



Interior MARKET PRICING SYSTEM

Update – 2019

July 1, 2019

Timber Pricing Branch

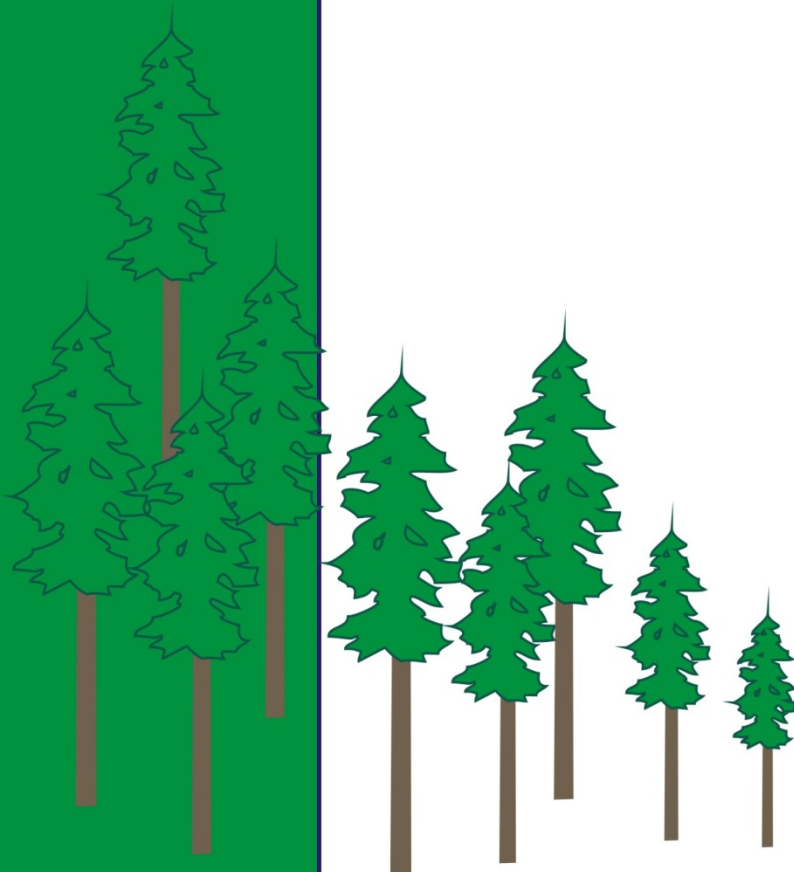


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Interior Market Pricing System: Update – 2019

1. INTRODUCTION

The purpose of this paper is to provide an overview of the July 1, 2019 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 3083 sales over the 12-year period January 1, 2007 through December 31, 2018.

3. EQUATIONS

The 2018 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	2018 Equation		¹ Benchmark Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	4.882293	18.73092	5.468604	17.78398
Constant	12.34014	2.701086	16.41626	3.078106
Real Stand Selling Price	0.321006	31.90652	0.368814	34.62304
Cedar Fraction	15.64885	3.901579	13.33979	2.827092
Cedar Fraction*Cedar Decay	-108.3408	-6.361644	-132.5323	-6.600691
Hemlock Fraction	-16.95987	-11.57038	-19.14630	-11.41236
Balsam Fraction	-6.444100	-5.871217	-9.455557	-7.697584
Larch Fraction + Yellow Pine Fraction	-12.65617	-4.027727	-19.49202	-5.336605
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-4.637923	-2.890285	-3.097168	-1.807246
Cable Yarding	-19.66321	-15.69822	-22.15889	-15.55456
LN(Volume/1000)	1.857719	8.730014	2.242945	9.083234
Decay Fraction	-7.434944	-1.573458	-3.625549	-0.661500
Fire Damaged Fraction	-12.09745	-4.025529	-13.16653	-6.472434
LN(VPH)	0.906263	1.477537	0.122925	0.171880
LN (Volume per Tree)	7.970377	15.29429	7.851740	12.99574
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.331440	-12.20104	-1.494972	-12.14631
Zone 9	-8.595126	-12.36981	-8.187003	-10.31430
Cruise Based * (1 – RG35)	-5.906503	-8.617753	-6.595888	-8.373894
Cruise Based * (RG35)	-4.798896	-8.860104	-5.713188	-9.257376
Decked Fraction	53.67498	4.708957	37.27577	2.963743
Ground Skid Slope Squared (15-50)	-0.005954	-3.950435	-0.008094	-4.636139
2017 Auctions	4.386529	6.800024	n/a	n/a
2018 Auctions	n/a	n/a	19.72497	24.80011
Grey Fraction	-1.364460	-12.20796	-1.696334	-15.13539
Exchange Rate	-31.23580	-15.20823	-35.43622	-14.79999
Total Interior Harvest	0.429197	11.72246	0.431939	9.950382
Blowdown	-14.40353	-3.684896	-15.30230	-3.412376
Deciduous (Cruise Based)	-11.50487	-4.468151	-15.79432	-5.242445
Camp	-1.000290	-2.664921	-1.320808	-2.932124
Distance to Support Centre	-0.023724	-7.565300	-0.020422	-5.574702
# of Observations	2863		3083	
Adjusted R ²	0.771389		0.785927	

