Volume Estimator Library Equations

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1. Volume Equation Numbers

What are Volume Equation Numbers and how are they used? A volume equation number is a 10 digit code which identifies a specific mathematical model developed to produce the volume for a specific species in a specific area. These models can be direct volume estimators or profile models**.**

A direct volume estimator is a regression equation developed to predict a specific volume for a tree, whether it be a total cubic volume or a board foot volume for the merchantable portion of the tree. A profile model is developed to predict the diameter at any height up the bole of a tree. With this capability, a set of rules can be applied to a profile model to calculate a specific volume, whether it be a total cubic volume or a board foot volume for the merchantable portion of the tree.

The 10 digit volume equation number is made up of several different parts to help identify the volume equation or model. The first character is a geographic code to reference where the model was developed. The current geographic codes are as follows:

1 = Region 1	9 = Region 9
2 = Region 2	A = Region 10 (Alaska)
3 = Region 3	H = Hawaii
4 = Region 4	B = BLM Washington Oregon
5 = Region 5	I = INGY model
6 = Region 6	F = Flewelling Westside models
8 = Region 8	N= National-scale

The second and third character is a Subregional Code based on a Forest number, a log length, or some other numerical code.

Examples of Subregional Codes

00 = No Subregional Code - Region Wide Application
VB = Equation for both volume and biomass
INGY Subregional Codes (Both Taper and Bark Models)
- 11 = East Cascade
- 12 = Okanogan
- 13 = Blue Mountains
- 14 = Kootenai
- 15 = Central Idaho
- 21,22,23 = Canada Model

Region 1 Subregional Code is used to identify model types
- 01 = FVS Behre's Hyperbola
- 02 = Kemp Direct Volume Estimators Table 1
- 03 = Kemp Direct Volume Estimators Table 2
- 04 = Kemp Direct Volume Estimators Table 3
- 05 = Kemp Direct Volume Estimators Table 5

Region 2 Subregional Codes are based on Forest Number or Estimator Type
- 03 = Black Hills
- 13 = San Juan (Flewelling model)

Region 3 Subregional Codes are group of forests
- 01 = Lincoln, Coconino, Tonto, Apache - Sitgreaves, Coronado, Gila, Prescott

02 = Carson, Santa Fe, Cibola, Kaibab

Region 4 Subregional Codes are based on Forest Number when applicable or some numerical code when more than one forest is involved.

01 = Forest subset
05 = Caribou Forest only
07 = Dixie Forest only

Region 6 and Region 10 Subregional Codes based on Log Length

16 = Sixteen foot log length
32 = Thirty two foot log length
28 = Sixteen foot log length for cubic, thirty two foot log length for board foot
Flewelling equation subregion code:
I##FW2W*** and I##FW3W*** subregion as
00 – INGY regional wide
11 - East Cascade
12 – Okanogan
13 - Blue Mountains
F##FW2W*** and F##FW3W*** subregion as
00 – west coast regional wide

01 – CO OR	02 – EV OR	03 – NO WA
04 – RS WA	05 – So WA	06 – WE WA
07 – WV OR	08 – WC WA	

Region 7 (BLM of Washington and Oregon) Subregional Codes

01 = Coastal
02 = eastern

Region 8 Subregional codes for profile models are based on R8 Definitions. The first number is a geographic code and the second is a reference height.

First Number (Geo. Code)	Second Number (Ref. Ht)
1_ = Coastal Plain	_0 = Height to tip
2_ = Piedmont	_4 = Height to a 4 inch dob
3_ = Appalachian Mtns	_7 = Height to a 7 inch dob
4_ = Upper Coastal Plain	_9 = Height to a 9 inch dob
5_ = Deep South	_1 = Height to tip, 4", or 7/9" top
6_ = Arkansas	_8 = Height to tip for Pod 08
7_ = Delta / St. Francis	
9_ = Southwide	

Region 9 Subregional Codes are Gevorkiantz Board Foot Equation (DVE) Table number.

01 = Gevorkiantz Board Foot Equation – Table A
02 = Gevorkiantz Board Foot Equation – Table B
03 = Gevorkiantz Board Foot Equation – Table C
04 = Gevorkiantz Board Foot Equation – Table D
05 = Gevorkiantz Board Foot Equation – Table E
06 = Gevorkiantz Board Foot Equation – Table F
11 = Gevorkiantz Cubic Pulpwood Equation
12 = Gevorkiantz Merchantable Cubic Equation
21 = Gevorkiantz Cordwood Equation

Region 10 Subregional Codes are
Direct Volume Equation(DVE):

01 = Interior Alaska
00 = Region wide

Fleweling Equation:

F3 = 32 foot log length
FW = 16 foot log length

Demars Equation:

01 = 16 foot log length
02 = 16 foot for cubic and 32 foot for board foot
16 = 16 foot log length

32 = 32 foot log length

The fourth, fifth, and sixth characters define the model as follows:

DVE = Direct Volume Estimators (regression models usually)

BEH = Behre's Hyperbola
(Bell & Dilworth, 1988).

CLK = Alexander Clark et.al. profile model
(Clark et al. 1991. Southeastern For Exper Station. Research Paper SE-282).

CZ2 = Czaplewski's 2 point profile model
Czaplewski et al 1989. Research Paper RM-284)

CZ3 = Czaplewski's 3 point profile model
(Unpublished. Based on work presented in Czaplewski & McClure. 1988. Forest Science, Vol. 34, pp. 512 – 522)

DEM = DeMars and Bruce profile models
(Donald Demars. 1996. Pacific Northwest Res. Station Research Note. PNW-RN-517) &
(Bruce, D., 1984. Volume estimators for Sitka spruce and western hemlock in coastal Alaska. In Inventorying forest and other vegetation of the high latitude and high altitude regions. SAF pub 84-11. Bethesada, MD. pp. 96-102).

FW2 = Flewelling's 2 point profile model
(Unpublished. Based on work presented by Flewelling and Raynes. 1993 Canadian Journal of Forest Research Vol 23. Part I and Part II).

FW3 = Flewelling's 3 point profile model
(Unpublished. Based on work presented by Flewelling and Raynes. 1993 Canadian Journal of Forest Research Vol 23. Part I and Part II).

MAT = Mathis (Rastagi and Loveless profile model)
(Rustagi, K.R. and Loveless, R.S.,Jr., 1991. Compatible variable-form volume and stem-profile equations for Douglas-fir. Can. J. For. Res. 21:143-151).

SN2 = Sharpnack's 2 point profile model
(Sharpnack, David A. 1966. Predicting Volumes in Four Hawaii Hardwoods. Southwest Forest and Range Research Station Research Note SW-121)

WO2 = Wensel and Olsen 2 point profile model
(Wensel, L. C. and C. M. Olson. 1993. Tree Taper Models for Major Commercial California Conifers. Research Note No. 33. Northern Calif. Forest Yield Cooperative. Dept. of Forestry and Mgmt., Univ. of Calif., Berkeley. 28 pp.)

The seventh character defines Western or Eastern U.S

W = Regions 1,2,3,4,5,6

E = Region 8,9

The eighth, ninth, and tenth character defines species (Forest Survey Handbook)

Examples of species codes:

017 = Grand Fir

122 = Ponderosa Pine

242 = Western Red Cedar

802 = White oak

The National-scale Volume and Biomass (NSVB) equations (Westfall etal 2024) were also added to the NVEL. The NSVB equation number is different from the regular NVEL equation number. The NSVB equation starts with **NVB** and then followed by EcoRegion Division code (4 characters), such as M210 or 0210 etc. The last three characters are FIA species code. So the equation looks like: **NVBM210202** or **NVB0210202**

The list of NSVB equations is shown in Appendixes 9.5.

2. National Volume Estimator Library Call List

Type	Variable Name	Variable Type	Variable Description
Tree	REGN	INTEGER	Region number used to set Regional Merchandizing Rules
Tree	FORST	CHARACTER*2	Two digit forest number
Tree	PROD	CHARACTER*2	Product code: 01 = Sawtimber tree 02 = Pulpwood tree 06 = Roundwood tree.
Tree	VOLEQ	CHARACTER*10	The 10 character volume equation number for this tree
Tree	DBHOB	REAL	Diameter Breast Height outside bark
Tree	DRCOB	REAL	Diameter Root Collar outside bark (ground level diameter)
Tree	HTTOT[1]	REAL	Total tree height measured from ground to tip
Tree	HT1PRD[1]	REAL	Height to the minimum top diameter inside bark for primary product. Can be in feet or number of logs. If in logs: R6 & BLM use number of logs times 10. All other regions use number of logs. If in logs, HTTYPE variable MUST be set to L.
Tree	HT2PRD	REAL	Height to the minimum top diameter inside bark for secondary product. Can be in feet or number of logs. If in logs, HTTYPE variable MUST be set to L and HT1PRD variable MUST also have height in logs.
Tree	HTTYPE	CHARACTER*1	Height type for HT1PRD and HT2PRD variables: F = Height in feet (default value) L = Height in number of logs
Tree	HTLOG	INTEGER	If HTTYPE is set to L, this is the length of the logs recorded in the HT1PRD field (8,16, or 32). 16 is the default value.
Tree	UPSHT1[2]	REAL	Upper stem height in feet where upper stem diameter was measured or where AVG1 is to be applied. OR For Region 8 the upper stem reference height defined by their profile model (ht0, ht4, ht7, ht9). OR For region 9 the UPSHT1 is the height to 7.6/9.6 top diameter when HT1PRD is not the height to 7.6/9.6 top diameter.
Tree	UPSHT2	REAL	Second upper stem height in feet where a second upper stem diameter was measured.
Tree	UPSD1	REAL	Upper stem diameter measured at UPSHT1
Tree	UPSD2	REAL	Second upper stem diameter measured at UPSHT2
Tree	HTREF[2]	INTEGER	Reference height. Percent of total height where UPSD1 was measured or where AVGZ1 is to be applied.
Tree	AVGZ1	REAL	Flewelling's Average Z-Score value to be applied at either UPSHT1 or HTREF.
Tree	AVGZ2	REAL	Second average Z-Score value to be applied at UPSHT2.
Tree	FCLASS	INTEGER	Girard's form class. Diameter at the top of the first log given as a percent of DBH. It is also used for woodland species number of stems.
Tree	DBTBH	REAL	Double bark thickness at breast height in inches
Tree	BTR	REAL	Bark thickness ratio given as the percent of diameter inside

[1] Only one required for any one tree. The use of either TOTHT or HT1PRD is dependent upon the volume equation number and/or Regional requirements.

[2] Only one required (UPSD1 or AVGZ1) if using a Flewelling 3-point model.

			bark to diameter outside bark. (dib/dob *100).
Tree	CONSPEC	CHARACTER*4	Contract species. (used by BLM profile models. Currently is not in use)
Tree	HTTFLL	INTEGER	Height to first live limb in feet (used by Region 3 volume equation for ponderosa pine).
Tree	FIASPCD	INTEGER	Species 3 digits FIA code
Tree	BRKHT	REAL	Height to broken top or missing top
Tree	BRKHTD	REAL	Broken top diameter
Tree	CR	REAL	The percent of the tree bole supporting live, healthy foliage
Tree	CULL	REAL	The percent of the cubic-foot volume in a live or dead tally tree that is rotten or missing.
Tree	DECAYCD	INTEGER	A code indicating the stage of decay in a standing dead tree: 1. All limbs and branches are present; the top of the crown is still present; all bark remains; sapwood is intact, with minimal decay; heartwood is sound and hard. 2. There are few limbs and no fine branches; the top may be broken; a variable amount of bark remains; sapwood is sloughing with advanced decay; heartwood is sound at base but beginning to decay in the outer part of the upper bole. 3. Only limb stubs exist; the top is broken; a variable amount of bark remains; sapwood is sloughing; heartwood has advanced decay in upper bole and is beginning at the base. 4. Few or no limb stubs remain; the top is broken; a variable amount of bark remains; sapwood is sloughing; heartwood has advanced decay at the base and is sloughing in the upper bole. 5. No evidence of branches remains; the top is broken;
Tree	LIVE	CHARACTER*1	Live (“L”) or Dead (“D”) trees.
Merch	MTOPP	REAL	Minimum top diameter inside bark for primary product
Merch	MTOPS	REAL	Minimum top diameter inside bark for secondary product
Merch	STUMP	REAL	Stump height in feet
Merch	CUTFLG	INTEGER	Total cubic volume flag: 1) If set to 0, will not calculate the total cubic foot volume. 2) If set to 1, will calculate the total cubic foot volume.
Merch	BFPFLG	INTEGER	Board foot volume flag: 1) If set to 0, will not calculate the board foot volume for primary product. 2) If set to 1, will calculate the Scribner and International ¼ board foot volumes for primary product.
Merch	CUPFLG	INTEGER	Cubic foot volume flag: 1) If set to 0, will not calculate the merchantable cubic foot volume for primary product. 2) If set to 1, will calculate the merchantable cubic foot volume for primary product.
Merch	CDPFLG	INTEGER	Cordwood volume flag: 1) If set to 0, will not calculate the merchantable cordwood volume for primary product. 2) If set to 1, will calculate the cordwood volume for primary product.
Merch	CUSFLG	INTEGER	Cubic foot volume flag for secondary product:

			1) If set to 0, will not calculate the cubic foot volume for secondary product. 2) If set to 1, will calculate the cubic foot volume for secondary product..
Merch	CDSFLG	INTEGER	Cordwood volume flag for secondary product: 1) If set to 0, will not calculate the cordwood volume for secondary product. 2) If set to 1, will calculate the cordwood volume for secondary product.
Merch	SPFLG	INTEGER	Volume flag for secondary product: 1) If set to 0, will not calculate volume for secondary product. 2) If set to 1, will calculate the volume for secondary product in same units as primary product flags. 3) This variable replaces CDSFLG and CUSFLG.
Output	VOL (15)	REAL	Array of 15 tree volumes 1) Total Cubic Volume from ground to tip 2) Gross Scribner board foot volume. **Note: The VOL(2) is International ¼ board foot volume for Region 8 Forest 8, 9, 10, and 12 (except Andrew Pickens district); and Region 9 Forest 4,5,8,11,12,14,19,20,21,22,24, and 30 when using Clark profile equation.** 3) Net Scribner board foot volume. 4) Gross merchantable cubic foot volume 5) Net merchantable cubic foot volume 6) Merchantable cordwood volume 7) Gross secondary product volume in cubic feet 8) Net secondary product volume in cubic feet 9) Secondary product in cordwood 10) Gross International ¼ board foot volume 11) Net International ¼ board foot volume 12) Gross secondary product in Scribner board feet 13) Net secondary product in Scribner board feet 14) Stump volume 15) Tip volume
Output	LOGVOL (7.20)	REAL	The volume of up to 20 logs in a tree. 1) Gross Scribner board foot log volume (20 logs) 2) Gross removed Scribner board foot log volume (20 logs) 3) Net Scribner board foot log volume (20 logs) 4) Gross cubic foot log volume (20 logs) 5) Gross removed cubic foot log volume (20 logs) 6) Net cubic foot log volume (20 logs) 7) Gross International ¼ board foot log volume (20 logs), or log green weight for CTYPE='C'(Cruise)
Output	LOGDIA (21,3)	REAL	Log end diameters for up to 20 logs. 1) Scaling diameter inside bark (rounded or truncated value). 2) Actual predicted diameter inside bark. 3) Actual predicted diameter outside bark. First number is large end diameter butt log, second number is small end diameter of butt log and also large end diameter of second log and so on.
Output	LOGLEN (20)	REAL	Log lengths in feet for up to 20 logs.

Output	BOLHT(21)	REAL	The actual heights up the tree where the corresponding LOGDIA values were predicted.
Output	TLOGS	INTEGER	Total number of logs in a tree.
Output	LOGST	INTEGER	Total number of logs in a tree.
Output	NOLOGP	REAL	Number of 16 foot logs in the merchantable part of a tree, from stump to minimum top diameter for primary product.
Output	NOLOGS	REAL	Number of 16 foot logs in the topwood part or the tree, from the minimum top diameter for the primary product to the minimum top diameter for the secondary product.
Output	ERRFLAG	INTEGER	Returned Error Code: 1. No volume equation match 2. No form class 3. DBH less than one 4. Tree height less than 4.5 5. D2H is out of bounds 6. No species match 7. Illegal primary product log height (Ht1prd) 8. Illegal secondary product log height (Ht2prd) 9. Upper stem measurements required 10. Illegal upper stem height (UPSHT1) 11. Unable to fit profile given dbh, merch ht and top dia 12. Tree has more than 20 logs 13. Top diameter greater than DBH inside bark 14. The bark equation for the VOLEQ does not exist or yields a negative DBHIB. 15. Invalid BIOEQ 16. Primary prod height(HT1PRD) required for biomass calculation 17. Secondary prod height(HT2PRD) required for biomass calculation 18. Stem cubic volume required for the select BIOEQ
Output	DRYBIO(15)	REAL	Dry biomass, array of 15 biomass elements: 1) above ground biomass (no foliage) 2) total stem wood 3) total stem bark 4) stump wood 5) stump bark 6) sawtimber wood (primary) 7) sawtimber bark 8) topwood wood (secondary) 9) topwood bark 10) tip wood 11) tip bark 12) branches 13) foliage 14) top and limb 15) carbon content
Output	GRNBIO(15)	REAL	Green biomass (elements same as DRYBIO)
Input	BA	INTEGER	Basal Area of the stand. Optional variable used when calculating the merchantable heights required with the current Region 8 and Region 9 volume models.
Input	SI	INTEGER	Site Index of the stand. Optional variable used when calculating the merchantable heights required with the current Region 8 and Region 9 volume models.
Input	CTYPE	STRING	Cruise Type: Flag to set some special volume criteria.

			'C' or blank = Cruise volumes. Will return zero volumes if required fields are missing. 'F' = FVS volumes. Missing merchantable heights and form class variables will be calculated if they are required. 'V' = Variable log length cruise. Requires the TLOGS variable to contain the number of logs and the LOGLEN variable to contain the variable log lengths. 'I" = FIA. This flag to let NSVB equation to calculate merchantable volume as the total volume from stump to merchantable height without removing trims. Trims will be removed for log volume calculation.

3. Merchandizing Rules Applied to Profile Models by Region

When Profile models (or taper equations) are used to estimate the volume of a tree, the main stem of the tree needs to be segmented into logs. Several merchandizing rules, determined by each Region, are applied to determine these log lengths.

Region 1:

Scribner Decimal C
Only even log lengths
Maximum log length is 16 feet
Minimum log length is 8 feet (16 feet for Prod 08)
Minimum log length for topwood logs is 16 feet
Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, will default to a one foot stump.
At least one 8 foot (16 feet for Prod 08) log must be present for the tree to be considered merchantable.

Region 2:

Scribner Decimal C
Only even log lengths
Maximum log length is 16 feet
Minimum log length is 2 feet
Minimum log length for topwood logs is 2 feet
Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, will default to a one foot stump.
At least one 8 foot log must be present for the tree to be considered merchantable.

Region 3:

Scribner Decimal C
Only even log lengths
Maximum log length is 16 feet
Minimum log length is 2 feet
Minimum log length for topwood logs is 2 feet
Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.

If no stump height is recorded, will default to a one foot stump.
At least one 8 foot log must be present for the tree to be considered merchantable.

Region 4:

Scribner Decimal C
Only even log lengths
Maximum log length is 16 feet
Minimum log length is 2 feet
Minimum log length for topwood logs is 2 feet
Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, will default to a one foot stump.
At least one 8 foot log must be present for the tree to be considered merchantable.

Region 5:

Scribner Decimal C
Only even log lengths
Maximum log length is 16 feet
Minimum log length is 2 feet
Minimum log length for topwood logs is 2 feet
Segmentation logic:

Logs are divided into 16 foot logs. If the top log is greater than 2 feet and less than 16 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 16 and an 8 foot log become two 12 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, will default to a one foot stump.
At least one 8 foot log must be present for the tree to be considered merchantable.

Region 6:

Scribner factor volume reported to nearest board foot.
Only even log lengths
Maximum log length is 16 feet
Minimum log length is 2 feet
Minimum log length for topwood logs is 2 feet
Segmentation logic:

Logs are divided into 16 foot logs with the top log standing on it's own. (ie: A 16 and an 8 foot log stay 16 and 8 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, no stump height will be accounted for.
At least one 8 foot log must be present for the tree to be considered merchantable.

To calculate board foot volumes for 32 foot logs, the first two logs are added together, the volume computed using the small end diameter for the top log using the total log length,

then the volume is prorated back to the two 16 foot log segments. The next two logs are added together and so on up the tree.

Region 8:

Scribner Decimal C
Only even log lengths
Maximum log length is 8 feet
Minimum log length is 2 feet
Minimum log length for topwood logs is 4 feet
Segmentation logic:

Logs are divided into 8 foot logs. If the top log is greater than 4 feet and less than 8 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 8 and an 4 foot log become two 6 foot logs).

A 4 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, will default to a one foot stump for sawtimber and 0.5 foot for pulp.
At least one 8 foot log must be present for the tree to be considered merchantable.

Region 9:

Scribner Decimal C
Only even log lengths
Maximum log length is 8 feet
Minimum log length is 2 feet
Minimum log length for topwood logs is 4 feet
Segmentation logic:

Logs are divided into 8 foot logs. If the top log is greater than 2 feet and less than 8 feet, it is added to the previous log and split into two nearly equal even lengths. (ie: A 8 and an 4 foot log become two 6 foot logs).

A 4 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, will default to a one foot stump for sawtimber and 0.5 foot for pulp.
At least one 8 foot log must be present for the tree to be considered merchantable.

Region 10:

Scribner Decimal C
Only even log lengths
Maximum log length is 16 feet
Minimum log length is 8 feet
Minimum log length for topwood logs is 8 feet
Segmentation logic:

Logs are divided into 16 foot logs with the top log standing on it's own. (ie: A 16 and an 8 foot log stay 16 and 8 foot logs).

A 6 inch trim allowance will be accounted for when determining number of logs in a tree.
If no stump height is recorded, a 1.0 stump height will be used.
At least one 8 foot log must be present for the tree to be considered merchantable.

To calculate board foot volumes for 32 foot logs, the first two logs are added together, the volume computed using the small end diameter for the top log using the total log length, then the volume is prorated back to the two 16 foot log segments. The next two logs are added together and so on up the tree.

4. Volume Equation Numbers By Region.

A Forest Number of zero represents a Region-wide volume model.

A Forest Number other the zero means the volume model applies to this Forest.

