implement a specified operations cost estimate in the calculation of the stumpage rate.

The specified operations will be used to adjust the MPS stumpage rate for the estimated incremental cost of the identified situation. The explicit assumption is that if a bidder was faced with a similar situation he or she would lower the bid by the extra cost incurred because of the identified situation.

The situations that may be eligible for specified operations adjustment will be determined according to the following principles:

- the expectation that a bid would be influenced by this situation;
- representation (number of samples, if any, in the auction data set);
- materiality of estimated cost differential (supported by verifiable financial data); and,
- statistical analysis (including the premise that other represented situations and variables in the MPS database and equations may serve as a proxy for the situation in question).

The ministry, after considering the above and any other relevant technical information, may or may not designate the situation as an identified situation eligible for specified operations and, if eligible, will specify the dollars per cubic metre adjustment.

The ultimate objective is to have a representative auction database and hence, few, if any, specified operations adjustments.

The following are identified as specified operations for the Interior MPS. Cost estimates from the updated *Interior Appraisal Manual* are used for the following:

- Rail Haul
- Rail haul including truck to rail transfer and rail transport.
- Barge/Ferry
- Barge/ferry used to truck haul (private).
- Barge/ferry not used for truck haul (private).
- Dump and boom
- Tow
- Dewater and reload
- Camp costs
- Skyline Yarding
- Horse Logging
- Market Logger Specified Operations Cost
- High Development Cost (BCTS only)
- Helicopter