¹2018 Equation using 2019 Auction Data Set

²LN means the natural logarithm

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Number of Bidders Equation

Dep. Var.= LN(NB) Variable	2018 Equation		¹ Benchmark Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.020570	23.98552	0.016694	-6.436399
Constant	-0.391719	-7.104697	-0.350881	23.97498
2017 Auctions	-0.246139	-6.479509	n/a	n/a
2018 Auctions	n/a	n/a	-0.412701	-9.500077
Cruise Based * (1 – (RG35))	0.076465	1.762103	0.036826	0.895492
Cruise Based * (RG35)	0.113136	4.454770	0.098787	4.063002
District Average Number of Bidders	0.251390	15.30768	0.255186	15.63477
Partial Cut Fraction	-0.545238	-2.446274	-0.617751	-0.617751
Slope	-0.006906	-7.109679	-0.006325	-6.905746
First and Second Quarter Auctions	0.091342	4.591913	0.085760	4.496124
Highway Haul	0.083135	3.029907	0.093823	3.538207
# of Observations	2863		3083	
Adjusted R ²	0.293247		0.282028	

¹2018 Equation using 2019 Auction Data Set

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

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Estimated Winning Bid Equation

² Variable	¹ Benchmark Equation		2019 Final Equation	
	Co-efficient	t – Statistic	Co-efficient	t – Statistic
LN (Number of Bidders)	5.468604	17.78398	5.645983	18.68617
Constant	16.41626	3.078106	16.93933	5.095687
Real Stand Selling Price	0.368814	34.62304	0.396380	36.54996
Cedar Fraction	13.33979	2.827092	6.184692	1.318824
Cedar Fraction*Cedar Decay	-132.5323	-6.600691	-119.9346	-6.073678
Hemlock Fraction	-19.14630	-11.41236	-17.29641	-10.02510
Balsam Fraction	-9.455557	-7.697584	-9.114423	-7.450354
Larch Fraction + Yellow Pine Fraction	-19.49202	-5.336605	-20.57435	-5.711647
[(Fir Fraction + Yellow Pine Fraction) * Dry Belt] or [District DRM or DMH]	-3.097168	-1.807246	-2.552084	-1.492784
Cable Yarding	-22.15889	-15.55456	-26.14861	-16.93750
LN(Volume/1000)	2.242945	9.083234	2.181481	9.288632
Decay Fraction	-3.625549	-0.661500	-6.352795	-1.104891
Fire Damaged Fraction	-13.16653	-6.472434	-13.32654	-6.636796
LN(VPH)	0.122925	0.171880	n/a	n/a
LN (Volume per Tree)	7.851740	12.99574	8.016289	16.28899
Cycle + 0.5 *(Cycle – 6.0 hours)	-1.494972	-12.14631	-1.546972	-13.20136
Zone 9	-8.187003	-10.31430	-8.400546	-10.81873
Cruise Based * (1 – RG35)	-6.595888	-8.373894	-6.741704	-7.273510
Cruise Based * (RG35)	-5.713188	-9.257376	-6.140987	-8.324546
Decked Fraction	37.27577	2.963743	34.86799	2.807464
Ground Skid Slope Squared (15-50)	-0.008094	-4.636139	-0.009319	-5.476265
2018 Auctions	n/a	n/a	17.85364	22.20353
Grey Fraction	-1.696334	-15.13539	-1.726250	-15.63409
Exchange Rate	-35.43622	-14.79999	-35.28441	-14.68966
Total Interior Harvest	0.431939	9.950382	0.399176	9.269189
Blowdown	-15.30230	-3.412376	-13.98428	-3.154222
Deciduous (Cruise Based)	-15.79432	-5.242445	-16.22394	-6.312350
Camp	-1.320808	-2.932124	-1.507718	-3.500876
Distance to Support Centre	-0.020422	-5.574702	-0.037535	-6.091626
Partial Cut 2030	n/a	n/a	-3.933856	-1.694758
Other Attack	n/a	n/a	-7.485194	-2.689111
Adjusted R ²	0.785927		0.791256	