Region 1

Region 1 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Balsam fir	0	I00FW3W012	Flewelling Profile Model 3pt	0
Balsam fir	0	I00FW2W012	Flewelling Profile Model	1/0
Blue spruce	0	102DVEW090	Kemp Equation	1/0
Blue spruce	0	101DVEW090	Allen Equation	0
Bristlecone pine	0	101DVEW108	Allen Equation	0
Bristlecone pine	0	100JB2W108	Byrne Equation	0
Bristlecone pine	0	102DVEW108	Kemp Equation	1/0
Cottonwood	0	101DVEW740	Edminster Equation	0
Cottonwood	0	102DVEW740	Kemp Equation	1
Douglas fir	0	100JB2W202	Byrne Equation	0
Douglas fir	0	101DVEW202	Allen Equation	0
Douglas fir	0	102DVEW202	Kemp Equation	0
Douglas fir	0	I00FW2W202	Flewelling Profile Model	1
Douglas fir	0	103DVEW202	Kemp Equation	0
Douglas fir	0	I00FW3W202	Flewelling Profile Model 3pt	0
Engelmann's spruce	0	I00FW2W093	Flewelling Profile Model	1
Engelmann's spruce	0	101DVEW090	Allen Equation	0
Engelmann's spruce	0	I00FW3W093	Flewelling Profile Model 3pt	0
Engelmann's spruce	0	102DVEW090	Kemp Equation	0
Grand fir	0	I00FW3W017	Flewelling Profile Model 3pt	0
Grand fir	0	101DVEW017	Allen Equation	0
Grand fir	0	100JB2W017	Byrne Equation	0
Grand fir	0	I00FW2W017	Flewelling Profile Model	1
Grand fir	0	102DVEW017	Kemp Equation	0
Juniper	0	102DVEW060	Kemp Equation	0/1
Larch	0	I00FW2W073	Flewelling Profile Model	1
Limber pine	0	I00FW2W073	Flewelling Profile Model	1
Limber pine	0	101DVEW108	Allen Equation	0
Limber pine	0	102DVEW108	Kemp Equation	0
Lodgepole pine	0	104DVEW108	Kemp Equation	0
Lodgepole pine	0	102DVEW108	Kemp Equation	0
Lodgepole pine	0	101DVEW108	Allen Equation	0
Lodgepole pine	0	100JB2W108	Byrne Equation	0
Lodgepole pine	14	103DVEW108	Kemp Equation	0
Lodgepole pine	0	I00FW3W108	Flewelling Profile Model 3pt	0
Lodgepole pine	0	I00FW2W108	Flewelling Profile Model	1

Region 1 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Mountain hemlock	0	102DVEW260	Kemp Equation	0
Mountain hemlock	0	I00FW2W260	Flewelling Profile Model	1
Mountain hemlock	0	101DVEW060	Allen Equation	0
Other Softwoods	0	I00FW2W073	Flewelling Profile Model	0/1
Pacific yew	0	616BEHW231	Behre's Hyperbola	0/1
Paper birch	0	101DVEW375	N. Central Station Equation	0/1
Pinyon Pine	0	102DVEW106	Kemp Equation	0
Ponderosa pine	0	100JB2W122	Byrne Equation	0
Ponderosa pine	8	104DVEW122	Kemp Equation	0
Ponderosa pine	0	102DVEW122	Kemp Equation	0
Ponderosa pine	8	105DVEW122	Kemp Equation	0
Ponderosa pine	8	106DVEW122	Kemp Equation	0
Ponderosa pine	0	I00FW3W122	Flewelling Profile Model 3pt	1
Ponderosa pine	8	203FW2W122	Flewelling Profile Model	1
Ponderosa pine	0	I00FW2W122	Flewelling Profile Model	0
Ponderosa pine	14	103DVEW122	Kemp Equation	0
Ponderosa pine	0	101DVEW122	Allen Equation	0
Quaking aspen	0	200DVEW746	Edminster Equation	1
Quaking aspen	0	102DVEW746	Kemp Equation	0/1
Rocky Mountain maple	0	200DVEW746	Edminster Equation	0
Subalpine fir	0	102DVEW019	Kemp Equation	0
Subalpine fir	0	101DVEW019	Allen Equation	0
Subalpine fir	0	100JB2W019	Byrne Equation	0
Subalpine fir	0	I00FW3W019	Flewelling Profile Model 3pt	1
Subalpine fir	0	I00FW2W019	Flewelling Profile Model	1
Subalpine larch	0	100JB2W073	Byrne Equation	0
Subalpine larch	0	102DVEW073	Kemp Equation	0
Subalpine larch	0	101DVEW073	Allen Equation	0
Unknown	0	101DVEW999	Allen Equation	0
Western hemlock	0	101DVEW260	Allen Equation	1
Western hemlock	0	I00FW2W260	Flewelling Profile Model	0
Western hemlock	0	I00FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	102DVEW260	Kemp Equation	0
Western larch	0	I00FW3W073	Flewelling Profile Model 3pt	1
Western larch	0	I00FW2W073	Flewelling Profile Model	0
Western larch	0	102DVEW070	Kemp Equation	0
Western larch	0	100JB2W073	Byrne Equation	0
Western larch	0	101DVEW073	Allen Equation	1
Western redcedar	0	I00FW2W242	Flewelling Profile Model	0
Western redcedar	0	101DVEW240	Allen Equation	0

Region 1 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Western redcedar	0	I00FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	0	102DVEW240	Kemp Equation	1
Western white pine	0	I00FW2W119	Flewelling Profile Model	0
Western white pine	0	102DVEW119	Kemp Equation	0
Western white pine	0	101DVEW119	Allen Equation	0
Western white pine	0	I00FW3W119	Flewelling Profile Model 3pt	0
White fir	0	102DVEW017	Kemp Equation	0
White fir	0	100JB2W017	Byrne Equation	0
White fir	0	101DVEW017	Allen Equation	0
White spruce	0	101DVEW090	Allen Equation	0
White spruce	0	102DVEW090	Kemp Equation	0
Whitebark pine	0	100JB2W108	Byrne Equation	0
Whitebark pine	0	101DVEW108	Allen Equation	0
Whitebark pine	0	100JB2W108	Byrne Equation	0
Whitebark pine	0	102DVEW108	Kemp Equation	0
Whitebark pine	0	102DVEW101	Kemp Equation	0
Whitebark pine	0	I00FW2W012	Flewelling Profile Model	1

Region 2

Region 2 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Bur Oak	0	200DVEW823	Chojnacky Equation	1
Douglas fir	0	200FW2W202	Flewelling Profile Model	1
Douglas fir	0	200FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	200CZ2W202	Czaplewski Profile Model	0
Douglas fir	0	200DVEW093	Myers Equation	0
Douglas fir	0	200CZ3W202	Czaplewski Profile Model 3pt	0
Engelmann's spruce	0	200CZ3W093	Czaplewski Profile Model 3pt	0
Engelmann's spruce	0	200CZ2W093	Czaplewski Profile Model	0
Engelmann's spruce	0	407FW2W093	Flewelling Profile Model	1
Engelmann's spruce	0	210DVEW093	Myers Equation	0
Engelmann's spruce	0	200DVEW093	Myers Equation	0
Gambel Oak	0	200DVEW814	Chojnacky Equation	1/0
Mountain Mahogany	0	200DVEW475	Chojnacky Equation	1/0
Lodgepole pine	0	200CZ3W108	Czaplewski Profile Model 3pt	0
Lodgepole pine	0	200DVEW108	Myers Equation	0
Lodgepole pine	0	210DVEW108	Myers Equation	0
Lodgepole pine	2	202FW3W108	Flewelling Profile Model 3pt	0
Lodgepole pine	0	200CZ2W108	Czaplewski Profile Model	0

Region 2 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Lodgepole pine	0	200FW3W108	Flewelling Profile Model 3pt	1
Lodgepole pine	0	200FW2W108	Flewelling Profile Model	1
Lodgepole pine	2,14	202FW2W108	Flewelling Profile Model	1
Oneseed Juniper	0	200DVEW069	Chojnacky Equation	1
Other Hardwoods	0	200DVEW998	Chojnacky Equation	1
Pinyon Pine	0	200DVEW106	Chojnacky Equation	1
Ponderosa pine	3	203FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	0	200FW2W122	Flewelling Profile Model	1
Ponderosa pine	0	200FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	0	212DVEW122	Edminster Equation 1	0
Ponderosa pine	13	213FW2W122	Flewelling Profile Model	1
Ponderosa pine	0	213DVEW122	Edminster Equation 1	0
Ponderosa pine	3	203FW2W122	Flewelling Profile Model	1
Ponderosa pine	3	223DVEW122	Direct Volume equation for small non-saw product trees	1
Ponderosa pine	0	200CZ3W122	Czaplewski Profile Model 3pt	0
Ponderosa pine	3	203CZ3W122	Czaplewski Profile Model 3pt	0
Ponderosa pine	0	200CZ2W122	Czaplewski Profile Model	0
Ponderosa pine	3	203CZ2W122	Czaplewski Profile Model	0
Ponderosa pine	0	210DVEW122	Edminster Equation 1	0
Ponderosa pine	0	200DVEW122	Edminster Equation 1	0
Ponderosa pine	3	203DVEW122	Myers Equation	0
Ponderosa pine	13	213FW3W122	Flewelling Profile Model 3pt	0
Quaking aspen	0	200CZ2W746	Czaplewski Profile Model	0
Quaking aspen	0	200DVEW746	Edminster Equation 2	0
Quaking aspen	0	200CZ3W746	Czaplewski Profile Model 3pt	0
Quacking aspen	0	200FW2W746	Flewelling Profile Model	1
Quacking aspen	0	200FW3W746	Flewelling Profile Model 3pt	0
Quaking aspen	0	210DVEW746	Edminster Equation 2	0
Rocky Mtn. Juniper	0	200DVEW066	Chojnacky Equation	1/0
Subalpine fir	0	I00FW2W019	Flewelling Profile Model	1
Subalpine fir	0	200CZ3W019	Czaplewski Profile Model 3pt	0
Subalpine fir	0	200CZ2W019	Czaplewski Profile Model	0
Subalpine fir	0	200DVEW093	Myers Equation	0
Utah Juniper	0	200DVEW065	Chojnacky Equation	1
White fir	0	200FW2W015	Flewelling Profile Model	1
White fir	0	200FW3W015	Flewelling Profile Model 3pt	0
White fir	0	200CZ2W015	Czaplewski Profile Model	0
White fir	0	200CZ3W015	Czaplewski Profile Model 3pt	0
White fir	0	200DVEW015	Myers Equation	0

Region 3

Region 3 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Black maple	0	300DVEW314	Chojnacky Equation	1/0
Douglas fir	0	301DVEW202	Hann and Bare Equation	0/1
Douglas fir	2	302DVEW202	Hann and Bare Equation	0/1
Douglas fir	3	302DVEW202	Hann and Bare Equation	0/1
Douglas fir	7	302DVEW202	Hann and Bare Equation	0/1
Douglas fir	10	302DVEW202	Hann and Bare Equation	0/1
Douglas fir	10	301FW2W202	Flewelling Profile Model	0/1
Douglas fir	0	300FW2W202	Flewelling Profile Model	1/0
Engelmann's spruce	0	300DVEW093	Hann and Bare Equation	0/1
Engelmann's spruce	0	NVBM330093	National-scale Volume and Biomass	1/0
Juniper	0	300DVEW060	Chojnacky Equation	1
Limber pine	0	300DVEW113	Hann and Bare Equation	1
Maple	0	300DVEW310	Chojnacky Equation	1
Oak	0	300DVEW800	Chojnacky Equation	1
Pinyon Pine	0	300DVEW106	Chojnacky Equation	1
Ponderosa pine	0	300FW2W122	Flewelling Profile Model	0/1
Ponderosa pine	0	300FW3W122	Flewelling Profile Model 3pt	0/1
Ponderosa pine	0	300DVEW122	Eager Mill Study Equation	0/1
Ponderosa pine	10	301FW2W122	Flewelling Profile Model	0
Quaking aspen	0	300DVEW746	Hann and Bare Equation	0/1
Quaking aspen	0	NVB0000746	National-scale Volume and Biomass	1/0
Unknown	0	300DVEW999	Chojnacky Equation	1
White fir	2	302DVEW015	Hann and Bare Equation	0/1
White fir	7	302DVEW015	Hann and Bare Equation	0/1
White fir	3	302DVEW015	Hann and Bare Equation	0/1
White fir	10	302DVEW015	Hann and Bare Equation	0/1
White fir	10	301FW2W015	Flewelling Profile Model	0/1
White fir	0	301DVEW015	Hann and Bare Equation	0/1
White fir	0	NVB0000015	National-scale Volume and Biomass	1/0
White pine	10	301FW2W108	Flewelling Profile Model	0/1
White pine	0	NVBM240119	National-scale Volume and Biomass	1/0

Region 4

Region 4 Volume Equation Numbers By Species and Forest Number

Species Name	Forest Number	Volume Equation Number	Volume Model Name	Used By Cruise/FVS 1 = Yes
Blue spruce	7	407FW2W093	Flewelling Profile Model	1
Blue spruce	0	400MATW093	Rustagi Profile Model	1
Blue spruce	12	I15FW2W093	Flewelling Profile Model	1
Blue spruce	13	I15FW2W093	Flewelling Profile Model	1
Blue spruce	8	407MATW093	Rustagi Profile Model	1
Blue spruce	2	I15FW2W093	Flewelling Profile Model	1
California red fir	9	400MATW020	Rustagi Profile Model	1/0
California red fir	17	400MATW020	Rustagi Profile Model	1/0
Douglas fir	12	I15FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	12	I15FW2W202	Flewelling Profile Model	1
Douglas fir	2	I15FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	2	I15FW2W202	Flewelling Profile Model	1
Douglas fir	5	405MATW202	Rustagi Profile Model	1
Douglas fir	0	400MATW202	Rustagi Profile Model	1
Douglas fir	2	401MATW202	Rustagi Profile Model	0
Douglas fir	12	401MATW202	Rustagi Profile Model	0
Douglas fir	13	I15FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	13	I15FW2W202	Flewelling Profile Model	1
Engelmann's spruce	12	I15FW2W093	Flewelling Profile Model	1
Engelmann's spruce	13	I15FW2W093	Flewelling Profile Model	1
Engelmann's spruce	7	407FW3W093	Flewelling Profile Model 3pt	0
Engelmann's spruce	12	I15FW3W093	Flewelling Profile Model 3pt	0
Engelmann's spruce	7	407FW2W093	Flewelling Profile Model	1
Engelmann's spruce	2	I15FW3W093	Flewelling Profile Model 3pt	0
Engelmann's spruce	8	407MATW093	Rustagi Profile Model	1
Engelmann's spruce	2	I15FW2W093	Flewelling Profile Model	1
Engelmann's spruce	7	407MATW093	Rustagi Profile Model	0
Engelmann's spruce	13	I15FW3W093	Flewelling Profile Model 3pt	0
Engelmann's spruce	0	400MATW093	Rustagi Profile Model	1
Grand fir	2	I15FW3W017	Flewelling Profile Model 3pt	0
Grand fir	0	400MATW015	Rustagi Profile Model	1
Grand fir	2	I15FW2W017	Flewelling Profile Model	1
Grand fir	13	I15FW2W017	Flewelling Profile Model	1
Grand fir	12	I15FW3W017	Flewelling Profile Model 3pt	0
Grand fir	13	I15FW3W017	Flewelling Profile Model 3pt	0
Grand fir	12	I15FW2W017	Flewelling Profile Model	1
Incense cedar	9	400MATW081	Rustagi Profile Model	1
Incense cedar	17	400MATW081	Rustagi Profile Model	1
Limber pine	17	401MATW108	Rustagi Profile Model	1
Limber pine	9	401MATW108	Rustagi Profile Model	1
Limber pine	0	400MATW108	Rustagi Profile Model	1
Lodgepole pine	17	401MATW108	Rustagi Profile Model	1

Region 4 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Lodgepole pine	9	401MATW108	Rustagi Profile Model	1
Lodgepole pine	0	400MATW108	Rustagi Profile Model	1
Mountain hemlock	9	401MATW015	Rustagi Profile Model	1/0
Mountain hemlock	17	401MATW015	Rustagi Profile Model	1/0
Mountain Mahogany	0	400DVEW475	Chojnacky Equation	1
Other Hardwoods	0	400DVEW998	Chojnacky Equation	1
Pinyon Pine	0	400DVEW106	Chojnacky Equation	1
Pinyon Pine Single Leaf	0	400DVEW133	Chojnacky Equation	1
Ponderosa pine	2	I15FW2W122	Flewelling Profile Model	1
Ponderosa pine	9	403MATW122	Rustagi Profile Model	1
Ponderosa pine	0	400MATW122	Rustagi Profile Model	1
Ponderosa pine	19	402MATW122	Rustagi Profile Model	1
Ponderosa pine	18	402MATW122	Rustagi Profile Model	1
Ponderosa pine	10	402MATW122	Rustagi Profile Model	1
Ponderosa pine	8	402MATW122	Rustagi Profile Model	1
Ponderosa pine	7	402MATW122	Rustagi Profile Model	1
Ponderosa pine	1	401MATW122	Rustagi Profile Model	1
Ponderosa pine	13	I15FW2W122	Flewelling Profile Model	1
Ponderosa pine	17	403MATW122	Rustagi Profile Model	1
Ponderosa pine	12	I15FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	13	I15FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	2	I15FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	12	I15FW2W122	Flewelling Profile Model	1
Quaking aspen	0	400MATW746	Rustagi Profile Model	1
Rocky Mtn. Juniper	0	400DVEW066	Chojnacky Equation	1
Subalpine fir	0	400MATW019	Rustagi Profile Model	1
Subalpine fir	5	405MATW019	Rustagi Profile Model	1
Sugar pine	17	400MATW117	Rustagi Profile Model	1/0
Sugar pine	9	400MATW117	Rustagi Profile Model	1/0
Utah Juniper	0	400DVEW065	Chojnacky Equation	1
Utah Juniper	1	401DVEW065	Chojnacky Equation	1
Utah Juniper	10	401DVEW065	Chojnacky Equation	1
Western Juniper	0	400DVEW064	Chojnacky Equation	1
Western larch	14	400MATW073	Rustagi Profile Model	1
Western larch	13	400MATW073	Rustagi Profile Model	1
Western larch	6	400MATW073	Rustagi Profile Model	1
Western larch	2	400MATW073	Rustagi Profile Model	1
Western larch	12	400MATW073	Rustagi Profile Model	1
Western white pine	17	400MATW117	Rustagi Profile Model	1
Western white pine	9	400MATW117	Rustagi Profile Model	1

Region 4 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
White fir	0	400MATW015	Rustagi Profile Model	1
White fir	9	401MATW015	Rustagi Profile Model	1
White fir	17	401MATW015	Rustagi Profile Model	1
White fir	2	I15FW2W017	Flewelling Profile Model	1
White fir	12	I15FW2W017	Flewelling Profile Model	1
White fir	13	I15FW2W017	Flewelling Profile Model	1
White fir	12	I15FW3W017	Flewelling Profile Model 3pt	0
White fir	13	I15FW3W017	Flewelling Profile Model 3pt	0
White fir	2	I15FW3W017	Flewelling Profile Model 3pt	0
Whitebark pine	0	400MATW108	Rustagi Profile Model	1
Whitebark pine	9	401MATW108	Rustagi Profile Model	1
Whitebark pine	17	401MATW108	Rustagi Profile Model	1

Region 5

Region 5 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Bigleaf maple	0	500DVEW312	Pillsbury & Kirkley Equation	1
Blue oak	0	500DVEW807	Pillsbury & Kirkley Equation	1
California black oak	0	500DVEW818	Pillsbury & Kirkley Equation	1
California laurel	0	500DVEW981	Pillsbury & Kirkley Equation	1
California live oak	0	500DVEW801	Pillsbury & Kirkley Equation	1
California red fir	0	500WO2W020	Wensel &Olsen Profile Model	1
California red fir	5,6,8,9,10,14	532WO2W020	Wensel &Olsen Profile Model – Scribner 32	0
California white oak	0	500DVEW821	Pillsbury & Kirkley Equation	1
Canyon live oak	0	500DVEW805	Pillsbury & Kirkley Equation	1
Douglas fir	0	500WO2W202	Wensel &Olsen Profile Model	1
Douglas fir	5,6,8,9,10,14	532WO2W202	Wensel &Olsen Profile Model – Scribner 32	0
Engelmann's oak	0	500DVEW811	Pillsbury & Kirkley Equation	1
Engelmann spruce	0	500WO2W015	Wensel &Olsen Profile Model	1
Eucalyptus	0	H01SN2W510	Sharpnack Profile Model	1/0
Eucalyptus	0	H00SN2W510	Sharpnack Profile Model	1/0
Giant sequoia	0	500DVEW212	Pillsbury & Kirkley Equation	1
Golden chinkapin	0	500DVEW431	Pillsbury & Kirkley Equation	1
Incense cedar	0	500WO2W081	Wensel &Olsen Profile Model	1
Incense cedar	5,6,8,9,10,14	532WO2W081	Wensel &Olsen Profile Model – Scribner 32	0
Interior live oak	0	500DVEW839	Pillsbury & Kirkley Equation	1

Region 5 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Jeffrey pine	0	500WO2W116	Wensel &Olsen Profile Model	1
Jeffrey pine	5,6,8,9,10,14	532WO2W116	Wensel &Olsen Profile Model – Scribner 32	0
Juniper	0	500DVEW060	Pillsbury & Kirkley Equation	1
Koa	0	H00SN2W301	Sharpnack Profile Model	0
Koa	0	616BEHW000	Behre's Hyperbola	1/0
Lodgepole pine	0	500WO2W108	Wensel &Olsen Profile Model	1
Lodgepole pine	5,6,8,9,10,14	532WO2W108	Wensel &Olsen Profile Model – Scribner 32	0
Ohia	0	H00SN2W671	Sharpnack Profile Model	1/0
Oregon white oak	0	500DVEW815	Pillsbury & Kirkley Equation	1
Pacific madrone	0	500DVEW361	Pillsbury & Kirkley Equation	1
Ponderosa pine	0	500WO2W122	Wensel &Olsen Profile Model	1
Ponderosa pine	5,6,8,9,10,14	532WO2W122	Wensel &Olsen Profile Model – Scribner 32	0
Red alder	0	500DVEW351	Pillsbury & Kirkley Equation	1
Redwood	0	500WO2W211	Wensel &Olsen Profile Model	1
Redwood	5,6,8,9,10,14	532WO2W211	Wensel &Olsen Profile Model – Scribner 32	0
Sugar pine	0	500WO2W117	Wensel &Olsen Profile Model	1
Sugar pine	5,6,8,9,10,14	532WO2W117	Wensel &Olsen Profile Model – Scribner 32	0
Tanoak	0	500DVEW631	Pillsbury & Kirkley Equation	1
White fir	0	500WO2W015	Wensel &Olsen Profile Model	1
White fir	5,6,8,9,10,14	532WO2W015	Wensel &Olsen Profile Model – Scribner 32	0
White fir	0	516TRFW015	PNW tariff Equation	0
White fir	0	532TRFW015	PNW tariff Equation	0
California red fir	0	516TRFW021	PNW tariff Equation	0
California red fir	0	532TRFW021	PNW tariff Equation	0
Juniper	0	516TRFW060	PNW tariff Equation	0
Juniper	0	532TRFW060	PNW tariff Equation	0
Incense cedar	0	516TRFW081	PNW tariff Equation	0
Incense cedar	0	532TRFW081	PNW tariff Equation	0
Lodgepole pine	0	516TRFW108	PNW tariff Equation	0
Lodgepole pine	0	532TRFW108	PNW tariff Equation	0
Sugar pine	0	516TRFW117	PNW tariff Equation	0
Sugar pine	0	532TRFW117	PNW tariff Equation	0
Ponderosa pine	0	516TRFW122	PNW tariff Equation	0
Ponderosa pine	0	532TRFW122	PNW tariff Equation	0
Douglas-fir	0	516TRFW202	PNW tariff Equation	0
Redwood	0	616TRFW211	PNW tariff Equation	0

Region 5 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Redwood	0	632TRFW211	PNW tariff Equation	0

Region 6

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Balsam fir	10	632BEHW012	Behres Hyperbola	0/1
Balsam fir	6	632BEHW012	Behres Hyperbola	0/1
Balsam fir	15	632BEHW012	Behres Hyperbola	0/1
Balsam fir	0	628BEHW012	Behres Hyperbola	0
Balsam fir	18	632BEHW012	Behres Hyperbola	0/1
Balsam fir	9	632BEHW012	Behres Hyperbola	0/1
Balsam fir	12	632BEHW012	Behres Hyperbola	0/1
Balsam fir	0	616BEHW012	Behres Hyperbola	1
Balsam fir	11	632BEHW012	Behres Hyperbola	0/1
Balsam fir	0	I00FW3W012	Flewelling Profile Model 3pt	0
Balsam fir	5	632BEHW012	Behres Hyperbola	0/1
Balsam fir	3	632BEHW012	Behres Hyperbola	0/1
Balsam fir	0	I00FW2W012	Flewelling Profile Model	0
Douglas fir	18	632BEHW202	Behres Hyperbola	0/1
Douglas fir	0	F02FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	602DVEW204	Direct Volume Equation	0
Douglas fir	14	I13FW2W202	Flewelling Profile Model	1
Douglas fir	9	632BEHW202	Behres Hyperbola	0/1
Douglas fir	15	632BEHW202	Behres Hyperbola	0/1
Douglas fir	0	F03FW2W202	Flewelling Profile Model	0
Douglas fir	0	628BEHW202	Behres Hyperbola	0
Douglas fir	0	F01FW2W202	Flewelling Profile Model	0
Douglas fir	0	F02FW2W202	Flewelling Profile Model	0
Douglas fir	16	I11FW2W202	Flewelling Profile Model	1
Douglas fir	0	I00FW2W202	Flewelling Profile Model	0
Douglas fir	7	I12FW2W202	Flewelling Profile Model	1
Douglas fir	0	F03FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	I00FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	10	632BEHW202	Behres Hyperbola	0/1
Douglas fir	0	F00FW2W202	Flewelling Profile Model	0
Douglas fir	0	F04FW2W202	Flewelling Profile Model	0
Douglas fir	5	632BEHW202	Behres Hyperbola	0/1
Douglas fir	4	I12FW2W202	Flewelling Profile Model	1
Douglas fir	12	632BEHW202	Behres Hyperbola	0/1
Douglas fir	3	632BEHW202	Behres Hyperbola	0/1
Douglas fir	6	632BEHW202	Behres Hyperbola	0/1
Douglas fir	0	F04FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	601DVEW205	Direct Volume Equation	0
Douglas fir	0	I12FW2W202	Flewelling Profile Model	0

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Douglas fir	0	F00FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	F01FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	11	632BEHW202	Behres Hyperbola	0/1
Douglas fir	0	F08FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	F07FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	F06FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	F05FW3W202	Flewelling Profile Model 3pt	0
Douglas fir	0	F08FW2W202	Flewelling Profile Model	0
Douglas fir	0	F07FW2W202	Flewelling Profile Model	0
Douglas fir	0	F06FW2W202	Flewelling Profile Model	0
Douglas fir	0	F05FW2W202	Flewelling Profile Model	0
Douglas fir	0	616BEHW202	Behres Hyperbola	1
Engelmann's spruce	18	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	6	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	3	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	9	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	0	616BEHW093	Behres Hyperbola	1
Engelmann's spruce	11	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	0	I00FW3W093	Flewelling Profile Model 3pt	0
Engelmann's spruce	14	I00FW2W093	Flewelling Profile Model	1
Engelmann's spruce	0	628BEHW093	Behres Hyperbola	0
Engelmann's spruce	0	I00FW2W093	Flewelling Profile Model	0
Engelmann's spruce	15	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	10	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	12	632BEHW093	Behres Hyperbola	0/1
Engelmann's spruce	5	632BEHW093	Behres Hyperbola	0/1
Grand fir	12	632BEHW017	Behres Hyperbola	0/1
Grand fir	0	I13FW3W017	Flewelling Profile Model 3pt	0
Grand fir	0	I12FW3W017	Flewelling Profile Model 3pt	0
Grand fir	15	632BEHW017	Behres Hyperbola	0/1
Grand fir	0	I11FW3W017	Flewelling Profile Model 3pt	0
Grand fir	0	I14FW2W017	Flewelling Profile Model	0
Grand fir	0	I11FW2W017	Flewelling Profile Model	0
Grand fir	0	I00FW2W017	Flewelling Profile Model	0
Grand fir	0	I13FW2W017	Flewelling Profile Model	0
Grand fir	0	I12FW2W017	Flewelling Profile Model	0
Grand fir	0	I00FW3W017	Flewelling Profile Model 3pt	0
Grand fir	18	632BEHW017	Behres Hyperbola	0/1
Grand fir	5	632BEHW017	Behres Hyperbola	0/1
Grand fir	0	616BEHW017	Behres Hyperbola	1

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Grand fir	6	632BEHW017	Behres Hyperbola	0/1
Grand fir	3	632BEHW017	Behres Hyperbola	0/1
Grand fir	7	I12FW2W017	Flewelling Profile Model	1
Grand fir	14	I13FW2W017	Flewelling Profile Model	1
Grand fir	16	I11FW2W017	Flewelling Profile Model	1
Grand fir	9	632BEHW017	Behres Hyperbola	0/1
Grand fir	10	632BEHW017	Behres Hyperbola	0/1
Grand fir	0	I14FW3W017	Flewelling Profile Model 3pt	0
Grand fir	11	632BEHW017	Behres Hyperbola	0/1
Grand fir	4	I12FW2W017	Flewelling Profile Model	1
Grand fir	0	628BEHW017	Behres Hyperbola	0
Lodgepole pine	4	I00FW2W108	Flewelling Profile Model	1
Lodgepole pine	0	I00FW2W108	Flewelling Profile Model	0
Lodgepole pine	15	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	6	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	3	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	14	I00FW2W108	Flewelling Profile Model	1
Lodgepole pine	0	628BEHW108	Behres Hyperbola	0
Lodgepole pine	12	632BEHW108	Behres Hyperbola	0
Lodgepole pine	10	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	0	I00FW3W108	Flewelling Profile Model 3pt	0
Lodgepole pine	0	616BEHW108	Behres Hyperbola	1
Lodgepole pine	9	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	11	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	5	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	0	602DVEW108	Direct Volume Equation	0
Lodgepole pine	18	632BEHW108	Behres Hyperbola	0/1
Lodgepole pine	7	I00FW2W108	Flewelling Profile Model	1
Mountain hemlock	3	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	10	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	0	F02FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	18	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	0	F03FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	0	628BEHW000	Behres Hyperbola	0
Mountain hemlock	0	F00FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	0	F04FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	0	F08FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	9	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	11	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	12	632BEHW264	Behres Hyperbola	0/1

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Mountain hemlock	15	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	0	F06FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F01FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	0	616BEHW264	Behres Hyperbola	1
Mountain hemlock	0	F07FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	0	F05FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	5	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	0	I00FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	0	F01FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F02FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F03FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F08FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F00FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F04FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F05FW2W260	Flewelling Profile Model	0
Mountain hemlock	0	F06FW3W260	Flewelling Profile Model 3pt	0
Mountain hemlock	0	F07FW2W260	Flewelling Profile Model	0
Mountain hemlock	6	632BEHW264	Behres Hyperbola	0/1
Mountain hemlock	0	I00FW2W260	Flewelling Profile Model	0
Ponderosa pine	0	I14FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	0	I00FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	0	I11FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	14	I13FW2W122	Flewelling Profile Model	1
Ponderosa pine	12	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	4	I12FW2W122	Flewelling Profile Model	1
Ponderosa pine	9	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	0	I21FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	3	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	0	I13FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	0	600DVEW122	Direct Volume Equation	0
Ponderosa pine	15	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	0	616BEHW122	Behres Hyperbola	1
Ponderosa pine	18	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	10	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	0	I00FW2W122	Flewelling Profile Model	0
Ponderosa pine	0	I22FW2W122	Flewelling Profile Model	0
Ponderosa pine	0	I12FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	0	I21FW2W122	Flewelling Profile Model	0
Ponderosa pine	5	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	0	I14FW2W122	Flewelling Profile Model	0

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Ponderosa pine	0	I22FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	6	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	0	628BEHW122	Behres Hyperbola	0
Ponderosa pine	0	I23FW2W122	Flewelling Profile Model	0
Ponderosa pine	0	I23FW3W122	Flewelling Profile Model 3pt	0
Ponderosa pine	0	I12FW2W122	Flewelling Profile Model	0
Ponderosa pine	16	I11FW2W122	Flewelling Profile Model	1
Ponderosa pine	11	632BEHW122	Behres Hyperbola	0/1
Ponderosa pine	7	I12FW2W122	Flewelling Profile Model	1
Ponderosa pine	0	I13FW2W122	Flewelling Profile Model	0
Ponderosa pine	0	I11FW2W122	Flewelling Profile Model	0
Subalpine fir	10	632BEHW019	Behres Hyperbola	0/1
Subalpine fir	0	628BEHW019	Behres Hyperbola	0
Subalpine fir	9	632BEHW019	Behres Hyperbola	0/1
Subalpine fir	0	616BEHW019	Behres Hyperbola	1
Subalpine fir	18	632BEHW119	Behres Hyperbola	0/1
Subalpine fir	0	I00FW3W019	Flewelling Profile Model 3pt	0
Subalpine fir	3	632BEHW019	Behres Hyperbola	0/1
Subalpine fir	0	I00FW2W019	Flewelling Profile Model	0
Subalpine fir	6	632BEHW019	Behres Hyperbola	0/1
Subalpine fir	11	632BEHW019	Behres Hyperbola	0/1
Subalpine fir	5	632BEHW019	Behres Hyperbola	0/1
Subalpine fir	14	I00FW2W019	Flewelling Profile Model	1
Subalpine fir	12	632BEHW119	Behres Hyperbola	0/1
Subalpine fir	15	632BEHW119	Behres Hyperbola	0/1
Western hemlock	0	F08FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	616BEHW263	Behres Hyperbola	1
Western hemlock	3	632BEHW263	Behres Hyperbola	0/1
Western hemlock	0	F06FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	5	632BEHW263	Behres Hyperbola	0/1
Western hemlock	0	628BEHW263	Behres Hyperbola	0
Western hemlock	9	632BEHW263	Behres Hyperbola	0/1
Western hemlock	6	632BEHW263	Behres Hyperbola	0/1
Western hemlock	12	632BEHW263	Behres Hyperbola	0/1
Western hemlock	10	632BEHW263	Behres Hyperbola	0/1
Western hemlock	15	632BEHW263	Behres Hyperbola	0/1
Western hemlock	0	601DVEW263	Direct Volume Equation	0
Western hemlock	18	632BEHW263	Behres Hyperbola	0/1
Western hemlock	0	F07FW2W260	Flewelling Profile Model	0
Western hemlock	0	F03FW3W260	Flewelling Profile Model 3pt	0

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Western hemlock	0	F08FW2W260	Flewelling Profile Model	0
Western hemlock	11	632BEHW263	Behres Hyperbola	0/1
Western hemlock	0	F05FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	F01FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	F04FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	I00FW2W260	Flewelling Profile Model	0
Western hemlock	0	F05FW2W260	Flewelling Profile Model	0
Western hemlock	0	F02FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	F07FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	F06FW2W260	Flewelling Profile Model	0
Western hemlock	0	F04FW2W260	Flewelling Profile Model	0
Western hemlock	0	F03FW2W260	Flewelling Profile Model	0
Western hemlock	0	F02FW2W260	Flewelling Profile Model	0
Western hemlock	0	F01FW2W260	Flewelling Profile Model	0
Western hemlock	0	F00FW2W260	Flewelling Profile Model	0
Western hemlock	0	F00FW3W260	Flewelling Profile Model 3pt	0
Western hemlock	0	I00FW3W260	Flewelling Profile Model 3pt	0
Western larch	3	632BEHW073	Behres Hyperbola	0/1
Western larch	0	I00FW2W073	Flewelling Profile Model	0
Western larch	0	I21FW2W073	Flewelling Profile Model	0
Western larch	7	I12FW2W073	Flewelling Profile Model	1
Western larch	0	I23FW2W073	Flewelling Profile Model	0
Western larch	0	I13FW2W073	Flewelling Profile Model	0
Western larch	0	I00FW3W073	Flewelling Profile Model 3pt	0
Western larch	10	632BEHW073	Behres Hyperbola	0/1
Western larch	12	632BEHW073	Behres Hyperbola	0/1
Western larch	11	632BEHW073	Behres Hyperbola	0/1
Western larch	14	I13FW2W073	Flewelling Profile Model	1
Western larch	15	632BEHW073	Behres Hyperbola	0/1
Western larch	0	I11FW2W073	Flewelling Profile Model	0
Western larch	6	632BEHW073	Behres Hyperbola	0/1
Western larch	0	I12FW2W073	Flewelling Profile Model	0
Western larch	0	I22FW2W073	Flewelling Profile Model	0
Western larch	0	I11FW3W073	Flewelling Profile Model 3pt	0
Western larch	0	I12FW3W073	Flewelling Profile Model 3pt	0
Western larch	0	616BEHW073	Behres Hyperbola	1
Western larch	18	632BEHW073	Behres Hyperbola	0/1
Western larch	5	632BEHW073	Behres Hyperbola	0/1
Western larch	0	I14FW2W073	Flewelling Profile Model	0
Western larch	0	I14FW3W073	Flewelling Profile Model 3pt	0

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Western larch	0	I21FW3W073	Flewelling Profile Model 3pt	0
Western larch	0	I22FW3W073	Flewelling Profile Model 3pt	0
Western larch	0	628BEHW073	Behres Hyperbola	0
Western larch	0	I23FW3W073	Flewelling Profile Model 3pt	0
Western larch	9	632BEHW073	Behres Hyperbola	0/1
Western larch	0	I13FW3W073	Flewelling Profile Model 3pt	0
Western redcedar	0	616BEHW242	Behres Hyperbola	1
Western redcedar	0	F00FW2W242	Flewelling Profile Model	0
Western redcedar	0	I00FW2W242	Flewelling Profile Model	0
Western redcedar	0	I00FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	0	I11FW2W242	Flewelling Profile Model	0
Western redcedar	10	632BEHW242	Behres Hyperbola	0/1
Western redcedar	9	632BEHW242	Behres Hyperbola	0/1
Western redcedar	6	632BEHW242	Behres Hyperbola	0/1
Western redcedar	18	632BEHW242	Behres Hyperbola	0/1
Western redcedar	0	F02FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	0	F01FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	12	632BEHW242	Behres Hyperbola	0/1
Western redcedar	5	632BEHW242	Behres Hyperbola	0/1
Western redcedar	0	F01FW2W242	Flewelling Profile Model	0
Western redcedar	0	F00FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	0	F04FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	3	632BEHW242	Behres Hyperbola	0/1
Western redcedar	0	F04FW2W242	Flewelling Profile Model	0
Western redcedar	0	F03FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	11	632BEHW242	Behres Hyperbola	0/1
Western redcedar	0	F03FW2W242	Flewelling Profile Model	0
Western redcedar	0	F02FW2W242	Flewelling Profile Model	0
Western redcedar	15	632BEHW242	Behres Hyperbola	0/1
Western redcedar	0	628BEHW242	Behres Hyperbola	0
Western white pine	15	632BEHW119	Behres Hyperbola	0/1
Western white pine	18	632BEHW119	Behres Hyperbola	0/1
Western white pine	0	628BEHW119	Behres Hyperbola	0
Western white pine	0	616BEHW119	Behres Hyperbola	1
Western white pine	3	632BEHW119	Behres Hyperbola	0/1
Western white pine	5	632BEHW119	Behres Hyperbola	0/1
Western white pine	9	632BEHW119	Behres Hyperbola	0/1
Western white pine	0	I00FW3W119	Flewelling Profile Model 3pt	0
Western white pine	12	632BEHW119	Behres Hyperbola	0/1
Western white pine	0	I00FW2W119	Flewelling Profile Model	0

Region 6 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Western white pine	11	632BEHW119	Behres Hyperbola	0/1
Western white pine	6	632BEHW119	Behres Hyperbola	0/1
Western white pine	10	632BEHW119	Behres Hyperbola	0/1
White fir	0	601DVEW015	Direct Volume Equation	0
White fir	7	I12FW2W017	Flewelling Profile Model	1
White fir	16	I11FW2W017	Flewelling Profile Model	1
White fir	0	602DVEW015	Direct Volume Equation	0
Subalpine fir	0	616TRFW019	PNW tariff Equation	0
Western larch	0	616TRFW073	PNW tariff Equation	0
Western larch	0	632TRFW073	PNW tariff Equation	0
White spruce	0	616TRFW094	PNW tariff Equation	0
Sitka spruce	0	616TRFW098	PNW tariff Equation	0
Sitka spruce	0	632TRFW098	PNW tariff Equation	0
Lodgepole pine	0	616TRFW108	PNW tariff Equation	0
Lodgepole pine	0	632TRFW108	PNW tariff Equation	0
Ponderosa pine	0	616TRFW122	PNW tariff Equation	0
Ponderosa pine	0	632TRFW122	PNW tariff Equation	0
Douglas-fir	0	616TRFW202	PNW tariff Equation	0
Douglas-fir	0	632TRFW202	PNW tariff Equation	0
Western redcedar	0	616TRFW242	PNW tariff Equation	0
Western redcedar	0	632TRFW242	PNW tariff Equation	0
Western hemlock	0	616TRFW263	PNW tariff Equation	0
Western hemlock	0	632TRFW263	PNW tariff Equation	0
Mountain hemlock	0	616TRFW264	PNW tariff Equation	0
Mountain hemlock	0	632TRFW264	PNW tariff Equation	0
Red alder	0	616TRFW351	PNW tariff Equation	0
Red alder	03	A16CURW351	Curtis Profile Model	1/0
Red alder	12	NVBM240351	National-scale Volume and Biomass	1/0
Quacking aspen	0	616TRFW746	PNW tariff Equation	0
Black cottonwood	0	616TRFW747	PNW tariff Equation	0
Unknown hardwood	0	616TRFW998	PNW tariff Equation	0
Pacific silver fir	0	632TRFW011	PNW tariff Equation	0

Region 7 (BLM)

(BLM) Total Tree Height or Height in 16 Foot Logs					
Species Name	**Code**	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Douglas fir/Cascade	PSME	ALL	B01BEHW202	Behre's Hyperbola	1
Douglas fir/Coast	PSME	ALL	B02BEHW202	Behre's Hyperbola	1

(BLM) Total Tree Height or Height in 16 Foot Logs					
Species Name	**Code**	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Douglas fir/Southwest	PSME	ALL	B03BEHW202	Behre's Hyperbola	1/0
Redwood	SESE3	ALL	B00BEHW211	Behre's Hyperbola	1
Pond. pine/Yellow	PIPO	ALL	B00BEHW122	Behre's Hyperbola	1
Jeffery pine	PIJE	ALL	B00BEHW116	Behre's Hyperbola	1
Sugar pine	PILA	ALL	B00BEHW117	Behre's Hyperbola	1
Western white pine	PIMO3	ALL	B00BEHW119	Behre's Hyperbola	1
Lodgepole pine	PICO	ALL	B00BEHW108	Behre's Hyperbola	1
Pacific yew	TABR2	ALL	B00BEHW231	Behre's Hyperbola	1
Tan oak	LIDE3	ALL	B00BEHW631	Behre's Hyperbola	1
Red alder	ALRU2	ALL	B00BEHW351	Behre's Hyperbola	1
Oregon myrtle		ALL	B00BEHW998	Behre's Hyperbola	1/0
Big leaf maple	ACMA3	ALL	B00BEHW312	Behre's Hyperbola	1
Pacific madrone	ARME	ALL	B00BEHW361	Behre's Hyperbola	1
Golden chinquapin	CHCHC4	ALL	B00BEHW431	Behre's Hyperbola	1
Oregon ash	FRLA	ALL	B00BEHW542	Behre's Hyperbola	1
Black cottonwood	POBAT	ALL	B00BEHW747	Behre's Hyperbola	1
Oak species	QUESPP	ALL	B00BEHW800	Behre's Hyperbola	1
White fir/Westside	ABCO	ALL	B00BEHW015	Behre's Hyperbola	1
Shasta red fir	ABSH	ALL	B00BEHW021	Behre's Hyperbola	1
Grand fir	ABGR	ALL	B00BEHW017	Behre's Hyperbola	1
Pacific. silver fir	ABAM	ALL	B00BEHW011	Behre's Hyperbola	1
Noble fir	ABPR	ALL	B00BEHW022	Behre's Hyperbola	1
Engelmann spruce	PIEN	ALL	B00BEHW093	Behre's Hyperbola	1
Sitka spruce	PISI	ALL	B00BEHW098	Behre's Hyperbola	1
Hemlock	TSHE	ALL	B00BEHW260	Behre's Hyperbola	1
Incense cedar	CADE27	ALL	B00BEHW081	Behre's Hyperbola	1
Alaska cedar	CHNO	ALL	B00BEHW042	Behre's Hyperbola	1
Port Orford cedar	CHLA	ALL	B00BEHW041	Behre's Hyperbola	1
Western red cedar	THPL	ALL	B00BEHW242	Behre's Hyperbola	1
Western larch	LAOC	ALL	B00BEHW073	Behre's Hyperbola	1/0
Misc. species	UNLSPP	ALL	B00BEHW999	Behre's Hyperbola	1

All = Equation good for all Forest or Districts.

(BLM) Total Tree Height or Height in 32 Foot Logs					
Species Name	**Code**	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Douglas fir/Cascade	PSME	ALL	B01B32W202	Behre's Hyperbola	1/0
Douglas fir/Coast	PSME	ALL	B02B32W202	Behre's Hyperbola	1/0
Douglas fir/Southwest	PSME	ALL	B03B32W202	Behre's Hyperbola	1/0
Redwood	SESE3	ALL	B00B32W211	Behre's Hyperbola	1/0

(BLM) Total Tree Height or Height in 32 Foot Logs					
Species Name	**Code**	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Pond. pine/Yellow	PIPO	ALL	B00B32W122	Behre's Hyperbola	1/0
Jeffery pine	PIJE	ALL	B00B32W116	Behre's Hyperbola	1/0
Sugar pine	PILA	ALL	B00B32W117	Behre's Hyperbola	1/0
Western white pine	PIMO3	ALL	B00B32W119	Behre's Hyperbola	1/0
Lodgepole pine	PICO	ALL	B00B32W108	Behre's Hyperbola	1/0
Pacific yew	TABR2	ALL	B00B32W231	Behre's Hyperbola	1/0
Tan oak	LIDE3	ALL	B00B32W631	Behre's Hyperbola	1/0
Red alder	ALRU2	ALL	B00B32W351	Behre's Hyperbola	1/0
Oregon myrtle		ALL	B00B32W998	Behre's Hyperbola	1/0
Big leaf maple	ACMA3	ALL	B00B32W312	Behre's Hyperbola	1/0
Pacific madrone	ARME	ALL	B00B32W361	Behre's Hyperbola	1/0
Golden chinquapin	CHCHC4	ALL	B00B32W431	Behre's Hyperbola	1/0
Oregon ash	FRLA	ALL	B00B32W542	Behre's Hyperbola	1/0
Black cottonwood	POBAT	ALL	B00B32W747	Behre's Hyperbola	1/0
Oak species	QUESPP	ALL	B00B32W800	Behre's Hyperbola	1/0
White fir/Westside	ABCO	ALL	B00B32W015	Behre's Hyperbola	1/0
Shasta red fir	ABSH	ALL	B00B32W021	Behre's Hyperbola	1/0
Grand fir	ABGR	ALL	B00B32W017	Behre's Hyperbola	1/0
Pacific. silver fir	ABAM	ALL	B00B32W011	Behre's Hyperbola	1/0
Noble fir	ABPR	ALL	B00B32W022	Behre's Hyperbola	1/0
Engelmann spruce	PIEN	ALL	B00B32W093	Behre's Hyperbola	1/0
Sitka spruce	PISI	ALL	B00B32W098	Behre's Hyperbola	1/0
Hemlock	TSHE	ALL	B00B32W260	Behre's Hyperbola	1/0
Incense cedar	CADE27	ALL	B00B32W081	Behre's Hyperbola	1/0
Alaska cedar	CHNO	ALL	B00B32W042	Behre's Hyperbola	1/0
Port Orford cedar	CHLA	ALL	B00B32W041	Behre's Hyperbola	1/0
Western red cedar	THPL	ALL	B00B32W242	Behre's Hyperbola	1/0
Western larch	LAOC	ALL	B00B32W073	Behre's Hyperbola	1/0
Misc. species	UNLSPP	ALL	B00B32W999	Behre's Hyperbola	1/0

All = Equation good for all Forest or Districts.