¹2018 Equation using 2019 Auction Data Set

²LN means the natural logarithm

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Number of Bidders Equation

Variable	¹ Benchmark Equation		2019 Final Equation	
	Co-efficient	t - Statistic	Co-efficient	t - Statistic
Forecast Real Winning Bid	0.016694	-6.436399	0.016506	23.84090
Constant	-0.350881	23.97498	-0.351963	-6.448943
2018 Auctions	-0.412701	-9.500077	-0.405907	-9.355655
Cruise Based * (1 – (RG35))	0.036826	0.895492	0.035800	0.869822
Cruise Based * (RG35)	0.895492	4.063002	0.096625	3.973465
District Average Number of Bidders	0.255186	15.63477	0.254747	15.58366
Partial Cut Fraction	-0.617751	-0.617751	-0.489824	-0.489824
Slope	-0.006325	-6.905746	-0.006303	-6.875751
First and Second Quarter Auctions	0.085760	4.496124	0.094023	4.926083
Highway Haul	0.093823	3.538207	0.096795	3.646542
Adjusted R ²	0.282028		0.280763	

¹2018 Equation using 2019 Auction Data Set

The new dataset is made up of 12 years of sales. The oldest year (2007) was preserved in order to make sure an entire market cycle is represented in the dataset, including the last major downturn. Two new variables called Other Attack and Partial Cut 2030 were added and the variable called Volume per Hectare was removed. Together these updates help to improve the model.

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 bidder's equations and variable definitions.

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4. SPECIFIED OPERATIONS

The auction dataset used to develop the MPS equation is comprised of 3083 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 (July 1, 2018)	Update July 1, 2019
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	N/A	N/A
5. Skyline Yarding	\$2.85/m ³	\$2.07/m ³
6. Horse Logging	\$8.67/m ³	\$8.67/m ³
7. Market Logger Specified Operations Cost	\$0.07/m ³ Combined in Final Tenure Obligation Adjustment	\$0.07/m ³ Combined in Final Tenure Obligation Adjustment
8. Helicopter	\$99.64/m ³	\$108.58/m ³

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5. TENURE OBLIGATION ADJUSTMENTS

As outlined in the Interior Tenure Obligations Adjustment paper (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, 2019
Total Administration Cost	2015/16 Cost Base	2016/17 Cost Base
Development Cost	2015/16 Cost Base	2016/17 Cost Base
Total Road Management Cost	2015/16 Cost Base	2016/17 Cost Base
Market Logger Development Cost	\$1.39/m ³	\$1.45/m ³
Total Silviculture Cost	2015/16 Cost Base	2016/17 Cost Base
Return to Forest Management		
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, 2019.

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APPENDIX 1

FINAL ESTIMATED WINNING BID

Dependent Variable: BID*151.3/CPI

Method: Least Squares

Date: 06/07/19 Time: 09:17

Sample: 1 3617 IF IN_3083

Included observations: 3083

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.93933	3.324249	5.095687	0.0000
LOG(NB)	5.645983	0.302148	18.68617	0.0000
SPI_3_1*151.3/CPI	0.396380	0.010845	36.54996	0.0000
CE	6.184692	4.689549	1.318824	0.1873
CE*CEDAR_DECAY	-119.9346	19.74663	-6.073678	0.0000
HE	-17.29641	1.725310	-10.02510	0.0000
BA+2*(BA-0.5)*(BA>.5)	-9.114423	1.223354	-7.450354	0.0000
LA+YE	-20.57435	3.602175	-5.711647	0.0000
(FI+YE)*DRY_OR_DRM_DMH	-2.552084	1.709613	-1.492784	0.1356
CABLE*(AWARD_YEAR<=2012)	-3.485623	1.772239	-1.966791	0.0493
CABLE*(AWARD_YEAR>=2013)	-26.14861	1.543830	-16.93750	0.0000
LOG(CVOL/1000)	2.181481	0.234855	9.288632	0.0000
FIRE	-13.32654	2.007979	-6.636796	0.0000
DECAY*SB	-6.352795	5.749703	-1.104891	0.2693
LOG(VPT)	8.016289	0.492129	16.28899	0.0000
Z9	-8.400546	0.776482	-10.81873	0.0000
CYCLE+0.5*CYCLE_6PLUS	-1.546972	0.117183	-13.20136	0.0000
OTHER	-7.485194	2.783520	-2.689111	0.0072
GREY*((AWARD_YEAR-2008)*(AWARD_YEAR>=2008)+3*(AWARD_YEAR-2015)*(AWARD_YEAR>=2015))*CB*D_RG35	-1.726250	0.110416	-15.63409	0.0000
CB*(1-D_RG35)	-6.741704	0.926884	-7.273510	0.0000
CB*D_RG35	-6.140987	0.737696	-8.324546	0.0000
DECKED	34.86799	12.41975	2.807464	0.0050
GS*GS_SLOPE_SQ_15_50	-0.009319	0.001702	-5.476265	0.0000
FX_3_1	-35.28441	2.401989	-14.68966	0.0000
HARVOL_S_12M1	0.399176	0.043065	9.269189	0.0000
NET_BLOWDOWN	-13.98428	4.433513	-3.154222	0.0016
NET_DECID*(CB+DECID_BONUS*SB)	-16.22394	2.570190	-6.312350	0.0000
DSC_2019_IAM_100	-0.037535	0.006162	-6.091626	0.0000
CAMP_DIST<=16	-1.507718	0.430669	-3.500876	0.0005
PARCUT_20_30	-3.933856	2.321190	-1.694758	0.0902
D2018	17.85364	0.804090	22.20353	0.0000
R-squared	0.793287	Mean dependent var	28.68615	
Adjusted R-squared	0.791256	S.D. dependent var	20.65895	