Region 8

Region 8 Volume Equation Numbers By Forest and District Number					
Replace the * with the Species Code from the Species Table Below**					
Species Name	**Forest Number**	**District Number**	**Equation Number (Cubic and Board Foot Volume)**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
All	0	0	891CLKE***	Clark Profile Model	1
All	1	0	841CLKE***	Clark Profile Model	1
All	1	3	811CLKE***	Clark Profile Model	1

Region 8 Volume Equation Numbers By Forest and District Number					
Replace the *** with the Species Code from the Species Table Below					
Species Name	**Forest Number**	**District Number**	**Equation Number (Cubic and Board Foot Volume)**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
All	2	0	831CLKE***	Clark Profile Model	1
All	3	0	831CLKE***	Clark Profile Model	1
All	3	8	821CLKE***	Clark Profile Model	1
All	4	0	831CLKE***	Clark Profile Model	1
All	5	0	811CLKE***	Clark Profile Model	1
All	6	0	851CLKE***	Clark Profile Model	1
All	7	0	851CLKE***	Clark Profile Model	1
All	7	6	871CLKE***	Clark Profile Model	1
All	7	7,17	841CLKE***	Clark Profile Model	1
All	8	0	831CLKE***	Clark Profile Model	1
All	9	0	861CLKE***	Clark Profile Model	1
All	10	0	861CLKE***	Clark Profile Model	1
All	10	3	811CLKE***	Clark Profile Model	1
All	10	10	821CLKE***	Clark Profile Model	1
All	11	0	831CLKE***	Clark Profile Model	1
All	12	0	821CLKE***	Clark Profile Model	1
All	12	2	831CLKE***	Clark Profile Model	1
All	12	5	811CLKE***	Clark Profile Model	1
All	13	0	851CLKE***	Clark Profile Model	1

Region 8 Volume Equation Numbers By Forest and District Number					
Replace the *** with the Species Code from the Species Table Below					
Species Name	**Forest Number**	**District Number**	**Equation Number (Board Foot Volume)**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
All	0	0	825DVEE***	Lasher Equations – Bdft	0
All	1	1	813DVEE***	Lasher Equations – Bdft	0
All	1	3	815DVEE***	Lasher Equations – Bdft	0
All	1	4	816DVEE***	Lasher Equations – Bdft	0
All	1	5,6	814DVEE***	Lasher Equations – Bdft	0
All	1	7	817DVEE***	Lasher Equations – Bdft	0
All	1	8	806DVEE***	Lasher Equations – Bdft	0
All	2	11,12,13,14,15,16,17	810DVEE***	Lasher Equations – Bdft	0
All	3	1,2,3,4,5,6,7	801DVEE***	Lasher Equations – Bdft	0
All	4	1,2,3,4,5,6	801DVEE***	Lasher Equations – Bdft	0
All	5	1,2,4,5,6	803DVEE***	Lasher Equations – Bdft	0

Region 8 Volume Equation Numbers By Forest and District Number					
Replace the *** with the Species Code from the Species Table Below					
Species Name	**Forest Number**	**District Number**	**Equation Number (Board Foot Volume)**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
All	6	1,2,3,4,5	802DVEE***	Lasher Equations – Bdft	0
All	6	6	809DVEE***	Lasher Equations – Bdft	0
All	7	1,10	819DVEE***	Lasher Equations – Bdft	0
All	7	2,3	820DVEE***	Lasher Equations – Bdft	0
All	7	4,8	821DVEE***	Lasher Equations – Bdft	0
All	7	5	822DVEE***	Lasher Equations – Bdft	0
All	7	6	818DVEE***	Lasher Equations – Bdft	0
All	7	7,17	823DVEE***	Lasher Equations – Bdft	0
All	8	1,2,3,4,5,6	811DVEE***	Lasher Equations – Bdft	0
All	9	1,6	830DVEE***	Lasher Equations – Bdft	0
All	9	2,3,4,5,7,8,9,10,11	831DVEE***	Lasher Equations – Bdft	0
All	9	12	832DVEE***	Lasher Equations – Bdft	0
All	10	1,2,3,4,5,6	804DVEE***	Lasher Equations – Bdft	0
All	10	7	805DVEE***	Lasher Equations – Bdft	0
All	11	2,4,5,6,7,8,9,11	801DVEE***	Lasher Equations – Bdft	0
All	11	3	807DVEE***	Lasher Equations – Bdft	0
All	11	10	808DVEE***	Lasher Equations – Bdft	0
All	12	1,3,7,8	824DVEE***	Lasher Equations – Bdft	0
All	12	2	801DVEE***	Lasher Equations – Bdft	0
All	12	5,6	825DVEE***	Lasher Equations – Bdft	0
All	13	1	826DVEE***	Lasher Equations – Bdft	0
All	13	3,6	827DVEE***	Lasher Equations – Bdft	0
All	13	5,7	828DVEE***	Lasher Equations – Bdft	0
All	13	2,4	829DVEE***	Lasher Equations – Bdft	0
All	14	1,2,3,4,5,6	812DVEE***	Lasher Equations – Bdft	0

Region 8 Volume Equation Numbers By Forest and District Number								
Replace the *** with the Species Code from the Species Table Below								
			Pulpwood Trees All Species		**Sawtimber Softwoods**	**Sawtimber Hardwoods**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Species	**Forest Number**	**District Number**	**Total Height**	**Height 4” Top Diam**	**Height 7” Top Diam**	**Height 9” Top Diam**		
All	0	0	890CLKE***	894CLKE***	897CLKE***	899CLKE***	Clark Profile Model	0
All	1	0	840CLKE***	844CLKE***	847CLKE***	849CLKE***	Clark Profile Model	0
All	1	3	810CLKE***	814CLKE***	817CLKE***	819CLKE***	Clark Profile Model	0
All	2	0	830CLKE***	834CLKE***	837CLKE***	839CLKE***	Clark Profile Model	0
All	3	0	830CLKE***	834CLKE***	837CLKE***	839CLKE***	Clark Profile Model	0

Region 8 Volume Equation Numbers By Forest and District Number								
Replace the *** with the Species Code from the Species Table Below								
			Pulpwood Trees All Species		Sawtimber Softwoods	Sawtimber Hardwoods	Volume Model Name	Used By Cruise/FVS 1 = Yes
Species	Forest Number	District Number	Total Height	Height 4" Top Diam	Height 7" Top Diam	Height 9" Top Diam		
All	3	8	820CLKE***	824CLKE***	827CLKE***	829CLKE***	Clark Profile Model	0
All	4	0	830CLKE***	834CLKE***	837CLKE***	839CLKE***	Clark Profile Model	0
All	5	0	810CLKE***	814CLKE***	817CLKE***	819CLKE***	Clark Profile Model	0
All	6	0	850CLKE***	854CLKE***	857CLKE***	859CLKE***	Clark Profile Model	0
All	7	0	850CLKE***	854CLKE***	857CLKE***	859CLKE***	Clark Profile Model	0
All	7	6	870CLKE***	874CLKE***	877CLKE***	879CLKE***	Clark Profile Model	0
All	7	7,17	840CLKE***	844CLKE***	847CLKE***	849CLKE***	Clark Profile Model	0
All	8	0	830CLKE***	834CLKE***	837CLKE***	839CLKE***	Clark Profile Model	0
All	9	0	860CLKE***	864CLKE***	867CLKE***	869CLKE***	Clark Profile Model	0
All	10	0	860CLKE***	864CLKE***	867CLKE***	869CLKE***	Clark Profile Model	0
All	10	3	810CLKE***	814CLKE***	817CLKE***	819CLKE***	Clark Profile Model	0
All	10	10	820CLKE***	824CLKE***	827CLKE***	829CLKE***	Clark Profile Model	0
All	11	0	830CLKE***	834CLKE***	837CLKE***	839CLKE***	Clark Profile Model	0
All	12	0	820CLKE***	824CLKE***	827CLKE***	829CLKE***	Clark Profile Model	0
All	12	2	830CLKE***	834CLKE***	837CLKE***	839CLKE***	Clark Profile Model	0
All	12	5	810CLKE***	814CLKE***	817CLKE***	819CLKE***	Clark Profile Model	0
All	13	0	850CLKE***	854CLKE***	857CLKE***	859CLKE***	Clark Profile Model	0

Region 8 Species List for Volume Equation Numbers			
Hardwood Species		Softwood Species	
Species Name	Species Code	Species Name	Species Code
Acacia	300	Baldcypress	221
American beech	531	Eastern hemlock	261
American sycamore	731	Eastern white pine	129
Basswood	950	Loblolly pine	131
Birch	370	Longleaf pine	121
Black cherry	762	Pine	100
Black locust	901	Pitch pine	126
Black maple	314	Pond pine	128
Black oak	837	Pondcypress	222
Black tupelo	693	Sand pine	107
Black walnut	602	Shortleaf pine	110
Blue ash	546	Slash pine	111
Boxelder	313	Spruce	197
Bur oak	823	Spruce pine	115

Region 8 Species List for Volume Equation Numbers			
Hardwood Species		Softwood Species	
Species Name	Species Code	Species Name	Species Code
Butternut	601	Table mountain pine	123
California buckeye	330	Virginia pine	132
Cherrybark oak	813		
Chestnut oak	832		
Chinkapin oak	826		
Common persimmon	521		
Cucumbertree	651		
Eastern cottonwood	742		
Elm	970		
Green Ash	544		
Hackberry	460		
Hawthorn	500		
Hickory	400		
Honeylocust	550		
Lauel oak	820		
Magnolia	650		
Northern red oak	833		
Nuttall oak	828		
Oak	800		
Overcup oak	822		
Pecan	404		
Pin oak	830		
Post oak	835		
Pumpkin ash	545		
Red maple	316		
Sassafras	930		
Scarlet oak	806		
Shingle oak	817		
Shumard oak	834		
Silver maple	317		
Silverbell	580		
Sourwood	711		
Southern magnolia	652		
Southern red oak	812		
Sugar maple	318		
Swamp chestnut oak	825		
Swamp tupelo	694		
Swamp white oak	804		
Sweetbay	653		
Sweetgum	611		

Region 8 Species List for Volume Equation Numbers			
Hardwood Species		**Softwood Species**	
Species Name	**Species Code**	**Species Name**	**Species Code**
Water oak	827		
Water tupelo	691		
White ash	541		
White oak	802		
Whitethorn acacia	300		
Willow	920		
Willow oak	831		
Yellow popular	621		

Region 9

Region 9 Volume Equation Numbers By Species and Forest Number				
Replace the *** with the Species Code from the Species Table Below				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used by Cruise/FVS**
All	ALL	900CLKE***	Region 9 Clark's Profile Model	1
All	2	901DVEE***	Gevorkiantz Board Foot Equation – Table A	0
All	3	901DVEE***	Gevorkiantz Board Foot Equation – Table A	0
All	4	902DVEE***	Gevorkiantz Board Foot Equation – Table B	0
All	5	902DVEE***	Gevorkiantz Board Foot Equation – Table B	0
All	6	901DVEE***	Gevorkiantz Board Foot Equation – Table A	0
All	7	901DVEE***	Gevorkiantz Board Foot Equation – Table A	0
All	8	902DVEE***	Gevorkiantz Board Foot Equation – Table B	0
All	9	901DVEE***	Gevorkiantz Board Foot Equation – Table A	0
All	10	901DVEE***	Gevorkiantz Board Foot Equation – Table A	0
All	11	902DVEE***	Gevorkiantz Board Foot Equation – Table B	0
All	18	902DVEE***	Gevorkiantz Board Foot Equation – Table B	0
All	19	903DVEE***	Gevorkiantz Board Foot Equation – Table C	0
All	20	904DVEE***	Gevorkiantz Board Foot Equation – Table D	0
All Hardwoods	21	905DVEE***	Gevorkiantz Board Foot Equation – Table E	0
All Softwoods	21	906DVEE***	Gevorkiantz Board Foot Equation – Table F	0
All	22	904DVEE***	Gevorkiantz Board Foot Equation – Table D	0
All	24	902DVEE***	Gevorkiantz Board Foot Equation – Table B	0
All	31	902DVEE***	Gevorkiantz Board Foot Equation – Table B	0
All	0	911DVEE***	Gevorkiantz Cubic Pulpwood Equation	0
All	0	912DVEE***	Gevorkiantz Merchantable Cubic Equation	0
All	0	921DVEE***	Gevorkiantz Cordwood Equation	0

Region 9 Species List for Volume Equation Numbers			
Hardwood Species		**Softwood Species**	
Species Name	**Species Code**	**Species Name**	**Species Code**
American basswood	951	Balsam fir	012
American beech	531	Black Spruce	095
American sycamore	731	Eastern hemlock	261
Balsam poplar	741	Eastern redcedar	068
Black ash	543	Eastern white pine	129
Black cherry	762	Jack pine	105
Black locust	901	Loblolly pine	131
Black oak	837	Red pine	125
Black walnut	602	Red spruce	097

Region 9 Species List for Volume Equation Numbers			
Hardwood Species		Softwood Species	
Species Name	Species Code	Species Name	Species Code
Blackjack oak	824	Shortleaf pine	110
Bur oak	823	Tamarack	071
Butternut	601	White spruce	094
California buckeye	330		
Cherrybark oak	813		
Chestnut oak	832		
Cucumbertree	651		
Eastern cottonwood	742		
Elm	970		
Hackberry	460		
Hickory	400		
Northern red oak	833		
Paper birch	375		
Pecan	404		
Pin oak	830		
Post oak	835		
Quaking aspen	746		
Red maple	316		
River birch	373		
Scarlet oak	806		
Sugar maple	318		
Sweetgum	611		
White ash	541		
White oak	802		
Willow	920		
Yellow birch	371		
Yellow popular	621		

Region 10

Region 10 Volume Equation Numbers By Species and Forest Number				
Species Name	Forest Number	Volume Equation Number	Volume Model Name	Used By Cruise/FVS 1 = Yes
Alaska yellow cedar	0	A00FW3W042	Flewelling Profile Model 3pt	0
Alaska yellow cedar	0	A00F32W042	Flewelling Profile Model (32 foot log rule)	1
Alaska yellow cedar	0	A00FW2W042	Flewelling Profile Model	0
Alaska yellow cedar	0	A61DEMW042	Demars Profile Model	0
Alaska yellow cedar	0	A32DEMW042	Demars Profile Model	0
Alaska yellow cedar	0	A02DEMW000	Demars Profile Model	0

Region 10 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Alaska yellow cedar	4	A01DEMW000	Demars Profile Model	0
Alaska yellow cedar	4	A16DEMW042	Demars Profile Model	0
Alaska yellow cedar	5	A00F32W042	Flewelling Profile Model	1
Lodgepole pine	0	A00F32W260	Flewelling Profile Model	1
Lodgepole pine	4	A01DEMW000	Demars Profile Model	1
Mountain Hemlock	0	A00F32W260	Flewelling Profile Model	1
Mountain Hemlock	4	A01DEMW000	Demars Profile Model	1
Other Hardwood	0	A00F32W260	Flewelling Profile Model	1
Other Hardwood	4	A01DEMW000	Demars Profile Model	1
Other Softwood	0	A00F32W260	Flewelling Profile Model	1
Other Softwood	4	A01DEMW000	Demars Profile Model	1
Pacific silver fir	0	A00F32W260	Flewelling Profile Model	1
Pacific silver fir	4	A01DEMW000	Demars Profile Model	1
Red Alder	0	A16CURW260	Curtis Profile Model	1
Red Alder	4	A32CURW000	Curtis Profile Model (32 foot log rule)	1
Sitka spruce	4	A16DEMW098	Demars Profile Model	0
Sitka spruce	0	A00F32W098	Flewelling Profile Model (32 foot log rule)	1
Sitka spruce	0	A00FW2W098	Flewelling Profile Model	0
Sitka spruce (Second Growth)	0	A02F32W098	Flewelling Profile Model (32 foot log rule)	1
Sitka spruce (Second Growth)	0	A02FW2W098	Flewelling Profile Model	0
Sitka spruce	0	A02DEMW000	Demars Profile Model	0
Sitka spruce	0	A32DEMW098	Demars Profile Model	0
Sitka spruce	0	A61DEMW098	Demars Profile Model	0
Sitka spruce	4	A01DEMW000	Demars Profile Model	1/0
Western hemlock	4	A01DEMW000	Demars Profile Model	1/0
Western hemlock	0	A02DEMW000	Demars Profile Model	0
Western hemlock	0	A32DEMW098	Demars Profile Model	0
Western hemlock	4	A16DEMW098	Demars Profile Model	0
Western hemlock	0	A61DEMW098	Demars Profile Model	0
Western hemlock	0	A00F32W260	Flewelling Profile Model (32 foot log rule)	1/0
Western hemlock	0	A00FW2W260	Flewelling Profile Model	1
Western hemlock (Second Growth)	0	A02F32W260	Flewelling Profile Model (32 foot log rule)	1/0
Western hemlock (Second Growth)	0	A02FW2W260	Flewelling Profile Model	0
Western redcedar	0	A32DEMW242	Demars Profile Model	0
Western redcedar	4	A01DEMW000	Demars Profile Model	1

Region 10 Volume Equation Numbers By Species and Forest Number				
Species Name	**Forest Number**	**Volume Equation Number**	**Volume Model Name**	**Used By Cruise/FVS 1 = Yes**
Western redcedar	0	A02DEMW000	Demars Profile Model	0
Western redcedar	0	A00FW2W242	Flewelling Profile Model	0
Western redcedar	0	A00F32W242	Flewelling Profile Model (32 foot log rule)	1
Western redcedar	0	A00FW3W242	Flewelling Profile Model 3pt	0
Western redcedar	0	A61DEMW242	Demars Profile Model	0
Western redcedar	4	A16DEMW242	Demars Profile Model	0
White spruce	4	A00DVEW094	Larson Volume Equation	1
Paper birch	4	A00DVEW375	Larson Volume Equation	1/0
Cottonwood	4	A00DVEW747	Larson Volume Equation	1
White spruce	4	A01DVEW094	Haack & Gregory Volume Equation	0
Paper birch	4	A01DVEW375	Haack & Gregory Volume Equation	0
Cottonwood	4	A01DVEW747	Haack & Gregory Volume Equation	0
White spruce	4	A00DVEW108	Brackett Volume Equation	0
Paper birch	4	A00DVEW310	Brackett Volume Equation	0
Cottonwood	4	A00DVEW351	Brackett Volume Equation	0

5. Required and Optional Variables by Volume Model.

Model Name	Required Vairables	Optional Variables	Volume Types	Defaults	Equations
Behres Hyperbola Profile Model (Region 6 and BLM)	6**BEHW***: DBHOB HTTOT FCLASS[1] (FORST*) *use forest number to find Form Class) DBTBH (needed to calculate DBHIB, this affect Total Cubic) MTOPP B**BEHW***: DBHOB HTTOT FCLASS	6**BEHW***: HT1PRD (This height will only work when HTTOT is not provided) B**BEHW***: MTOPP	Merch Cubic Board Foot Total Cubic (ground to tip)	6**BEH: MTOPP=6.0 STUMP=1.0 TRIM=0.3/0.6 MAXLEN=16/32 (32 for 632 EQ) B**BEH: MTOPP=0.184*DBH+2.24 STUMP=1 TRIM=0.3 MAXLEN=16 MINLEN=8 MERCHL=8 EVOD=2 OPT=23	616BEHW000 632BEHW000 628BEHW000 Note: 000 can be replaced with species code B00BEHW011 B00BEHW015 B00BEHW017 B00BEHW021 B00BEHW022 B00BEHW081 B00BEHW093 B00BEHW098 B00BEHW108 B00BEHW116 B00BEHW117 B00BEHW119 B00BEHW122 B00BEHW231 B00BEHW260 B00BEHW263 B00BEHW312 B00BEHW351 B00BEHW361 B00BEHW431 B00BEHW542 B00BEHW631 B00BEHW747 B00BEHW800 B00BEHW998 B01BEHW202 B02BEHW202 B03BEHW202
BIA Behres Hyperbola equation	DBHOB HTTOT FCLASS	MTOPP	Boardfoot	STUMP=1 LOGLEN=16 TRIM=0.3	I16BEHW000 Note 000 can be any species code
BIA Johnson Equation	DBHOB HTTOT FCLASS		Merch Cubic		I00DVEW000 Note 000 can be any species code
Brackett Volume Equation (Region 10)	DBHOB HTTOT	None	Total Cubic Merch Cubic Board Foot Topwood	STUMP=1 MTOPP=6/8(hard/soft) MTOPS=4	TARIF Equation
Bruce Profile Model (Region 10)	REGN DBHOB HTTOT MTOPP	HT1PRD	Total Cubic Merch Cubic Board Foot (01 = 16 FT, 02 = 32 Ft) Topwood		A01BRUW042 A01BRUW098 A01BRUW242 A01BRUW351 A02BRUW042 A02BRUW098 A02BRUW242 A02BRUW351
Byrne Equation (Region 1)	FORST DBHOB HTTOT MTOPP	None	Total Cubic Merch Cubic Board Foot Topwood	none	100JB2W017 100JB2W070 100JB2W073 100JB2W108 100JB2W119 100JB2W122 100JB2W202

Model Name	Required Vairables	Optional Variables	Volume Types	Defaults	Equations
Chojnacky Equation (Regions 2, 3, 4)	DBHOB/DRCOB HTTOT	FCLASS: 0 = multi-stem model (default) 1 = single stem model	Total Cubic Merch Cubic		200DVEW065 200DVEW066 200DVEW069 200DVEW106 300DVEW060 301DVEW060 302DVEW060 301DVEW106 302DVEW106 400DVEW064 400DVEW066 400DVEW065 401DVEW065 402DVEW065 403DVEW065 400DVEW133 400DVEW106 400DVEW475 400DVEW998
Clark Profile Model (Region 8)	DBHOB FORST HTTOT HT1PRD[2] HT2PRD [2]		Total Cubic Merch Cubic Topwood	MTOPP=7/9 (DOB) MTOPS=4 (DOB) STMUP=0.5/1	Listed in Table: R8 Clark Equations
Clark Profile Model (Region 9)	DBHOB HTTOT / HT1PRD/HT2PRD[2]	UPSHT1 [2]	Total Cubic Merch Cubic Topwood Boardfoot	MTOPP=7.6/9.6 MTOPS=4 TRIM=0.3 MAXLEN=8 MINLEN=4 STUMP=0.5/1	Listed in R9 Clark and DVE equations
Curtis Profile Model (Region 10)	REGN DBHOB HTTOT MTOPP	HT1PRD	Total Cubic Merch Cubic Board Foot Topwood		
Czaplewski Profile Model (Region 2)	REGN DBHOB HTTOT MTOPP	HT1PRD HT2PRD	Total Cubic Merch Cubic Board Foot Topwood Cords	MTOPP=6 MTOPS=4 STUMP=1 TRIM=0.5 MAXLEN=16 MINLEN=2 MINLENT=2 OPT=22	200CZ2W015 200CZ2W019 200CZ2W093 200CZ2W108 200CZ2W122 200CZ2W202 200CZ2W746 203CZ2W122
Czaplewski Profile Model 3pt (Region 2)	REGN DBHOB HTTOT MTOPP UPSD1 + UPSHT1	DBTBH HT1PRD HT2PRD	Total Cubic Merch Cubic Board Foot Topwood Cords	MTOPP=6 MTOPS=4 STUMP=1 TRIM=0.5 MAXLEN=16 MINLEN=2 MINLENT=2 OPT=22	200CZ3W015 200CZ3W019 200CZ3W093 200CZ3W108 200CZ3W122 200CZ3W202 200CZ3W746 203CZ3W122
Demars Profile Model (Region 10)	REGN DBHOB HTTOT MTOPP	HT1PRD	Total Cubic MerchCubic Board Foot Topwood	MTOPP=6 MTOPS=4 STUMP=1 MAXLEN=16/32 MINLEN=8 MINLT=8 TRIM=0.5 OPT=23 EVOD=2	A16DEMW042 A16DEMW098 A16DEMW242 A16DEMW351 A32DEMW042 A32DEMW098 A32DEMW242 A32DEMW351 A01DEMW000 A02DEMW000

Model Name	Required Vairables	Optional Variables	Volume Types	Defaults	Equations
Direct Volume Equation (Region 6)	DBHOB HTTOT	None	Board Foot	none	601DVEW205 601DVEW263 601DVEW015 602DVEW204 602DVEW015 602DVEW108 600DVEW122
Eager Mill Study Equation & Hann and Bare Equation (Region 3)	DBHOB/DRCOB HTTOT /HT1PRD	None	Total Cubic MerchCubic Board Foot	MTOPP=6 MTOPS=4	300DVEW122 301DVEW202 302DVEW202 301DVEW015 302DVEW015 300DVEW093 300DVEW113 300DVEW746 -pulpwood only 300DVEW060 300DVEW106 300DVEW310 300DVEW800 300DVEW999 300DVEW314
Edminster Equation (Region 1)	DBHOB HTTOT	None	Merch Cubic		
Edminster Equation & Myers Equation (Region 2)	DBHOB/DRCOB HTTOT	FCLASS (=0 for multistems, =1 for single stem)	Total Cubic MerchCubic Board Foot	MTOPP=6 (8 for black hill PP) MTOPS=4 STUMP=1	200DVEW746 200DVEW108 203DVEW122 200DVEW122 212DVEW122 200DVEW093 200DVEW069 200DVEW066 200DVEW065 200DVEW814 200DVEW823 200DVEW106 200DVEW475 200DVEW998 -total cubic only 210DVEW746 210DVEW108 210DVEW122 213DVEW122 210DVEW093
Flewelling Profile Model (Region 1, 2, 4, 6, 10)	REGN DBHOB HTTOT MTOPP	HT1PRD UPSHT1 DBTBH BTR	Total Cubic MerchCubic Board Foot Topwood Cords	MTOPP=6 (R1=5.6, R6=2, R7=anint((0.184*DBHOB)+2.24)) MTOPS=4 STUMP=1 (R6=0) TRIM=0.5 MAXLEN=16 MINLEN=2 EVOD=2 OPT=22(R6/7/10=23) MINLENT=2(R10=8)	Listed in Fleweling profile equations table (FW2)
Flewelling Profile Model 3pt (Region 1,	REGN DBHOB HTTOT MTOPP	HT1PRD HT2PRD DBTBH BTR	Total Cubic Merch Cubic Board Foot Topwood		Listed in Fleweling profile equations table (FW3 and F3)

Model Name	Required Vairables	Optional Variables	Volume Types	Defaults	Equations
2, 4, 6, 10)	AVGZ1 + HTREF or AVGZ1 + UPSHT1 or UPSD1 + UPSHT1 or UPSD1 + HTREF		Cords		
Gevorkiantz Equation (Region 9)	REGN DBHOB HT1PRD^2 HT2PRD^2	Total Height Site Index Basal Area	Merch Cubic Board Foot Topwood Cords		Listed in table: R9 DVE equations
Haack and Gregory Volume Equation & Larson Volume Equation (Region 10)	DBHOB HTTOT	None	Total Cubic Merch Cubic Board Foot	none	A00DVEW094 A00DVEW095 A01DVEW094 A01DVEW095 A00DVEW375 A00DVEW746 A00DVEW920 A01DVEW375 A01DVEW746 A01DVEW920 A00DVEW747 A01DEVW747 A00DVEW108 A00DVEW310 A00DVEW351 A00DVEW660
Hahn (NC-250) Equation (Region 9)	DBHOB HTTOT	HT1PRD HT2PRD MTOPP MTOPS SI BA	Total Cubic Merch Cubic Board Foot	MTOPP = 7 (soft)/9(hard) MTOPS = 4 SI = 60 BA = 90	925DVEE*** Species List: 12,68,71,94,95, 105,125,129,132, 241,261,299,313, 314,316,317,318, 371,373,375,400, 460,531,541,543, 544,601,602,611, 621,694,731,741, 742,743,746,762, 802,806,812,830, 833,834,837,920, 951,970,998,999
Hann & Bare (BIA)	DBHOB HTTOT	MTOPP	Total Cubic Merch Cubic Board Foot		blackjack 301HAB0122 302HAB0122 Yellow pine 300HAB1122
Honer Equation (Canada, used by BIA)	DBHOB HTTOT MTOPP	MTOPS	Total cubic Merch Cubic Boardfoot		C00DVEE*** Species List: 12,71,94,95,97,105, 125,129, 241,261, 315,316,317,318, 330, 371,375,379, 531,541,543,742, 743,746,762,833, 951,990,999
Kemp Equation (Region 1)	DBHOB HTTOT	Live_Dead Prod	Merch Cubic Board Foot	STUMP=1 MAXLEN=16 TRIM=0.5	101DVEW119 101DVEW073 101DVEW202 101DVEW017

Model Name	Required Vairables	Optional Variables	Volume Types	Defaults	Equations
					101DVEW263 101DVEW242 101DVEW108 101DVEW093 101DVEW019 101DVEW122 101DVEW999 101DVEW375 101DVEW740 102DVEW746 102DVEW740 102DVEW017 102DVEW019 102DVEW070 102DVEW073 102DVEW090 102DVEW093 102DVEW101 102DVEW108 102DVEW119 102DVEW122 102DVEW202 102DVEW240 102DVEW242 102DVEW260 102DVEW263 102DVEW060 102DVEW106 103DVEW101 103DVEW108 103DVEW122 103DVEW202 104DVEW108 104DVEW122 105DVEW122 106DVEW122
Lasher Equations – Bdft (Region 8)	DBHOB FORST HT1PRD^2 HTREF^2	Total Height Site Index Basal Area	Merch Cubic Board Foot		Listed in R8 Clark and DVE equations
Malone, T. et al. (Region 10)	DBHOB, HTTOT	MTOPP	Total cubic Merch cubic to 2, 4, 6 inch top		A02DVEW094
Pillsbury and Kirkley Equation (Region 5)	DBHOB HTTOT MTOPP	None	Total Cubic Merch Cubic Board Foot		500DVEW060 500DVEW351 500DVEW312 500DVEW818 500DVEW807 500DVEW805 500DVEW431 500DVEW801 500DVEW839 500DVEW981 500DVEW361 500DVEW815 500DVEW631 500DVEW821 500DVEW212 500DVEW811
PNW Tariff Equation (Region 5,	DBHOB HTTOT MTOPP	None	Total Cubic Merch Cubic Board Foot		500TRFW475 500TRFW312 500TRFW351 500TRFW361

Model Name	Required Vairables	Optional Variables	Volume Types	Defaults	Equations
6)					500TRFW431 500TRFW631 500TRFW801 500TRFW805 500TRFW807 500TRFW811 500TRFW815 500TRFW818 500TRFW821 500TRFW839 500TRFW981 500TRFW015 500TRFW021 500TRFW060 500TRFW081 500TRFW108 500TRFW117 500TRFW122 500TRFW202 616TRFW122 616TRFW263 616TRFW019 616TRFW011 616TRFW094 616TRFW098 616TRFW108 616TRFW264 616TRFW073 616TRFW211 616TRFW351 616TRFW746 616TRFW747 616TRFW998 616TRFW202 616TRFW242 632TRFW122 632TRFW263 632TRFW019 632TRFW011 632TRFW094 632TRFW098 632TRFW108 632TRFW264 632TRFW073 632TRFW211 632TRFW351 632TRFW746 632TRFW747 632TRFW998 632TRFW202 632TRFW242
Rustagi Profile Model (Region 4)	REGN DBHOB HTTOT MTOPP	HT1PRD	Total Cubic Merch Cubic Board Foot Topwood(actually Tip) Cords	STUMP=1 TRIM=0.5 MTOPP=6 MTOPS=1 MAXLEN=16	400MATW746 400MATW202 405MATW202 401MATW202 400MATW019 405MATW019 400MATW015 401MATW015 400MATW081 400MATW073 400MATW122 401MATW122 402MATW122 403MATW122 400MATW108

Model Name	Required Vairables	Optional Variables	Volume Types	Defaults	Equations
					401MATW108 400MATW093 407MATW093 400MATW020 400MATW117
Sharpnack Profile Model (Region 5)	DBHOB HT1PRD FCLASS MTOPP	None	Total Cubic Merch Cubic Board Foot	MAXLEN=8 TRIM=0.15	H00SN2W301 H00SN2W510 H00SN2W671 H01SN2W510
Wensel and Olsen Profile Model (Region 5)	DBHOB HTTOT	HT1PRD HT2PRD MTOPP MTOPS	Total Cubic Merch Cubic Board Foot Topwood Cords	MTOPP=6 MTOPS=4 STUMP=1 MAXLEN=16 MINLEN=2 MINLENT=2 TRIM=0.5 OPT=22	500WO2W015 500WO2W020 500WO2W081 500WO2W108 500WO2W116 500WO2W117 500WO2W122 500WO2W202 500WO2W211
Westfall NSVB Equation (Nation wide)	DBHOB HTTOT	BRKHT BRKHTD CR CULL DECAYCD	Total Cubic Merch Cubic Board Foot Topwood Stump Dry biomass Green biomass		NVB####*** (#### = EcoRegion DIVISION code *** = FIA species code)

[1] These variables will be estimated if left blank or set to zero.

[2] These variables will be estimated from total height if left blank or set to zero.

6. EXCEL ADDINS FUNCTIONS

6.1 INTRODUCTION

The Volume Estimator Library is a collection of volume estimators in use by the Forest Management group of the USDA Forest Service. This library contains not only the currently used estimators, but also some estimators that were used historically and have been retired. It is not, however, the complete list of all of the volume estimators in use by all the functionaries of the Forest Service. The Volume Estimator Library, as presented in these functions, supports the National Cruise Program, the Forest Vegetation Simulator (FVS), and the Field Sampled Vegetation (FSVeg) group.

Due to the complexity and rigorous implementation process of many of the volume estimators, they cannot be easily added to a spreadsheet or simple program designed to calculate the volume of one or more trees. To help make the volume estimator library more accessible, the code was compiled into a Dynamic Link Library (DLL) which can be utilized in many different programs and functions without the programmer having to maintain the code directly. This also allows for the volume estimator library (written and maintained in FORTRAN) to be called by programs written in C, C++, and Visual Basic.

Using this volume estimator library DLL, a series of Excel Functions were developed using the Visual Basic language. Once these functions are linked into an Excel spreadsheet, they can be used to calculate the volumes of individual trees.

Due to the number of possible data input variables that are available across all the Regions, two different sets of Excel functions were developed: one using just the minimum data requirements and one containing the list of all available input variables, many of which are optional or used only for specific volume estimators.

Although these routines have been thoroughly tested, much of the error checking for missing or invalid data input has been historically done outside of the volume estimator library, either through the National Cruise Program, FVS, or other programs that call the volume library. Although some error checking has been incorporated into the volume estimator library, there is still a chance for the Excel functions to produce an error based on some specific combination of data input that will cause the program to crash. If you receive such an error, please fill out the Error Report document and email it to yingfang.wang@usda.gov so the error can be corrected.

6.2 SETUP

Warning: *When installing the Excel Volume Functions version 2022.12.01, the old version of Excel Volume Functions needs to be removed first. To remove the old version, first open Excel program, click on File. At the bottom of the newly displayed form, click the 'Options' button. From the next form, select the 'Add-Ins' option from the list displayed on the lefthand side. Click the 'Go…' button at the bottom of the form. If the Add-ins list has Forest Service Tree Volume Calculations and Forest Service Advanced Tree Volume Calculations, uncheck the*

check boxes and then click OK button. Close Excel program. Then click on Windows -> Settings, from Apps to find the Excel Volume Functions to uninstall.

Before the Excel volume functions can be used, they need to be 'added' into the Excel function library. This involves three simple steps.

Step 1: For Forest Service computers, go to Software Center and search Excel Volume Functions. For non-Forest Service computers, download the following files from the Forest Management Service Center web page (https://www.fs.usda.gov/forestmanagement/products/measurement/volume/nvel/index.php):

'Excel (64-bit) Volume Functions' or 'Excel (32-bit) Volume Functions'

Step 2: Install the functions by running the program (**you will need admin privileges to install the functions)**:

The installation process will copy the files FSVolume.xla, FSVolumeAdv.xla, and VolLib.lib into the following directory C:\fsapps\FMSC Software\Excel Functions

Additional files (VolLib.dll) will be copied into your Windows system directory. C:\Windows\System32 for 64-bit Excel or C:\Windows\SysWOW64 for 32-bit Excel

Step 3: Run the Excel program.

Open Excel program, click on File. At the bottom of the newly displayed form, click the 'Options' button. From the next form, select the 'Add-Ins' option from the list displayed on the lefthand side. Click the 'Go…' button at the bottom of the form. From the next form, click on the Browse button to navigate to C:\fsapps\FMSC Software\Excel Functions to select FSVolume.xla and FSVolumeAdv.xla one by one. Click OK to add in the functions. Make sure the box next to the functions called Forest Service Tree Volume Calculations and Forest Service Advanced Tree Volume Calculations are checked.

You are now ready to use the volume library Excel functions.

6.3 USING THE FUNCTIONS

Using the volume library functions in Excel is no different than using any Excel functions. You can type in the name of the function, use the Insert Function icon from the toolbar, or select *Insert* | *Function* from the main menu. If you use either of the Insert Function options, you will need to select *User Defined* from the category pull-down list.

As with other Excel functions, the input variables can be entered directly or can be references to cell locations that contain the data. For example, DBH can be entered as 11.5 or can be a cell reference, say C2, containing the value 11.5.

6.4 Available Functions

There are seventeen separate functions available within each set. Some functions are designed to return a specific volume for the tree, some will return information based on profile models (height to a specific diameter or diameter to a specific height), others will return log level information (log lengths or log end diameters). There are also functions to return a full description of any error code that might be returned by a volume function, return the default volume equation number given species, region, and forest numbers, and the current version number of the Volume Library DLL.

The functions for biomass with name start with calcWt…or getWt… for advanced function.

calcTotCubic(…) & *getTotCubicAdv(…)* Functions
These two functions will calculate the total cubic volume of the main stem of a tree from ground to tip. This volume is calculated for trees of all sizes. However, not every volume equation has the ability to calculate this volume.

calcBdft(…) & *getBdftAdv(…)* Functions
These functions will calculate the volume of the merchantable portion of the tree in terms of board feet. For the most part, this is in terms of Scribner's log rule. However, there are some volume equations that do not calculate a Scribner's board foot volume, so an International ¼ inch log rule will be returned. This volume is returned for sawtimber sized trees only.

calcBdft(…) & *getBdftAdv(…)* Functions
These functions will calculate the volume of the merchantable portion of the tree in terms of International ¼ inch log rule board feet. This volume is returned for sawtimber sized trees only. However, not every volume equation has the ability to calculate this volume.

calcMerchCubic(…) & *getMerchCubicAdv(…)* Functions
These functions will calculate the merchantable cubic foot volume of the tree. This volume is calculated for both sawtimber and non-sawtimber sized trees.

calcCords(…) & *getCordsAdv(…)* Functions
These functions will calculate the volume of the merchantable portion of the tree in terms of cords. The number of cords does take into account bark and airspace existing in a stack of logs 4 feet deep by 4 feet high by 8 feet long. Not every volume equation has the ability to calculate this volume.

calcCubicTW(…) & g*etCubicTWAdv(…)* Functions
These functions will calculate the volume of the topwood, or the volume between the merchantable top diameter in a sawtimber sized tree to some secondary top diameter in

terms of cubic feet. This is volume not acceptable by sawtimber standards, but can be utilized to make other products. This volume is calculated for sawtimber sized trees only. However, not every volume equation has the ability to calculate this volume.

calcCordTW(…) & *getCordTWAdv(…)* Functions
These functions also calculate the volume of the topwood, or the volume between the merchantable top diameter in a sawtimber sized tree to some secondary top diameter, but in terms of cords. This is volume not acceptable by sawtimber standards, but can be utilized to make other products. The number of cords does take into account bark and airspace existing in a stack of logs 4 feet deep by 4 feet high by 8 feet long. This volume is calculated for sawtimber sized trees only. However, not every volume equation has the ability to calculate this volume.

calcLogVolCubic(…) & getLogVolCubicAdv(…) Functions
These functions will return the cubic foot volume of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log. The sum of all log volumes should equal the merchantable cubic foot volume for the tree.

calcLogVolBdft(…) & getLogVolBdftAdv(…) Functions
These functions will return the board foot volume of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log. The sum of all log volumes should equal the merchantable cubic foot volume for the tree.

calcLogLength(…) & getLogLengthAdv(…) Functions
These functions will return the estimated length of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log.

calcLogDiam(…) & getLogDiamAdv(…) Functions
These functions will return the estimated inside diameter of a single log, assuming a profile model has been selected. The last parameter of the function is the number of the log, with log one being the butt log.

calcLogScalingDiam(…) & getLogScalingDiamAdv(…) Functions
These functions will return the estimated scaling diameter of a single log, assuming a profile model has been selected. The scaling diameter is the diameter used in the calculation of the volume for the log. The last parameter of the function is the number of the log, with log one being the butt log.

calcXHt(…) & getXHt Functions
These functions will return a height from the ground to the specified top diameter. This function will only work for profile models. If the function cannot return a height to the top diameter, a height of zero will be returned.

calcDib(…) & *calcDob(...) & getDibAdv(…) & getDobAdv(…)* Functions
These functions will return a diameter at a specific height. This functions will only work with profile models. Not all profile models can return a diameter outside bark (calcDob). If the function can not return a diameter to the specified height, a diameter of zero will be returned.

ErrorMessages(…) Function
This function will take an error message produced by the volume function and display a text message describing the error message.

VersionNumber() Function
This function will return the version number for the volume library DLL you are using.

VolumeEquationNumber() Function
This function will return the volume equation number used by the Forest Service given information like the species code, region number, and forest number.

calcBiomassFromBioEq() Functions
This function will return the dry and green biomass for the selected biomass equation. The convertion from dry to green or from green to dry is using the moisture content from Miles and Smith (2009).

getNSVB_Eq () Function
This function will return the default NSVB equation for a given information like species code, region number, forest number and ranger district number.

calcWtAGB() & getWtAGB() Functions
These functions will return dry and green biomass for above ground total without foliage.

calcWtTotStem() Functions
These functions will return dry and green biomass for total stem wood and bark.

calcWtTotStemWood() & getWtTotStemWood () Functions
These functions will return dry and green biomass for total stem wood.

calcWtTotStemBark() & getWtTotStemBark () Functions
These functions will return dry and green biomass for total stem bark.

calcWtMerchStem() Functions
These functions will return dry and green biomass for merchantable stem wood and bark from stump to merchantable top.

calcWtMerchStemWood() & getWtMerchStemWood () Functions
These functions will return dry and green biomass for merchantable stem wood from stump to merchantable top.

calcWtMerchStemBark() & getWtMerchStemBark() Functions
These functions will return dry and green biomass for merchantable stem bark from stump to merchantable top.

calcWtTW() Functions
These functions will return dry and green biomass for topwood wood and bark from primary top diameter to secondary top diameter.

calcWtTWwood() & getWtTWwood() Functions
These functions will return dry and green biomass for topwood wood from primary top diameter to secondary top diameter.

calcWtTWbark() & getWtTWbark() Functions
These functions will return dry and green biomass for topwood bark from primary top diameter to secondary top diameter.

calcWtTip() Functions
These functions will return dry and green biomass for tip wood and bark (from secondary top diameter to tip).

calcWtTipWood() & getWtTipWood() Functions
These functions will return dry and green biomass for tip wood (from secondary top diameter to tip).

calcWtTipBark() & getWtTipBark() Functions
These functions will return dry and green biomass for tip bark (from secondary top diameter to tip).

calcWtBranch() & getWtBranch() Functions
These functions will return dry and green biomass for branches wood and bark.

calcWtFoliage() & getWtFoliage() Functions
These functions will return dry and green biomass for foliage.

calcWtStump() Functions
These functions will return dry and green biomass for stump wood and bark

calcWtStumpWood() & getWtStumpWood() Functions
These functions will return dry and green biomass for stump wood

calcWtStumpBark() & getWtStumpBark() Functions
These functions will return dry and green biomass for stump bark.

calcWtTopLimb() & getWtTopLimb() Functions
These functions will return dry and green biomass for branches and stem tip.

calcCarbonContent() & getCarbonContent() Functions
These functions will return carbon content for above ground total (without foliage).

The function name starts with *calcBiomass*… calculates biomass using Jenkins with CRM methods. Those functions are currently not used by CruiseProcessing biomass calculation. Those function are still available to use. They are:

```
calcBiomassAboveGroundTotalGreen(Region As Long, Forest As String, SPN As Long, DBH As
Single, TotalHt As Single, VolEquNum As String)

calcBiomassMerchStemGreen(Region As Long, Forest As String, SPN As Long, DBH As Single,
TotalHt As Single, Optional VolEquNum As String)

calcBiomassBranchesGreen(Region As Long, Forest As String, SPN As Long, DBH As Single,
TotalHt As Single, Optional VolEquNum As String)

calcBiomassFoliageGreen(Region As Long, Forest As String, SPN As Long, DBH As Single,
TotalHt As Single, Optional VolEquNum As String
```

6.5 Variables for the Basic Functions (calc…)

Each of the basic volume functions has a short list of required variables. These variables can be entered as values or as references to a cell that contains the value. The variable names and descriptions are listed below.

Region = Forest Service Region number (see Appendix: Region and Forest Numbers).

Forest = Forest Service Forest number (see Appendix: Region and Forest Numbers).

District = Forest Service District number (when in doubt, use 01).

VolEquNum = Volume Equation Number (see Volume Equation Numbers).

Dbh = Diameter at Breast Height (4.5 feet from the ground).

TotalHt = Total tree height measured from the ground to the tip.

TopDia = Minimum top diameter for calculating the main stem volume. Some volume equations use a set minimum top diameter that cannot be changed.

TopDiaTW = Minimum top diameter for calculating the topwood (or secondary) volume in a tree. Some volume equations use a set minimum top diameter for topwood that cannot be changed.

Height = Height to a point up the stem. Used by the *calcDib* and *calcDob* functions.

LogNum = The log number to display. Must be a value between 1 and 20. Used by the functions *calcLogVolCubic, calcLogVolBdft, calcLogDiam, calcLogScalingDiam,* and *calcLogLength*.

Product = Product code for the tree.
01 = Sawtimber tree
02 = Non-sawtimber tree or pulpwood

SpeciesCode = Three digit species code (see Appendix: Species Codes).

SPCD_or_NVBEQ = Three digit species code or NSVB equation number.

CalcType = Calculation type for volume. Valid type includes FVS, Cruise and FIA. The default is FVS.

6.6 Variables for the Advanced Functions (get…Adv)

Each of the advanced volume functions has a list of input variables. Some of these variables are optional variables that can be set to a value or set to zero if no data is available. Note: All variables must have data (a zero or actual data). You may not leave a variable blank. This will cause the function to fail. The variable names and descriptions are listed below.

Region = Forest Service Region number (see Appendix: Region and Forest Numbers).

Forest = Forest Service Forest number (see Appendix: Region and Forest Numbers).

VolEquNum = Volume Equation Number (see Volume Equation Numbers).

Dbh = Diameter at Breast Height (4.5 feet from the ground).

TotalHt = Total tree height measured from the ground to the tip.

TopDia = Minimum top diameter for calculating the main stem volume. Some volume equations use a set minimum top diameter that cannot be changed.

TopDiaTW = Minimum top diameter for calculating the topwood (or secondary) volume in a tree. Some volume equations use a set minimum top diameter for topwood that cannot be changed.

MerchHt = The height in either feet or number of logs to the merchantable top diameter. This is useful if you have a tree with a broken top. If you enter the merchantable height in terms of logs, you will need to put an 'L' in the LogOrFeet variable. For more information on using the MerchHt field, see the section 'Height Combinations' below.

MerchHtTW = The height in either feet or number of logs to the topwood merchantable top diameter. This is measured from the stump and not from the sawtimber merchantable height point. If you enter the merchantable height in terms of logs, you will need to put an 'L' in the LogOrFeet variable. For more information on using the MerchHtTW field, see the section 'Height Combinations' below.

FormClass = Girard's Form Class variable. This is defined as the diameter at the top of the first log expressed as a percentage of Dbh. This variable is only used when using a Behre's hyperbola volume equation.