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FINAL NUMBER OF BIDDERS

Dependent Variable: LOG(NB)

Method: Least Squares

Date: 06/07/19 Time: 09:39

Sample: 1 3617 IF IN_3083

Included observations: 3083

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.351963	0.054577	-6.448943	0.0000
BIDF*151.3/CPI	0.016506	0.000692	23.84090	0.0000
CB*(1-D_RG35)	0.035800	0.041158	0.869822	0.3845
CB*D_RG35	0.096625	0.024318	3.973465	0.0001
PARCUT	-0.489824	0.226867	-2.159085	0.0309
SLOPE	-0.006303	0.000917	-6.875751	0.0000
DANB_3083	0.254747	0.016347	15.58366	0.0000
HWY_TRAN	0.096795	0.026544	3.646542	0.0003
D_Q1+D_Q2	0.094023	0.019087	4.926083	0.0000
D2018	-0.405907	0.043386	-9.355655	0.0000

R-squared	0.282864	Mean dependent var	0.854976
Adjusted R-squared	0.280763	S.D. dependent var	0.619583

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VARIABLES AND DEFINITIONS FOR EQUATIONS

Variable	Definition
2017 Auctions	If the auction sold in 2017, then AUC 2017 =1.
2018 Auctions	If the auction sold in 2018, then AUC 2018 =1.
Balsam Fraction	Fraction of the Total Net Coniferous Volume that is balsam.
Blowdown	Blowdown fraction – grey fraction (can't be < 0)
Camp	1 if eligible for CAMP under IAM Section 3.2.30
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 2014, 2015, 2016, 2017 and 2018 auctions.
Cedar Decay Fraction	Cedar decay (%) from the appraisal summary report/100.
Cedar Fraction	Fraction of total net coniferous volume that is cedar.
Cedar Fraction * Cedar Decay Fraction	Fraction of total net coniferous volume that is cedar * Cedar decay (%) from the appraisal summary report/100.
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. As of 2019 only applies to scale based permits.
Deciduous Fraction	Fraction of the total net cruise volume that is the total net deciduous volume
Deciduous (Cruise Based)	Same as Deciduous Fraction but applies to cruise based only.
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.
DSC (Distance to Support Centre)	Distance to Support Centre: see IAM section 3.2.29
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'

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Dry Belt	<p>Dry Belt = 1 if the cutting authority volume is located in the Rocky Mountain (DRM) or 100 Mile House (DMH) Forest Districts.</p> <p>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 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>
Exchange Rate	US\$/C\$ (a stronger C\$ leads to a higher value) in decimal form.
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	$GREY * 3 * (2018.5 - 2015) * Cruise_Based * RG35$
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.
Hemlock Fraction	Fraction of the Total Net Coniferous Volume that is hemlock.
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.

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Larch Fraction + Yellow Pine Fraction	Fraction of total net coniferous volume that is larch and yellow pine.
Other Attack	Other Attack is the fraction of the Total Net Coniferous Volume that is insect attack other than Mountain Pine Beetle attacked Lodgepole 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.
Partial Cut 2030	Partial Cut 2030 is for cutting authorities with greater than 20% partial cut retention levels. See section 3.2.23 of the Appraisal Manual.
RBID	Real Winning bid (\$/m3).
Real Stand Selling Price	Real estimated stand lumber value (\$/m3). 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.
Total Interior Harvest	Total Interior harvest (million m3) in a recent 12 month period. Includes all species and tenure types. Excludes waste.
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

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	above
Volume per Tree	Cutting authority average net volume per tree, from appraisal summary report (m3).
Volume per hectare	Natural logarithm of volume per hectare.
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 licences, 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 meter 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.

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- 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