Product = Product code for the tree.
01 = Sawtimber tree
02 = Non-sawtimber tree or pulpwood

DblBarkBH = Double Bark Thickness at Breast Height.

BarkRatio = Bark thickness ratio. This is the inside bark to outside bark ratio at breast height. This is defined as the diameter inside bark at breast height divided by Dbh multiplied by 100.

LogOrFeet = This is a flag that tells the volume library if the MerchHt and MerchHtTW variables are measured in feet or logs. An 'L' indicates the merchantable height(s) are in terms of logs while an 'F' or blank indicates the merchantable height(s) are in feet.

LogLength = If the merchantable height is measured in logs, this variable tells the volume library the length of those logs. If left blank, the program defaults to 16 foot logs for the Western Regions and 8 foot logs for the Eastern Regions.

UpStemHt = The height up the stem where an upper stem diameter (UpStemDia) was measured. Part of a Height/Diameter pair required for multi-point profile modelsor can be used in conjunction with an Average Z-Score (AvgZ) variable. This variable is also used by Clark's profile model to be the height up the stem to a 4, 7, or 9 inch diameter, depending on the volume equation used.

UpStemDia = An upper stem diameter measured at a point identified by the upper stem height variable (UpStemHt). Part of a Height/Diameter pair required for multi-point profile models.

AvgZ = Flewelling's Average Z-Score variable. This is a standardized variable used to adjust the profile predicted by a Flewelling 2-point profile model. This variable requires either an upper stem height (UpStemHt) or reference height (RefHt) be given so the profile model knows where to apply the adjustment.

RefHt = The Reference Height variable has two uses based on the volume equation used. The first is in conjunction with a Flewelling's Average Z-Score (AvgZ) variable. It is the height up the stem where the AvgZ variable is to be applied expressed as a percent of

total height. The second is with the board foot model for ponderosa pine in Region 3 where the RefHt is the Height to the First Live Limb.

BasalArea = The basal area of the stand from where the tree came. This is used when a merchantable height is predicted for the Eastern Regions. If left blank, the program will use a default value. This variable is not need if a merchantable height (MerchHt) is input.

SiteIndex = The Site Index of the stand from where the tree came. This variable is also used when merchantable height is predicted for the Eastern Regions. If left blank, the program will calculate a default value based on Region, Forest, and species. This variable is not need if a merchantable height (MerchHt) is input.

Height = Height to a point up the stem. Used by the *getDibAdv* and *getDobAdv* functions.

LogNum = The log number to display. Must be a value between 1 and 20. Used by the functions *getLogVolCubic*, *getLogVolBdft*, *getLogDiam*, *getLogScalingDiam*, and *getLogLength*.

BrokenHt = Height to broken top or missing top

BrokenHtDia = Diameter at broken height

CR = Crown ratio (%)
CULL = The percent of the cubic-foot volume in a live or dead tree that is rotten or missing

DECAYCD = A code indicating the stage of decay in a standing dead tree

For more information about when an optional variable is used, see Appendix C, Variables Required for Volume Equations.

6.7 Determining Merchantable Volumes

Profile models are being implemented as volume estimators, replacing direct volume estimators, because of the flexibility that comes with using profile models. There are several ways to define the merchantable volume in a tree when using profile models. These methods are tied to specific combinations of heights and top diameter. The following is a complete list of these heights and top diameters and the types of volumes returned.

For the Behre, Bruce, Czaplewski, DeMars, Flewelling, Rastigi & Loveless, and Wensel & Olsen profile models:

- Dbh and total height is required for total cubic volume.
- Dbh, total height, and a minimum top diameter can be used to determine the merchantable volume in cubic or board feet. The merchantable length is determined by the profile model.

- Dbh, total height, minimum top diameter, and minimum top diameter for topwood can be used to determine the merchantable volume of the main stem in cords, cubic or board feet and the merchantable volume of top wood in cords or cubic feet. The merchantable lengths are determined by the profile model.
- Dbh, total height and merchantable height (in feet) can be used to determine the merchantable volume of a tree to a certain height. The minimum top diameter is determined by the profile model.

Additonally, for Behre, Bruce, Czaplewski, DeMars, Flewelling, and Wensel & Olsen profile models:

- Total height, merchantable height (in feet), and merchantable height of topwood (in feet) can be used to determine the volume of the merchantable piece and the volume of the topwood piece. The minimum top diameters are determined by the profile model.

Additionally, for Behre, Bruce, DeMars, and Flewelling profile models,:

- Dbh, merchantable height (feet or logs), and a minimum top diameter can be used to determine the volume of trees with broken tops. Total tree height is estimated using the profile model. No topwood volume is assumed.

For Clark's profile model, the following applies:

- Dbh and total height can be used to determine the volume of a tree to a 4 inch top diameter.
- Dbh and an upper stem height can be used to determine the merchantable volume to a 4 inch top (for product '02' trees) or a merchantable volume to a 7 or 9 inch top (softwood or hardwood species respectively).
- Dbh, upper stem height, and merchantable height can be used to determine the volume to the height given as merchantable height assuming the upper stem height is the height to the 4, 7, or 9 inch top and the merchantable height is less than or equal to the upper stem height.

6.8 Estimated Variables

Several of the volume estimators require one or more additional input variables then what is provided in the Basic Functions. To keep these functions simple, additional routines were added to the volume library for estimating these additional values. These routines were currently being used within the FVS program and were incorporated into the volume library to promote consistency between the FVS volumes and volumes produced by these Excel functions as well as simplify the Basic Functions input list of variables.

The volume estimators requiring additional variables and a description of the estimated variables are listed below.

Region 6: Behre's Hyperbola. This volume estimator requires a Girard Form Class, or the diameter at the top of the first log expressed as a percent of Dbh. The volume library will estimate an average form class value based on Forest number, species, and Dbh.

Region 8: Clark Profile Model. For sawtimber sized trees, the Clark profile model requires a merchantable height measured to either a 9 inch (for hardwoods) or a 7 inch (softwood) top diameter. The volume library will estimate this height based on Forest number, species, Dbh, basal area, and site index. If basal area and site index are not input, these values are also set to an average values based on Forest numbers.

Region 8: Lasher Equations. The Lasher equations require a merchantable height measured to either a 4 inch (pulpwood trees), 9 inch (hardwoods sawtimber) or a 7 inch (softwood sawtimber) top diameter. The volume library will estimate this height based on Forest number, species, Dbh, basal area, and site index. If basal area and site index are not input, these values are also set to an average values based on Forest numbers.

Region 9: Gevorkiantz Equation. The requires Gevorkiantz equations require a merchantable height, measured in number of 8 foot logs, to the minimum top diameter. The volume library will estimate this height based on Forest number, species, Dbh, basal area, and site index. If basal area and site index are not input, these values are also set to an average values based on Forest numbers.

6.9 ERROR MESSAGES

If the volume library function is unable to calculate the volume for a tree, and error message is returned. This might be due to incorrect data entry or a function of the tree size. Anytime an error message is returned, the volume is assumed to be zero. The error messages and their meanings are listed below.

#VOLEQ! = No volume equation match.
: The volume equation number entered does not match any in the volume estimator library. Double check the equation number.

#FORMCL = No form class (FormClass)
: Form class was not entered and the volume library was unable to estimate one.

#DBH<1! = DBH less than one
: No volume can be computed for trees with a Dbh of less then one.

#HT<4.5! = Tree height less than 4.5
: A tree with a height less then 4.5 has no Dbh by definition. No volume will be computed for trees with a height of less then 4.5 feet.

#D2H! = Dbh squared times total height is out of bounds
: The value Dbh squared times total height is not valid. Check your values for Dbh and Total Height.

#SPECIES! = No Species match (last three digits of the Volume Equation Number)
: The species code (the last three digits of the volume equation number) is sometimes used to determine other variables, such as form class or merchantable height. If the species code is not matched in the routine, this error will be returned. Check the volume equation number list for a species that can be used as a surrogate for the species entered.

#MERCH_HT! = Illegal primary product log height (MerchHT & LogOrFeet = L)

There are two possible reasons for this error. Some Regions require the merchantable height entered as logs to be recorded in 10s of logs. For example, a 3 log tree would be input as 30 logs. If a tree had 4 ½ logs, it should be input as 45 logs. Check the volume equation list to determine which form the volume equation takes.

The other reason is the volume equation requires a merchantable height to be entered as number of 8 foot logs and not in feet.

#MERCH_HTTW! = Illegal secondary product log height(MerchHT & LogOrFeet = L)

The volume equation requires the merchantable height to the top of the Topwood portion of the tree to be entered as number of 8 foot logs and not measured in feet.

#STEMDIA! = Upper stem measurement required (UpStemDia & UpStemHt)

The volume equation used is a three point model and requires an upper stem diameter (UpStemDia) and upper stem height (UpStemHt) be entered. This also means the volume equation requires the user to use the Advanced volume functions.

#STEMHT! = Illegal upper stem height value (UpStemHt > TotalHt or UpStemHt < 4.5)

For multi-point profile models where an upper stem height (UpStemHt) is given, the height needs to be greater then 4.5 and less then the total height of the tree.

#MERCH_ERR! = Unable to fit profile given dbh, merch ht and top dia.

This error is returned on trees where a merchantable height is entered with no total height, and the profile model is unable to fit a total tree height to the measurement. This can happen on large diameter trees that have broken off fairly low to the ground.

7. Use of VolLib.Dll

The National Volume Estimator Library DLL is a FORTRAN DLL compiled using Intel Visual Fortran. There are 32-bit and 64-bit DLL compiled The following files are the volume library files:

vollib.lib
vollib.dll

7.1 C++ access to the volume library

Additionally, the following files are provided to aid the developer in linking the National Volume Estimator Library DLL into a C++ application. The Fortran subroutine for C++ wrapper is VOLLIBCPP.

f90Char.h Class used to convert FORTRAN strings into C++ strings

The following instructions describe the procedure to link in and access the National Volume Estimator Library DLL using Visual Studio 2022.

Run Visual C++ and start a new project. Once the C++ project is set up, add the files f90Char.h to your project. The file VolLib.dll will need to reside in the same directory as your project's executable.

C++ Program:

```
typedef void(_stdcall* vollibcpp)(int*,f90Char*,f90Char*,int&,int&,int&,int&,int&,
    float*, float*, f90Char*, float*, int*, float*, float*, int*, int*,
    float*, float[7][20], float[21][3], float*, float*, int*, float*, float*, int*,
    int*, int*, int*, int*, f90Char*, f90Char*, f90Char*, int*, int*,
    float*, float*, int*,float*,float*, float*, float*, int*);

    //Load the DLL
    HMODULE hLib = LoadLibraryA("vollib.dll");

    //call VOLUMELIBRARY function
    vollibcpp VOLUMELIBRARY = (vollibcpp)GetProcAddress(hLib, "VOLLIBCPP");
    VOLUMELIBRARY(&REGN, &FORST, &VOLEQ, I3, I7, I15,
           I20, I21, &DBHOB, &DRCOB, &HTTYPE, &HTTOT,
           &HTLOG, &HT1PRD, &HT2PRD, &HTREF, &FCLASS,
           VOL, LOGVOL, LOGDIA, LOGLEN, BOLHT, &TLOGS,
           &NOLOGP, &NOLOGS, &CUTFLG, &BFPFLG, &CUPFLG,
           &CDPFLG, &SPFLG, &PROD, &LIVE, &CTYPE,
           &ERRFLAG,&iDIST, &BRKHT, &BRKHTD, &FIASPCD,
          DRYBIO, GRNBIO, &CR, &CULL, &DECAYCD);
```

You can find the variable definitions starting on page 6 (National Volume Estimator Library Call List) with the following exceptions:

I3 = 3
I7 = 7
I11 = 11
I20 = 20

I21 = 21

These integer variables are used to define arrays and character arrays.

7.2 C# and VB .net access to the volume library

Also included in this download is a C# application that can be used for testing the volume library on individual trees. This application also includes and an updated version of the Profile Model Tutorial originally developed by Ken Cormier. The new version allows users to display and compare up to 2 trees, change merchandizing rules and change models.

The PMT only works, however for a subset of profile models. These include Clark, Flewelling, Wenzel/Olsen, Demars and a few others. In addition to the PMT, for certain equations, you can also get the diameter inside bark (DIB) at a user defined height. Examples of how to access the volume library via C# .net are including in the files Form1.cs, MRules.cs and PMTForm.cs

C# program:

```
[DllImport("vollib.dll")]
static extern void VOLLIBCS(ref int regn, StringBuilder forst, StringBuilder voleq, ref float mtopp,
ref float mtops, ref float stump, ref float dbhob, ref float drcob, StringBuilder httype, ref float httot,
ref int htlog, ref float ht1prd, ref float ht2prd, ref float upsht1, ref float upsht2, ref float upsd1,
ref float upsd2, ref int htref, ref float avgz1, ref float avgz2, ref int fclass, ref float dbtbh,
ref float btr, ref int i3, ref int i7, ref int i15, ref int i20, ref int i21, float[] vol,
float[,] logvol, float[,] logdia, float[] loglen, float[] bohlt, ref int tlogs, ref float nologp,
ref float nologs, ref int cutflg, ref int bfpflg, ref int cupflg, ref int cdpflg, ref int spflg,
StringBuilder conspec, StringBuilder prod, ref int httfll, StringBuilder live, ref int ba, ref int si,
StringBuilder ctype, ref int errflg, ref int indeb, ref int pmtflg, ref MRules mRules, ref int dist, int
ll1, int ll2, int ll3, int ll4, int ll5, int ll6, int ll7, int charLen);

VOLLIBCS(ref REGN, FORST, VOLEQ, ref MTOPP, ref MTOPS, ref STUMP, ref DBHOB, ref DRCOB,
              HTTYPE, ref HTTOT, ref HTLOG, ref HT1PRD, ref HT2PRD, ref UPSHT1, ref UPSHT2,
               ref UPSD1, ref UPSD2,ref HTREF, ref AVGZ1, ref AVGZ2, ref FCLASS, ref DBTBH,
               ref BTR, ref I3, ref I7, ref I15, ref I20, ref I21, VOL, LOGVOL, LOGDIA, LOGLEN,
               BOLHT, ref TLOGS, ref NOLOGP, ref NOLOGS, ref CUTFLG, ref BFPFLG, ref CUPFLG,
              ref CDPFLG, ref SPFLG, CONSPEC, PROD, ref HTTFLL, LIVE, ref BA, ref SI, CTYPE,
              ref ERRFLAG, ref INDEB, ref PMTFLG, ref mRules, strlen, strlen, strlen, strlen,
              strlen, strlen, strlen, charLen);
```

The **VOLLIBCSNVB** makes the new Nation-scale Volume and Biomass (NSVB) equation available to use.

```
[DllImport("vollib.dll")]
static extern void VOLLIBCSNVB(ref int regn, StringBuilder forst, StringBuilder voleq, ref float mtopp,
ref float mtops, ref float stump, ref float dbhob, ref float drcob, StringBuilder httype, ref float httot,
ref int htlog, ref float ht1prd, ref float ht2prd, ref float upsht1, ref float upsht2, ref float upsd1,
ref float upsd2, ref int htref, ref float avgz1, ref float avgz2, ref int fclass, ref float dbtbh,
ref float btr, float[] vol, float[,] logvol, float[,] logdia, float[] loglen, float[] bohlt,
ref int tlogs, ref float nologp, ref float nologs, ref int cutflg, ref int bfpflg, ref int cupflg,
ref int cdpflg, ref int spflg, StringBuilder conspec, StringBuilder prod, ref int httfll,
StringBuilder live, ref int ba, ref int si, StringBuilder ctype, ref int errflg, ref int pmtflg,
ref MRules mRules, ref int dist, ref float brkht, ref float brkhtd, ref int fiaspcd, float[] drybio,
float[] grnbio, ref float cr, ref float cull, ref int decaycd, int ll1, int ll2, int ll3, int ll4,
int ll5, int ll6, int ll7, int charLen);

VOLLIBCSNVB(ref REGN, FORST, VOLEQ, ref MTOPP, ref MTOPS, ref STUMP, ref DBHOB, ref DRCOB,
 HTTYPE, ref HTTOT, ref HTLOG, ref HT1PRD, ref HT2PRD, ref UPSHT1, ref UPSHT2, ref UPSD1, ref UPSD2,
 ref HTREF, ref AVGZ1, ref AVGZ2, ref FCLASS, ref DBTBH, ref BTR, VOL, LOGVOL,
 LOGDIA, LOGLEN, BOLHT, ref TLOGS, ref NOLOGP, ref NOLOGS, ref CUTFLG, ref BFPFLG, ref CUPFLG,
 ref CDPFLG, ref SPFLG, CONSPEC, PROD, ref HTTFLL, LIVE, ref BA, ref SI, CTYPE, ref ERRFLAG, ref PMTFLG,
 ref mRules, ref IDIST, ref BRKHT, ref BRKHTD, ref FIASPCD, DRYBIO, GRNBIO, ref CR, ref CULL, ref DECAYCD,
 strlen, strlen, strlen, strlen, strlen, strlen, strlen, charLen);
```

VB.net program:

```
Declare Sub VOLUMELIBRARY Lib "vollib.dll" (ByRef REGN As Integer, ByVal FORST As String, _
ByVal FORST_LEN As Integer, ByVal VOLEQ As String, ByVal VOLEQ_LEN As Integer, _
ByRef MTOPP As Single, ByRef MTOPS As Single, ByRef STUMP As Single, ByRef DBHOB As Single, _
ByRef DRCOB As Single, ByVal HTTYPE As String, ByVal HTTYPE_LEN As Integer, _
ByRef HTTOT As Single, ByRef HTLOG As Integer, ByRef HT1PRD As Single, ByRef HT2PRD As Single, _
ByRef UPSHT1 As Single, ByRef UPSHT2 As Single, ByRef UPSD1 As Single, ByRef UPSD2 As Single, _
ByRef HTREF As Integer, ByRef AVGZ1 As Single, ByRef AVGZ2 As Single, ByRef FCLASS As Single, _
ByRef DBTBH As Single, ByRef BTR As Single, ByRef I3 As Integer, ByRef I7 As Integer, _
ByRef I15 As Integer, ByRef I20 As Integer, ByRef I21 As Integer, ByRef VOL As Single, _
ByRef LOGVOL As Single, ByRef LOGDIA As Single, ByRef LOGLEN As Single, ByRef BOLHT As Single, _
ByRef TLOGS As Integer, ByRef NOLOGP As Single, ByRef NOLOGS As Single, _
ByRef CUTFLG As Integer, ByRef BFPFLG As Integer, ByRef CUPFLG As Integer, _
ByRef CDPFLG As Integer, ByRef SPFLG As Integer, ByVal CONSPEC As String, _
ByVal CONSPEC_LEN As Integer, ByVal PROD As String, ByVal PROD_LEN As Integer, _
ByRef HTTFLL As Integer, ByVal LIVE As String, ByVal LIVE_LEN As Integer, _
ByRef BA As Integer, ByRef SI As Integer, ByVal CLTYPE As String, ByVal CLTYPE_LEN As Integer, _
ByRef ERRFLAG As Integer, ByRef DIST As Integer)

Declare PtrSafe Sub VOLUMELIBRARY2 Lib "vollib.dll" _
(REGN As Long, ByVal FORST As String, ByVal FORST_LEN As Long, _
 ByVal VOLEQ As String, ByVal VOLEQ_LEN As Long, MTOPP As Single, _
 MTOPS As Single, STUMP As Single, DBHOB As Single, DRCOB As Single, _
 ByVal HTTYPE As String, ByVal HTTYPE_LEN As Long, HTTOT As Single, _
 HTLOG As Long, HT1PRD As Single, HT2PRD As Single, UPSHT1 As Single, _
 UPSHT2 As Single, UPSD1 As Single, UPSD2 As Single, HTREF As Long, _
 AVGZ1 As Single, AVGZ2 As Single, FCLASS As Long, DBTBH As Single, _
 BTR As Single, VOL As Single, LOGVOL As Single, LOGDIA As Single, _
 LOGLEN As Single, BOLHT As Single, TLOGS As Long, NOLOGP As Single, _
 NOLOGS As Single, CUTFLG As Long, BFPFLG As Long, CUPFLG As Long, _
 CDPFLG As Long, SPGLG As Long, ByVal CONSPEC As String, _
 ByVal CONSPEC_LEN As Long, ByVal Prod As String, ByVal PROD_LEN As Long, _
 HTTFLL As Long, ByVal LIVE As String, ByVal LIVE_LEN As Long, BA As Long, _
 SI As Long, ByVal CTYPE As String, ByVal CTYPE_LEN As Long, ERRFLAG As Long, Dist As Long, _
 BRKHT As Single, BRKHTD As Single, FIASPCD As Long, DRYBIO As Single, GRNBIO As Single, _
 CR As Single, CULL As Single, DECAYCD As Long)
```

and the following has very few input parameters

```
Declare Sub VOLLIBVB8 Lib "vollib.dll" (ByVal VOLEQ As String, ByRef REGN As Long, _
ByRef DBHOB As Single, ByRef HTTOT As Single, ByRef TOPD As Single, ByRef TOTCU As Single, _
ByRef MERCHCU As Single, ByRef BDFT As Single, ByRef XINT As Single)
```

7.3 Python 3 access to the volume library

Included in this download is also an example (vollibTestPython3.py) of how to access the volume library via python version 3.

7.4 R Program access to the library

1. **The NVEL has the following subroutines for R program. They are:**

   `vernum_r(VERNUM)`

   `vernum_r` returns the version number for vollib.dll.

   `getvoleq_r(REGN,FORST,DIST,SPEC,VOLEQ,ERRFLAG)`

getvoleq_r returns the NVEL default VOLEQ for the given REGN, FORST and DIST. The default VOLEQ is used by National Cruise Processing program or FVS.

```
getnvbeq_r(REGN,FORST,DIST,SPEC,VOLEQ,ERRFLAG)
```
getnvbeq_r returns the default NSVB equation for a given species, region, forest and district.

```
vollibnvb_r(VOLEQ,REGN,FORST,DIST,SPEC,DBHOB,HTTOT,
               MTOPP,MTOPS,HT1PRD,HT2PRD,UPSHT1,UPSD1,STUMP,
               FCLASS,DBTBH,BTR,VOL,LOGVOL,LOGDIA,LOGLEN,BOLHT,
               TLOGS,NOLOGP,NOLOGS,ERRFLAG,BRKHT,BRKHTD,
               DRYBIO,GRNBIO,CR,CULL,DECAYCD,CULLMSTOP,CTYPE,LIVE,PROD)
```

vollibnvb_r calculates the volume and dry and green biomass for a given tree. If the National-scale Volume and Biomass (NSVB) equation is used, the volume and biomass will be calculated with the NSVB equation. When a non NSVB equation is used, the volume will be calculated with the provided equation, but the biomass will be calculated with the NSVB default equation for the given SPEC, REGN, FORST and DIST.

```
vollibnvb2_r(VOLEQ,REGN,FORST,DIST,SPEC,DBHOB,HTTOT,
               MTOPP,MTOPS,HT1PRD,HT2PRD,UPSHT1,UPSD1,STUMP,
               FCLASS,DBTBH,BTR,VOL,LOGVOL,LOGDIA,LOGLEN,BOLHT,
               TLOGS,NOLOGP,NOLOGS,ERRFLAG,BRKHT,BRKHTD,
               DRYBIO,GRNBIO,CR,CULL,DECAYCD,CULLMSTOP,CTYPE,LIVE,MAXLOGLEN)
```

vollibnvb2_r has additional input for MAXLOGLEN

```
ht2topd_r(VOLEQ,REGN,FORST,DBHOB,HTTOT,STEMDIB,STEMHT,ERRFLAG,UPSHT1,UPSD1)
```
ht2topd_r calculates stem height to a particular top diameter inside bark.

```
calcdib_r(VOLEQ,REGN,FORST,DBHOB,HTTOT,STEMHT,STEMDIB,ERRFLAG,UPSHT1,UPSD1)
```
calcdib_r calculates diameter inside bark at a given height on stem

```
calcdob_r(VOLEQ,REGN,FORST,DBHOB,HTTOT,STEMHT,STEMDOB,ERRFLAG,UPSHT1,UPSD1)
```
calcdob_r calculates diameter outside bark at a given height on stem if the profile model has the coefficient for outside bark diameter. Currently only Flewelling profile model calculates DOB.

```
biomasslib_r(BIOEQ,DBHOB,HTTOT,CROWNL,HT1PRD,HT2PRD,CV4,TOPD,STEMS,
DRYBIOM,GRNBIOM,ERRFLAG,SPN,GEOSUB)
```
biomasslib_r function calculates dry and green biomass (DRYBIOM and GRNBIOM) using BIOEQ equation number. All units are in English.

BIOEQ = biomass equation number (12 characters, such as AFF019BRL01D),
DBHOB = outside diameter at breast height (inches),
HTTOT = total height (ft),
CROWNL = crown length (ft),
HT1PRD = height for saw timber,
HT2PRD = height for pulp (to 4” top),
CV4 = cubic volume from stump to 4” top,
TOPD = merch top diameter,
STEMS = number of stems (woodland species),
DRYBIOM = dry biomass (lb),
GRNBIOM = green biomass (lb),
SPN = FIA species code,
GEOSUB = geographic subcode (use 0 if unknown).

`getwtfactor_r(REGN,FORST,SPN,GRMWF,DRYWF)`

This function returns the species default green and dry weight factor (weight (lb) of wood and bark per cubicfoot of wood) in a specified region and forest. If the region/forest does not setup the default weight factor, the national default vales will be returned.

REGN = National Forest Region number,
FORST = National Forest administration number,
SPN = species FIA number,
GRNWF = green weight factor (lb/cuft),
DRYWF = dry weight factor (lb/cuft),

2. How to use vollib.dll

Save the vollib.dll to a directory on your PC, such as `C:/development/NVEL/64` for the 64-Bits library. Then load the library with:

```
dyn.load("C:/development/NVEL/64/vollib.dll")
```

3. Example call to the library

(1) To get the NVEL version number:

```
.Fortran("vernum_r",vernum=integer(1))
```

Result:

```
$vernum
[1] 20170413
```

(2) To get the default VOLEQ for a species in a given site:

```
REGN=2
FORST="01"
DIST="01"
SPEC=122
VOLEQ="          "
ERRFLAG=0
.Fortran("getvoleq_r",as.integer(regn),as.character(forst),as.character(dist),as.integer(
spec),as.character(voleq),as.integer(errflg))
```

Result:

```
[[1]]
[1] 2

[[2]]
[1] "01"

[[3]]
[1] "01"

[[4]]
[1] 122

$ VOLEQ
[1] "200FW2W122"

[[6]]
[1] 0
```

(3) To calculate the volume/biomass for a tree, you need to provide values for the input variables. If any unknown, just use 0 (zero) (For FORST and DIST use "01"). When a non-NSVB equation is used, the default NSVB equation for the Region, forest and district will be used for biomass calculation and then the biomass will be adjusted with the main stem volume/biomass.

```
REGN=8
FORST="01"
DIST="01"
SPCD=110
VOLEQ="841CLKE110"
PROD="01"
DBHOB=19.6
HTTOT=76
MTOPP=7
MTOPS=4
STUMP=1
LIVE="L"
CTYPE="C"
HT1PRD=0
HT2PRD=0
UPSHT1=0
UPSD1=0
FCLASS=0
DBTBH=0
BTR=0
BRKHT=0
BRKHTD=0
CR=0
CULL=0
DECAYCD=0
CULLMSTOP=0
VOL=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)
LOGVOL=matrix(0,7,20)
LOGDIA=matrix(0,21,3)
LOGLEN=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)
BOLHT=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)
DRYBIO=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)
GRNBIO=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0)
TLOGS=0
NOLOGP=0
NOLOGS=0
ERRFLG=0

.Fortran("vollibnvb_r",as.character(VOLEQ),as.integer(REGN),as.character(FORST),
  as.character(DIST),as.integer(SPCD),as.double(DBHOB),as.double(HTTOT),as.double(MTOPP),
  as.double(MTOPS),as.double(HT1PRD),as.double(HT2PRD),as.double(UPSHT1),
  as.double(UPSD1),as.double(STUMP),as.integer(FCLASS),as.double(DBTBH),as.double(BTR),
  as.double(VOL),as.double(LOGVOL),as.double(LOGDIA),as.double(LOGLEN),as.double(BOLHT),
  as.integer(TLOGS),as.double(NOLOGP),as.double(NOLOGS),as.integer(ERRFLG),
  as.double(BRKHT),as.double(BRKHTD),as.double(DRYBIO),as.double(GRNBIO),as.double(CR),
  as.double(CULL),as.integer(DECAYCD), as.double(CULLMSTOP),as.character(CTYPE),
as.character(LIVE), as.character(PROD))
```

Result:

```
[[1]]
[1] "841CLKE110"

[[2]]
[1] 8

[[3]]
[1] "01"

[[4]]
[1] "01"

[[5]]
[1] 110

[[6]]
[1] 19.6
```

```
[[7]]
[1] 76

[[8]]
[1] 7

[[9]]
[1] 4

[[10]]
[1] 62.57652

[[11]]
[1] 68.32944

[[12]]
[1] 0

[[13]]
[1] 0

[[14]]
[1] 1

[[15]]
[1] 0

[[16]]
[1] 0

[[17]]
[1] 0

[[18]]
 [1]  68.5000000 384.0000000   0.0000000  67.5999985   0.0000000   0.0000000   0.8000000
0.0000000   0.0000000 425.0000000   0.0000000   4.0000000   0.0000000   2.3562629
0.1000015

[[19]]
  [1]  92.000000   0.000000   0.000000  14.128745   0.000000   0.000000 813.815674
80.000000   0.000000   0.000000  12.823584   0.000000   0.000000 738.638367  71.000000
0.000000   0.000000  11.593775   0.000000   0.000000 667.801392
 [22]  57.000000   0.000000   0.000000  10.160339   0.000000   0.000000 585.235535
48.000000   0.000000   0.000000   8.380128   0.000000   0.000000 482.695343  25.000000
0.000000   0.000000   6.253147   0.000000   0.000000 360.181244
 [43]  11.000000   0.000000   0.000000   3.781449   0.000000   0.000000 217.811432
4.000000   0.000000   0.000000   1.233487   0.000000   0.000000  71.048836   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
 [64]   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
 [85]   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
[106]   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
[127]   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000
0.000000   0.000000   0.000000   0.000000   0.000000   0.000000   0.000000

[[20]]
 [1] 18.000000 17.000000 16.000000 15.000000 14.000000 13.000000 10.000000  7.000000
4.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
0.000000  0.000000  0.000000  0.000000 17.742710 16.877954
```

```
[24] 16.106167 15.253469 14.091450 12.534372 10.406394  7.225215  4.195286  0.000000
0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
[47]  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000  0.000000

[[21]]
 [1] 8 8 8 8 8 8 8 6 0 0 0 0 0 0 0 0 0 0 0 0

[[22]]
 [1]  4.5  9.5 18.0 26.5 35.0 43.5 52.0 60.5 67.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
0.0  0.0  0.0  0.0

[[23]]
[1] 8

[[24]]
[1] 7

[[25]]
[1] 1

[[26]]
[1] 0

[[27]]
[1] 0

[[28]]
[1] 0

[[29]]
 [1] 2978.4753418 2033.7352295  236.8605347   77.8784866    9.0701694 1930.1591797
224.7974854   22.8421516    2.6603289    2.8553083    0.3325457  707.8795166  111.4809341
714.4610596 1422.3515625

[[30]]
 [1] 5381.763672 3674.726318  427.979828  140.717499   16.388758 3487.576416  406.183289
41.273094    4.806903    5.159215    0.600872 1279.057251  201.433258 1290.949219
2570.026123

[[31]]
[1] 0

[[32]]
[1] 0

[[33]]
[1] 0

[[34]]
[1] 0

[[35]]
[1] "B"

[[36]]
[1] "L"

[[37]]
[1] "01"
```

Note: The row in LOGVOL is the log sequence and the column in LOGVOL is the different type of volume. The log boardfoot volumes are in LOGVOL(1,i) and the log cubic volumes are in LOGVOL(4,i), where i is 1 to 20. The row in LOGDIA is the different type of diameter and the column in LOGDIA is the log sequence. The log scaled diameters are in LOGDIA(i,1) and the log actual predicted inside bark diameters are in LOGDIA(i,2), where i is 1 to 21.

If errflag > 0, some error returned from the volume library. Please check the error message for detail.

(4) To calculate stem height to a given diameter inside bark (stemdib) use `ht2topd_r`:

```
> voleq="I11FW3W202"
> regn=6
> forst="01"
> dbhob=19
> httot=76
> stemdib=9
> stemht=0
> errflg=0
> upsht1=40
> upsd1=12

> .Fortran("ht2topd_r",as.character(voleq),as.integer(regn),as.character(forst),
as.double(dbhob),as.double(httot),as.double(stemdib),as.double(stemht),as.integer(errflg)
,as.double(upsht1),as.double(upsd1))
```

Results:

```
[[1]]
[1] "I11FW3W202"

[[2]]
[1] 6

[[3]]
[1] "01"

[[4]]
[1] 19

[[5]]
[1] 76

[[6]]
[1] 9

[[7]]
[1] 50.76356

[[8]]
[1] 0

[[9]]
[1] 40

[[10]]
[1] 12
```

(5) To calculate stem diameter inside bark (stemdib) at a given height (stemht) use `calcdib_r`:

```
> voleq="I11FW3W202"
> regn=6
> forst="01"
> dbhob=19
> httot=76
```

```
> stemdib=0
> stemht=50
> errflg=0
> upsht1=40
> upsd1=12
> .Fortran("calcdib_r",as.character(voleq),as.integer(regn),as.character(forst),
as.double(dbhob),as.double(httot),as.double(stemht),as.double(stemdib),as.integer(errflg)
,as.double(upsht1),as.double(upsd1))
```

Results:

```
[[1]]
[1] "I11FW3W202"

[[2]]
[1] 6

[[3]]
[1] "01"

[[4]]
[1] 19

[[5]]
[1] 76

[[6]]
[1] 50

[[7]]
[1] 9.234578

[[8]]
[1] 0

[[9]]
[1] 40

[[10]]
[1] 12
```

(6) To calculate biomass using biomass equation in the National Biomass Estimator Library

```
> BIOEQ="AFF019AST01D"
> DBHOB=15
> HTTOT=65
> CROWNL=30
> HT1PRD=0
> HT2PRD=0
> CV4=0
> TOPD=0
> STEMS=0
> DRYBIOM=0
> GRNBIOM=0
> ERRFLSG=0
> SPN=999
> GEOSUB="0"
>
.Fortran("biomasslib_r",as.character(BIOEQ),as.double(DBHOB),as.double(HTTOT),as.double(CR
OWNL),as.double(HT1PRD),as.double(HT2PRD),as.double(CV4),as.double(TOPD),as.integer(STEMS)
,as.double(DRYBIOM),as.double(GRNBIOM),as.integer(ERRFLAG),as.integer(SPN),as.character(GE
OSUB))
```

And the calculated dry biomass = 859.5227 and green biomass = 1510.468

```
[[1]]
[1] "AFF019AST01D"
```

```
[[2]]
[1] 15

[[3]]
[1] 65

[[4]]
[1] 30

[[5]]
[1] 0

[[6]]
[1] 0

[[7]]
[1] 0

[[8]]
[1] 0

[[9]]
[1] 0

[[10]]
[1] 859.5227

[[11]]
[1] 1510.468

[[12]]
[1] 0

[[13]]
[1] 999

[[14]]
[1] "0"
```

(7) To get the species default weight factor

```
> REGN=6
> FORST="01"
> SPN=202
> GRNWF=0
> DRYWF=0
> .Fortran("getwtfactor_r",as.integer(REGN),as.character(FORST),as.integer(SPN),
as.double(GRNWF),as.double(DRYWF))
[[1]]
[1] 6

[[2]]
[1] "01"

[[3]]
[1] 202

[[4]]
[1] 60

[[5]]
[1] 32.8
```

The weight factor for Douglas-fir in Region 6 Forest 01 is green weight factor = 60 lb/cuft and dry weight factor = 32.8 lb/cuft.

(8) To get the default NSVB equation

```
> regn = 9
> forst = "03"
> dist = "01"
> spcd = 316
> voleq = "          "
> errflg = 0
>
.Fortran("getnvbeq_r",as.integer(regn),as.character(forst),as.character(dist),as.integer(s
pcd),as.character(voleq),as.integer(errflg))
[[1]]
[1] 9

[[2]]
[1] "03"

[[3]]
[1] "01"

[[4]]
[1] 316

[[5]]
[1] "NVB0210316"

[[6]]
[1] 0
```

8. Citations by Volume Model.

Model_Name	Citation
Behres Hyperbola	USFS-R6 Sale Preparation and Valuation Section of Diameter and Volume Procedures - R6 Timber Cruise System. 1978.
Bruce Profile Model	Bruce, D., 1984. Volume estimators for Sitka spruce and western hemlock in coastal Alaska. In Inventorying forest and other vegetation of the high latitude and high altitude regions. SAF pub 84-11. Bethesada, MD. pp. 96-102.
Byrne Equation	Johsn C. Byrne 1993. Incorporating Additional Tree and Environmental Variables in Lodgepole Pine Stem Profile Model. Western Journal of Applied Forestry Vol. 8
Chojnacky Equation	David Chojnacky 1985. Pinyon-Juniper Volume Equations for the Central Rocky Mountain States. Intermountain Research Station Research Paper INT-339.
Clark Profile Model	Clark, Alexander, Ray A. Souter, and Bryce E. Schlaegel. 1991. Stem Profile Equations for Southern Tree Species. Southeastern Forest Experiment Station Research Paper SE-282
Curtis Profile Model	Curtis, Robert O, David Bruce, and Caryanne VanCoevering. 1968. Volume and Taper Tables for Red Alder. Pacifc Northwest Forest and Range Exp. Sta. Research Paper PNW-56.
Czaplewski Profile Model	Czaplewski, Raymond L., Amy S. Brown, and Raymond C. Walker. 1989. Profile Models for Estimating Log End Diameters in the Rocky Mountain Region. Rocky Mtn. Forest and Range Experiment Station Research Paper RM-284
Czaplewski Profile Model 3pt	Unpublished. Based on work presented in Czaplewski & McClure. 1988. Conditioning a segmented stem profile model for two diameter measurements. Forest Science, Vol 34
Demars Profile Model	Demars, Donald. Relative Diameter and Relative Basal Area as Dependent Variables in Tree Profile Equations. Manuscript in Preparation.
Direct Volume Equation	(unknown source)
Direct Volume Equations - Bdft	Ted Lasher (unknown source)
Eager Mill Study Equation	Unpublished. Timber Cruising Handbook, Region 3 Suppliment.
Edminster Equation	Edminster, Carleton B., James R. Getter, and Donna R. Story. 1977. Past Diameters and Gross Volumes of Plains Cottonwood in Eastern Colorado. Rocky Mtn. Forest and Range Experiment Station Research Note RM - 351
Edminster Equation 1	Carleton B. Edminster et al 1980. Research Paper RM-218
Edminster Equation 2	Edminster, Carleton B., H. Todd Mowrer, and Thomas E. Hinds. 1982. Volume Tables and Point-Sampling Factors for Aspen in Colorado. Rocky Mtn Forest and Range Experiment Station Research Paper RM-232
Flewelling Profile Model	Unpublished. Based on work presented by Flewelling and Raynes. 1993. Variable-shape stem-profile predictions for western hemlock. Canadian Journal of Forest Research Vol 23. Part I and Part II.
Flewelling Profile Model 3pt	Unpublished. Based on work presented by Flewelling and Raynes. 1993. Variable-shape stem-profile predictions for western hemlock. Canadian Journal of Forest Research Vol 23. Part I and Part II.
Gevorkiantz Equation	Gevorkiantz, S.R. and L. P. Olsen. 1955. Composite Voume Tables for Timber and Their Application in the Lake States. USDA Forest Service Technical Bulletin No. 1104
Hann and Bare Equation	Hann, David W. and B. Bruce Bare 1978. Comprehensive Tree Volume Equations for Major Species of New Mexico and Arizona. Intermountain Forest and Range

Model_Name	Citation
	Experiment Station Research Paper INT-209.
Kemp Equation	Kemp, P.D. 1958. Unpublished report on file at USDA, Forest Service, Rocky Mountain Research Station, Interior West Resource Inventory, Monitoring, and Evaluation Program, Ogden, UT.
Larson Volume Equation	Larson, Frederic R. and Kenneth C Winterberger. 1988. Tables and Equations for Estimating Volumes of trees in the Susitna River Basin, Alaska. Pacific Northwest Research Station Research Note PNW-478.
Malone DVE	Malone, T., Liang, J., and Packee, E. C. 2013. Total and Merchantable Volume of White spruce in Alaska. West. J. Appl. For. 28(2):71-77
Myers Equation 1	Clifford A. Myers 1964. Volume tables and point sampling factors for ponderosa pine in the Black Hills. Research Paper RM - 8
Myers Equation 2	Clifford A. Myers 1969. Board-foot volumes to a 6-inch top for lodgepole pines in Colorado and Wyoming. Research Note RM - 157
Myers Equation 3	Clifford A. Myers 1972. Volume, taper, and related tables for southwestern ponderosa pine. Research Paper RM - 2
Myers Equation 4	Clifford A Myers & Carleton B Ediminster 1972. Volume tables and point-sampling factors for Engelmann spruce in Colorado and Wyoming. Research Paper RM-95
Pillsbury and Kirkley Equation	Norman H Pillsbury and Michael L Kirkley 1984 Equations for Total, Wood, and saw-Log Volume for Thirteen California Hardwoods. Pacific Northwest Forest and Range Experiment Station Research Note PNW-414.
PNW tariff Equation	Karen Waddell 2012. FIA Volume Equation Documentation.
Rustagi Profile Model	Rustagi, K.R. and Loveless, R.S.,Jr., 1991. Compatible variable-form volume and stem-profile equations for Douglas-fir. Can. J. For. Res. 21:143-151.
Sharpnack Profile Model	Sharpnack, David A. 1966. Predicting Volumes in Four Hawaii Hardwoods. Southwest Forest and Range Research Station Research Note SW-121.
Wensel and Olsen Profile Model	Wensel, L. C. and C. M. Olson. 1993. Tree Taper Models for Major Commercial California Conifers. Research Note No. 33. Northern Calif. Forest Yield Cooperative. Dept. of Forstry and Mgmt., Univ. of Calif., Berkeley. 28 pp.
Haack & Gregory Volume Equation	Haack, Paul M. 1963. Volume tables for trees of interior Alaska. Res. Note NOR-5. Juneau, AK: U.S. Department of Agriculture, Forest Service, Northern Forest Experiment Station. 11 p. Gregory, Robert A. and Paul M. Haack. 1964. Equations and tables for estimating cubic-foot volume of interior Alaska tree species. Res. Note NOR-6. Juneau, AK: U.S. Department of Agriculture, Forest Service, Northern Forest Experiment Station. 21 p.
Brackett Volume Equation	Brackett, Michael. 1973. Notes on tariff tree volume computation. Resource Management Report No. 24. Olympia, WA: State of Washington Department of Natural Resources. 26 p.
Westfall NSVB Equation	Westfall etal 2024. A national-scale tree volume, biomass, and carbon modeling system for the United States. USDA Forest Service GTR-104

9. APPENDIXES

9.1 Region and Forest Numbers.

NORTHERN REGION

Region 1 Forest Name	Forest Number	State
Beaverhead-Deerlodge	2	MT
Bitterroot	3	MT
Idaho Panhandle	4	ID
Clearwater	5	ID
Custer	8	MT
Flathead	10	MT
Gallatin	11	MT
Helena	12	MT
Kootenai	14	MT
Lewis & Clark	15	MT
Lolo	16	MT
Nezperce	17	ID

ROCKY MOUNTAIN REGION

Region 2 Forest Name	Forest Number	State
Bighorn	2	WY
Black Hills	3	SD
GMUG	4	CO
Medicine Bow-Routt	6	WY
Nebraska	7	CO
San Jaun-Rio Grande	9	CO
Arapaho-Roosevelt	10	CO
Pike-San Isabel	12	CO
Shoshone	14	WY
White River	15	CO

SOUTWESTERN REGION

Region 3 Forest Name	Forest Number	State
Apache-Sitgreaves	1	AZ
Carson	2	NM
Cibola	3	NM

Region 3 Forest Name	Forest Number	State
Coconino	4	AZ
Coronado	5	AZ
Gila	6	NM
Kaibab	7	AZ
Lincoln	8	NM
Prescott	9	AZ
Santa Fe	10	NM
Tonto	12	AZ

INTERMOUNTAIN REGION

Region 4 Forest Name	Forest Number	State
Ashley	1	UT
Boise	2	ID
Bridger-Teton	3	WY
Caribou	5	ID
Dixie	7	UT
Fishlake	8	UT
Humboldt	9	NV
Manti-LaSal	10	UT
Payette	12	ID
Challis	13	ID
Salmon	13	ID
Sawtooth	14	ID
Targhee	15	ID
Toiyabe	17	NV
Uinta	18	UT
Wasatch-Cache	19	UT

PACIFIC SOUTHWEST REGION

Region 5 Forest Name	Forest Number	State
Angeles	1	CA
Cleveland	2	CA
Eldorado	3	CA
Inyo	4	CA
Klamath	5	CA

Region 5 Forest Name	Forest Number	State
Lassen	6	CA
Los Padres	7	CA
Mendocino	8	CA
Modoc	9	CA
Plumas	11	CA
San Bernardino	12	CA
Sequoia	13	CA
Shasta-Trinity	14	CA
Sierra	15	CA
Six Rivers	10	CA
Stanislaus	16	CA
Tahoe	17	CA

PACIFIC NORTHWEST

Region 6 Forest Name	Forest Number	State
Deschutes	1	OR
Fremont	2	OR
Gifford Pinchot	3	WA
Malheur	4	OR
Mt. Baker-Snoqualmie	5	WA
Mt. Hood	6	OR
Ochoco	7	OR
Okanogan	8	WA
Olympic	9	WA
Rogue River	10	OR
Siskiyou	11	OR
Siuslaw	12	OR
Umatilla	14	OR
Umpqua	15	OR
Wallowa-Whitman	16	OR
Wenatchee	17	WA
Willamette	18	OR
Winema	20	OR
Colville	21	WA

SOUTHERN REGION

Region 8 Forest Name	Forest Number	State
National Forests Alabama	1	AL
Daniel Boone	2	KY
Chattahoochee-Oconee	3	GA
Cherokee	4	TN
National Forests Florida	5	FL
Kisatchie	6	LA
National Forests Mississippi	7	MS
George Washington-Jefferson	8	VA
Ouachita	9	AR
Ozark-St. Francis	10	AR
National Forests N.Carolina	11	NC
Francis Marion-Sumter	12	SC
National Forests Texas	13	TX
Caribbean	16	PR

EASTERN REGION

Region 9 Forest Name	Forest Number	State
Chequamegon	2	WI
Chippewa	3	MN
Huron-Manistee	4	MI
Mark Twain	5	MO
Nicolet	6	WI
Ottawa	7	MI
Shawnee	8	IL
Superior	9	MN
Hiawatha	10	MI
Wayne-Hoosier	11	
Hoosier	12	IN
Wayne	14	OH
Allegheny	19	PA
Green Mountain	20	VT
Monongahela	21	WV
White Mountain	22	NH

ALASKA REGION

Region 10 Forest Name	Forest Number	State
Chugach	4	AK
Tongass	5	AK

9.2 R9 Clark and Gevorkiantz (DVE) Equations

Clark Equations	Gevorkiantz (DVE) Equations		
	Boardfoot		Cubic
900CLKE012	901DVEE094	904DVEE012	911DVEE999
900CLKE068	901DVEE105	904DVEE261	912DVEE071
900CLKE090	901DVEE125	904DVEE094	912DVEE094
900CLKE094	901DVEE129	904DVEE097	912DVEE095
900CLKE095	901DVEE241	904DVEE125	912DVEE097
900CLKE100	901DVEE261	904DVEE129	912DVEE105
900CLKE105	901DVEE318	904DVEE316	912DVEE110
900CLKE110	901DVEE375	904DVEE746	912DVEE125
900CLKE125	901DVEE531	904DVEE762	912DVEE129
900CLKE129	901DVEE541	904DVEE833	912DVEE241
900CLKE241	901DVEE951	904DVEE951	912DVEE316
900CLKE261	901DVEE970	904DVEE970	912DVEE318
900CLKE299	901DVEE999	904DVEE375	912DVEE371
900CLKE310	902DVEE400	904DVEE541	912DVEE375
900CLKE316	902DVEE602	904DVEE376	912DVEE400
900CLKE317	902DVEE621	904DVEE371	912DVEE404
900CLKE318	902DVEE694	904DVEE999	912DVEE460
900CLKE370	902DVEE731	905DVEE316	912DVEE531
900CLKE371	902DVEE742	905DVEE371	912DVEE543
900CLKE375	902DVEE824	905DVEE802	912DVEE601
900CLKE400	902DVEE830	905DVEE951	912DVEE602
900CLKE407	902DVEE832	905DVEE318	912DVEE621
900CLKE531	902DVEE068	905DVEE373	912DVEE651
900CLKE540	902DVEE110	905DVEE531	912DVEE694
900CLKE541	902DVEE125	905DVEE541	912DVEE731
900CLKE543	902DVEE129	905DVEE621	912DVEE742
900CLKE621	902DVEE241	905DVEE651	912DVEE746
900CLKE740	902DVEE842	905DVEE261	912DVEE762
900CLKE741	902DVEE806	905DVEE833	912DVEE802
900CLKE742	902DVEE833	905DVEE999	912DVEE806
900CLKE743	902DVEE835	906DVEE097	912DVEE813
900CLKE746	902DVEE837	906DVEE129	912DVEE823
900CLKE752	902DVEE999	906DVEE999	912DVEE824
900CLKE760	903DVEE129		912DVEE830
900CLKE762	903DVEE261		912DVEE833
900CLKE800	903DVEE531		912DVEE835
900CLKE802	903DVEE541		912DVEE837
900CLKE806	903DVEE543		912DVEE920
900CLKE809	903DVEE621		912DVEE951
900CLKE823	903DVEE951		912DVEE970
900CLKE833	903DVEE806		912DVEE999
900CLKE837	903DVEE813		921DVEE999
900CLKE950	903DVEE823		
900CLKE951	903DVEE824		
900CLKE970	903DVEE830		
900CLKE972	903DVEE833		
900CLKE998	903DVEE835		
	903DVEE837		
	903DVEE999		

9.3 Fleweling Profile Model Equations

2 points equations	3 points equations	Used by region
I00FW2W012	I00FW3W012	01, 06
I00FW2W017	I00FW3W017	
I00FW2W019	I00FW3W019	
I00FW2W073	I00FW3W073	
I00FW2W093	I00FW3W093	
I00FW2W108	I00FW3W108	
I00FW2W119	I00FW3W119	
I00FW2W122	I00FW3W122	
I00FW2W202	I00FW3W202	
I00FW2W242	I00FW3W242	
I00FW2W263	I00FW3W263	
I00FW2W264	I00FW3W264	
I11FW2W017	I11FW3W017	06
I11FW2W019	I11FW3W019	
I11FW2W093	I11FW3W093	
I11FW2W122	I11FW3W122	
I11FW2W202	I11FW3W202	
I11FW2W263	I11FW3W263	
I11FW2W264	I11FW3W264	
I12FW2W017	I12FW3W017	
I12FW2W019	I12FW3W019	
I12FW2W093	I12FW3W093	
I12FW2W122	I12FW3W122	
I12FW2W202	I12FW3W202	
I12FW2W263	I12FW3W263	
I12FW2W264	I12FW3W264	
I13FW2W017	I13FW3W017	
I13FW2W019	I13FW3W019	
I13FW2W093	I13FW3W093	
I13FW2W122	I13FW3W122	
I13FW2W202	I13FW3W202	
I13FW2W263	I13FW3W263	
I13FW2W264	I13FW3W264	
I14FW2W017	I14FW3W017	01
I14FW2W019	I14FW3W019	
I14FW2W093	I14FW3W093	
I14FW2W122	I14FW3W122	
I14FW2W202	I14FW3W202	
I14FW2W263	I14FW3W263	
I14FW2W264	I14FW3W264	
I15FW2W017	I15FW3W017	04
I15FW2W019	I15FW3W019	
I15FW2W093	I15FW3W093	
I15FW2W122	I15FW3W122	
I15FW2W202	I15FW3W202	
I15FW2W263	I15FW3W263	
I15FW2W264	I15FW3W264	
I21FW2W017	I21FW3W017	Canada Model
I21FW2W019	I21FW3W019	
I21FW2W093	I21FW3W093	
I21FW2W122	I21FW3W122	
I21FW2W202	I21FW3W202	
I21FW2W263	I21FW3W263	

I21FW2W264 I22FW2W017 I22FW2W019 I22FW2W093 I22FW2W122 I22FW2W202 I22FW2W263 I22FW2W264 I23FW2W017 I23FW2W019 I23FW2W093 I23FW2W122 I23FW2W202 I23FW2W263 I23FW2W264	I21FW3W264 I22FW3W017 I22FW3W019 I22FW3W093 I22FW3W122 I22FW3W202 I22FW3W263 I22FW3W264 I23FW3W017 I23FW3W019 I23FW3W093 I23FW3W122 I23FW3W202 I23FW3W263 I23FW3W264	
F00FW2W202 F00FW2W242 F00FW2W263 F01FW2W202 F01FW2W242 F01FW2W263 F02FW2W202 F02FW2W242 F02FW2W263 F03FW2W202 F03FW2W242 F03FW2W263 F04FW2W202 F04FW2W242 F04FW2W263 F05FW2W202 F05FW2W242 F05FW2W263 F06FW2W202 F06FW2W242 F06FW2W263 F07FW2W202 F07FW2W242 F07FW2W263 F08FW2W202 F08FW2W242 F08FW2W263	F00FW3W202 F00FW3W242 F00FW3W263 F01FW3W202 F01FW3W242 F01FW3W263 F02FW3W202 F02FW3W242 F02FW3W263 F03FW3W202 F03FW3W242 F03FW3W263 F04FW3W202 F04FW3W242 F04FW3W263 F05FW3W202 F05FW3W242 F05FW3W263 F06FW3W202 F06FW3W242 F06FW3W263 F07FW3W202 F07FW3W242 F07FW3W263 F08FW3W202 F08FW3W242 F08FW3W263	06, 07
200FW2W015 200FW2W108 200FW2W122 200FW2W202 200FW2W746 203FW2W122	200FW3W015 200FW3W108 200FW3W122 200FW3W202 200FW3W746 203FW3W122	02
300FW2W122	300FW3W122	03
407FW2W122 407FW2W093	407FW3W122 407FW3W093	04
A00F32W042 A00F32W098 A00F32W242 A00F32W260 A00F32W263	A00F33W042 A00F33W098 A00F33W242 A00F33W260 A00F33W263	10

A00F32W264	A00F33W264	
A00FW2W042	A00FW3W042	
A00FW2W098	A00FW3W098	
A00FW2W242	A00FW3W242	
A00FW2W260	A00FW3W260	
A00FW2W263	A00FW3W263	
A00FW2W264	A00FW3W264	
A02F32W098	A02F33W098	
A02F32W260	A02F33W260	
A02F32W263	A02F33W263	
A02F32W264	A02F33W264	
A02FW2W098	A02FW3W098	
A02FW2W260	A02FW3W260	
A02FW2W263	A02FW3W263	
A02FW2W264	A02FW3W264	

9.4 Species Codes

Species Codes for Volume Equation Numbers			
Softwood Species		**Hardwood Species**	
Species Code	**Species Name**	**Species Code**	**Species Name**
012	Balsam fir	300	Acacia
014	Bristlecone fir	301	Koa
015	White fir	310	Maple
017	Grand fir	312	Bigleaf maple
018	Corkbark fir	313	Boxelder
019	Subalpine fir	314	Black maple
020	California red fir	316	Red maple
021	Shasta red fir	317	Silver maple
022	Noble fir	318	Sugar maple
041	Port Orford cedar	321	Rocky Mountain maple
042	Alaska yellow cedar	322	Bigtooth maple
050	Cypress	330	California buckeye
051	Arizona cypress	350	Alder
059	Redberry juniper	351	Red alder
060	Juniper	352	White alder
062	California juniper	361	Pacific madrone
063	Alligator juniper	370	Birch
064	Western juniper	371	Yellow birch
065	Utah juniper	373	River birch
066	Rocky Mountain juniper	374	Water birch
068	Eastern redcedar	375	Paper birch
069	Oneseed juniper	376	Western paper birch
070	Larch	378	Northwestern paper
071	Tamarack	400	Hickory
072	Subalpine larch	404	Pecan
073	Western larch	431	Golden chinkapin
081	Incense cedar	460	Hackberry
090	Spruce	475	Curlleaf mountain mahogany
092	Brewer's spruce	476	True mountain mahogany
093	Engelmann's spruce	477	Hairy mountain mahogany
094	White spruce	478	Birchleaf mountain mahogany
095	Black Spruce	492	Pacific dogwood
096	Blue spruce	500	Hawthorn
097	Red spruce	510	Eucalyptus
098	Sitka spruce	521	Common persimmon
100	Pine	531	American beech
101	Whitebark pine	540	Ash
102	Bristlecone pine	541	White ash
103	Knobcone pine	542	Oregon ash

Species Codes for Volume Equation Numbers			
Softwood Species		Hardwood Species	
104	Foxtail pine	543	Black ash
105	Jack pine	544	Green Ash
106	Pinyon Pine	545	Pumpkin ash
107	Sand pine	546	Blue ash
108	Lodgepole pine	550	Honeylocust
109	Coulter's pine	580	Silverbell
110	Shortleaf pine	594	?
111	Slash pine	600	California walnut
112	Apache pine	601	Butternut
113	Limber pine	602	Black walnut
114	Southwestern white pine	611	Sweetgum
115	Spruce pine	621	Yellow popular
116	Jeffrey pine	631	Tanoak
117	Sugar pine	650	Magnolia
118	Chihuahuan pine	651	Cucumbertree
119	Western white pine	652	Southern magnolia
120	Bishop pine	653	Sweetbay
121	Longleaf pine	660	Apple
122	Ponderosa pine	671	Ohia
123	Table mountain pine	691	Water tupelo
124	Monterey pine	693	Black tupelo
125	Red pine	694	Swamp tupelo
126	Pitch pine	711	Sourwood
127	California foothill pine	730	California sycamore
128	Pond pine	731	American sycamore
129	Eastern white pine	740	Cottonwood
131	Loblolly pine	741	Balsam poplar
132	Virginia pine	742	Eastern cottonwood
133	Singleleaf pinyon	743	Bigtooth Aspen
134	Border pinyon	745	Plains cottonwood
135	Arizona pine	746	Quaking aspen
197	Spruce	747	Black cottonwood
201	Bigcone Douglas fir	748	Fremont's cottonwood
202	Douglas fir	749	Narrowleaf cottonwood
211	Redwood	755	Syrian mesquite
212	Giant sequoia	756	Honey mesquite
221	Baldcypress	757	Velvet mesquite
222	Pondcypress	758	Screwbean mesquite
231	Pacific yew	760	Sweet cherry
240	Cedar	762	Black cherry
242	Western redcedar	764	Bitter cherry
251	California nutmeg	800	Oak

Species Codes for Volume Equation Numbers			
Softwood Species		**Hardwood Species**	
260	Hemlock	801	California live oak
261	Eastern hemlock	802	White oak
263	Western hemlock	803	Gray oak
264	Mountain hemlock	804	Swamp white oak
268	Eastern red cedar	805	Canyon live oak
299	Other Softwoods	806	Scarlet oak
		807	Blue oak
		810	Emory's oak
		811	Engelmann's oak
		812	Southern red oak
		813	Cherrybark oak
		814	Gambel's oak
		815	Oregon white oak
		817	Shingle oak
		818	California black oak
		820	Lauel oak
		821	California white oak
		822	Overcup oak
		823	Bur oak
		824	Blackjack oak
		825	Swamp chestnut oak
		826	Chinkapin oak
		827	Water oak
		828	Nuttall oak
		829	Mexican blue oak
		830	Pin oak
		831	Willow oak
		832	Chestnut oak
		833	Northern red oak
		834	Shumard oak
		835	Post oak
		837	Black oak
		839	Interior live oak
		843	Silverleaf oak
		901	Black locust
		902	New Mexico locust
		920	Willow
		930	Sassafras
		950	Basswood
		951	American basswood
		970	Elm
		981	California laurel

Species Codes for Volume Equation Numbers			
Softwood Species		Hardwood Species	
		990	Desert ironwood
		998	Other Hardwoods
		999	Unknown

9.5 List of NSVB Equations

List of NSVB Equations					
SPCD	DIVISION	NSVBEQ	SPCD	DIVISION	NSVBEQ
10	M240	NVBM240010	311		NVB0000311
10		NVB0000010	312	M240	NVBM240312
11	240	NVB0240011	312		NVB0000312
11	M210	NVBM210011	313		NVB0000313
11	M240	NVBM240011	315		NVB0000315
11		NVB0000011	316	210	NVB0210316
12	130	NVB0130012	316	220	NVB0220316
12	210	NVB0210012	316	230	NVB0230316
12	220	NVB0220012	316	M220	NVBM220316
12	M210	NVBM210012	316		NVB0000316
12		NVB0000012	317		NVB0000317
15	M260	NVBM260015	318	210	NVB0210318
15	M310	NVBM310015	318	220	NVB0220318
15	M330	NVBM330015	318	M210	NVBM210318
15		NVB0000015	318	M220	NVBM220318
16		NVB0000016	318		NVB0000318
17		NVB0000017	330	M220	NVBM220330
18		NVB0000018	330		NVB0000330
19	M130	NVBM130019	351	M240	NVBM240351
19	M210	NVBM210019	351		NVB0000351
19	M240	NVBM240019	370	230	NVB0230370
19	M330	NVBM330019	370	M220	NVBM220370
19		NVB0000019	370		NVB0000370
20	M260	NVBM260020	371	130	NVB0130371
20		NVB0000020	371	210	NVB0210371
42	M240	NVBM240042	371	220	NVB0220371
42		NVB0000042	371	M210	NVBM210371
43	230	NVB0230043	371		NVB0000371
43		NVB0000043	372		NVB0000372
68	220	NVB0220068	373		NVB0000373
68	230	NVB0230068	374		NVB0000374
68	250	NVB0250068	375	130	NVB0130375
68		NVB0000068	375	210	NVB0210375

71	130	NVB0130071	375	220	NVB0220375
71	210	NVB0210071	375	M130	NVBM130375
71	M130	NVBM130071	375	M210	NVBM210375
71	M210	NVBM210071	375	M330	NVBM330375
71	M330	NVBM330071	375		NVB0000375
71		NVB0000071	391		NVB0000391
73		NVB0000073	400	220	NVB0220400
81	M260	NVBM260081	400	230	NVB0230400
81		NVB0000081	400	M220	NVBM220400
90	130	NVB0130090	400	M230	NVBM230400
90	M130	NVBM130090	400		NVB0000400
90	M210	NVBM210090	402		NVB0000402
90	M330	NVBM330090	403	220	NVB0220403
90		NVB0000090	403		NVB0000403
91	210	NVB0210091	404	230	NVB0230404
91		NVB0000091	404		NVB0000404
93	M130	NVBM130093	405		NVB0000405
93	M210	NVBM210093	407		NVB0000407
93	M240	NVBM240093	409		NVB0000409
93	M330	NVBM330093	421	220	NVB0220421
93	M340	NVBM340093	421		NVB0000421
93		NVB0000093	460	230	NVB0230460
94	130	NVB0130094	460		NVB0000460
94	210	NVB0210094	461	230	NVB0230461
94	220	NVB0220094	461		NVB0000461
94	M130	NVBM130094	462		NVB0000462
94		NVB0000094	471		NVB0000471
95	130	NVB0130095	491	230	NVB0230491
95	210	NVB0210095	491		NVB0000491
95	M130	NVBM130095	521	230	NVB0230521
95		NVB0000095	521		NVB0000521
96		NVB0000096	531	210	NVB0210531
97	130	NVB0130097	531	220	NVB0220531
97	210	NVB0210097	531	230	NVB0230531
97	M210	NVBM210097	531	M210	NVBM210531
97		NVB0000097	531	M220	NVBM220531
98	M240	NVBM240098	531		NVB0000531
98		NVB0000098	540	230	NVB0230540
100	130	NVB0130100	540	M220	NVBM220540
100	M210	NVBM210100	540		NVB0000540
100		NVB0000100	541	210	NVB0210541
101		NVB0000101	541	220	NVB0220541
105	130	NVB0130105	541	M210	NVBM210541

105	210	NVB0210105	541	M220	NVBM220541
105	220	NVB0220105	541		NVB0000541
105		NVB0000105	543	210	NVB0210543
107	230	NVB0230107	543		NVB0000543
107		NVB0000107	544	230	NVB0230544
108	130	NVB0130108	544		NVB0000544
108	330	NVB0330108	552		NVB0000552
108	M130	NVBM130108	555	230	NVB0230555
108	M210	NVBM210108	555		NVB0000555
108	M240	NVBM240108	591	230	NVB0230591
108	M330	NVBM330108	591		NVB0000591
108		NVB0000108	601		NVB0000601
110	220	NVB0220110	602	M220	NVBM220602
110	230	NVB0230110	602		NVB0000602
110	250	NVB0250110	611	230	NVB0230611
110	M220	NVBM220110	611		NVB0000611
110	M230	NVBM230110	621	220	NVB0220621
110		NVB0000110	621	230	NVB0230621
111	230	NVB0230111	621	M220	NVBM220621
111		NVB0000111	621		NVB0000621
111	230	NVB0230111P	651		NVB0000651
111		NVB0000111P	652		NVB0000652
113		NVB0000113	653	230	NVB0230653
115	230	NVB0230115	653		NVB0000653
115		NVB0000115	680		NVB0000680
116		NVB0000116	691	230	NVB0230691
117	M260	NVBM260117	691		NVB0000691
117		NVB0000117	693	220	NVB0220693
119	M240	NVBM240119	693	230	NVB0230693
119	M330	NVBM330119	693	M220	NVBM220693
119		NVB0000119	693		NVB0000693
121	230	NVB0230121	694	230	NVB0230694
121		NVB0000121	694		NVB0000694
122	310	NVB0310122	701		NVB0000701
122	330	NVB0330122	711		NVB0000711
122	M210	NVBM210122	731	230	NVB0230731
122	M240	NVBM240122	731		NVB0000731
122	M260	NVBM260122	740	130	NVB0130740
122	M310	NVBM310122	740	230	NVB0230740
122	M330	NVBM330122	740	M330	NVBM330740
122	M340	NVBM340122	740		NVB0000740
122		NVB0000122	741	130	NVB0130741
123	M220	NVBM220123	741	210	NVB0210741

123		NVB0000123	741		NVB0000741
125	130	NVB0130125	742	250	NVB0250742
125	210	NVB0210125	742		NVB0000742
125	220	NVB0220125	743	130	NVB0130743
125		NVB0000125	743	210	NVB0210743
126	M220	NVBM220126	743	220	NVB0220743
126		NVB0000126	743		NVB0000743
128	230	NVB0230128	746	130	NVB0130746
128		NVB0000128	746	210	NVB0210746
129	130	NVB0130129	746	220	NVB0220746
129	210	NVB0210129	746	M130	NVBM130746
129	220	NVB0220129	746	M210	NVBM210746
129	230	NVB0230129	746	M240	NVBM240746
129	M210	NVBM210129	746	M330	NVBM330746
129	M220	NVBM220129	746		NVB0000746
129		NVB0000129	747	130	NVB0130747
130		NVB0000130	747	M130	NVBM130747
131	220	NVB0220131	747	M210	NVBM210747
131	230	NVB0230131	747	M330	NVBM330747
131	M230	NVBM230131	747		NVB0000747
131		NVB0000131	762	210	NVB0210762
131	230	NVB0230131P	762	230	NVB0230762
131		NVB0000131P	762	M220	NVBM220762
132	220	NVB0220132	762		NVB0000762
132	230	NVB0230132	800	230	NVB0230800
132	M220	NVBM220132	800		NVB0000800
132		NVB0000132	802	210	NVB0210802
202	130	NVB0130202	802	220	NVB0220802
202	240	NVB0240202	802	230	NVB0230802
202	260	NVB0260202	802	250	NVB0250802
202	340	NVB0340202	802	M220	NVBM220802
202	M210	NVBM210202	802	M230	NVBM230802
202	M240	NVBM240202	802		NVB0000802
202	M260	NVBM260202	804		NVB0000804
202	M310	NVBM310202	806	220	NVB0220806
202	M330	NVBM330202	806	230	NVB0230806
202		NVB0000202	806	M220	NVBM220806
211	260	NVB0260211	806		NVB0000806
211		NVB0000211	809	220	NVB0220809
221	230	NVB0230221	809		NVB0000809
221		NVB0000221	812	230	NVB0230812
222	230	NVB0230222	812		NVB0000812
222		NVB0000222	813	230	NVB0230813

241	210	NVB0210241	813		NVB0000813
241		NVB0000241	817		NVB0000817
242	240	NVB0240242	820	230	NVB0230820
242	340	NVB0340242	820		NVB0000820
242	M210	NVBM210242	822	230	NVB0230822
242	M240	NVBM240242	822		NVB0000822
242	M330	NVBM330242	823		NVB0000823
242		NVB0000242	825	230	NVB0230825
260	M210	NVBM210260	825		NVB0000825
260	M240	NVBM240260	826		NVB0000826
260	M330	NVBM330260	827	230	NVB0230827
260		NVB0000260	827		NVB0000827
261	210	NVB0210261	828	230	NVB0230828
261	M220	NVBM220261	828		NVB0000828
261		NVB0000261	830		NVB0000830
263	240	NVB0240263	831	230	NVB0230831
263	340	NVB0340263	831		NVB0000831
263	M210	NVBM210263	832	220	NVB0220832
263	M240	NVBM240263	832	230	NVB0230832
263	M330	NVBM330263	832	M220	NVBM220832
263		NVB0000263	832		NVB0000832
264	M240	NVBM240264	833	210	NVB0210833
264		NVB0000264	833	220	NVB0220833
1		NVB0000001	833	230	NVB0230833
2		NVB0000002	833	M220	NVBM220833
3		NVB0000003	833		NVB0000833
4		NVB0000004	834		NVB0000834
5		NVB0000005	835	220	NVB0220835
6		NVB0000006	835	230	NVB0230835
7		NVB0000007	835		NVB0000835
8		NVB0000008	837	210	NVB0210837
9		NVB0000009	837	220	NVB0220837
			837	230	NVB0230837
			837	250	NVB0250837
			837	M210	NVBM210837
			837	M220	NVBM220837
			837		NVB0000837
			838	230	NVB0230838
			838		NVB0000838
			901	M220	NVBM220901
			901		NVB0000901
			920		NVB0000920
			922		NVB0000922

931		NVB0000931
950	210	NVB0210950
950	M220	NVBM220950
950		NVB0000950
951	210	NVB0210951
951	220	NVB0220951
951		NVB0000951
970	230	NVB0230970
970		NVB0000970
971		NVB0000971
972	210	NVB0210972
972		NVB0000972
975		NVB0000975
999	230	NVB0230999
999	M220	NVBM220999
999		NVB0000999

Note: The character "P" in the equation NVB0230111P, NVB0000111P, NVB0230131P and NVB0000131P means for plantation