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A Compendium of
NFS Regional Vegetation
Classification Algorithms

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Preface

This document is a collection of vegetation classification systems developed by U.S. Forest Service Regional Offices. The computational algorithms have been coded within the Forest Vegetation Simulator. This document can be obtained from the Forest Management Service Center's Internet site (http://www.fs.fed.us/fmsc) or the FSWeb Intranet site (http://fsweb.ftcol.wo.fs.fed.us/frs/fmsc/fvs/).

Please let us know about any errors that you note in the document. If you have any questions or comments about this text or downloading, installing, and using the associated FVS software, do not hesitate to contact the Forest Management Service Center.

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Content

Introduction

Introduction

Fundamentally, a classification system that describes existing vegetation conditions is hierarchically based using components of forest type, size, density, and stories. USFS Regions have developed unique vegetation classification systems that capture floristic attributes native to their local geographic areas.
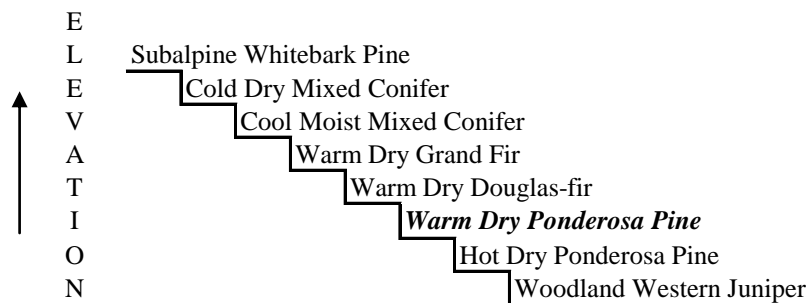
Typically, two types of data are used for planning projects: spatial and temporal. Spatial data is usually compiled from remote sensing imagery, and acreage compilation is accomplished by summing the various stand types residing within mapped polygons. Temporal data is collected by means of a field inventory and place-in-time attributes are gathered to provide an estimate of forest conditions. Inventory values render per acre estimates. When spatial data that complies with the vegetation stratification scheme is multiplied by temporal data obtained from field inventories, total strata estimates are generated.

Generally, three levels of planning analysis are acknowledged: broad, mid-scale, and base. At the broad level, regional-multi-forests land areas are considered. At the mid-scale, National Forests-biophysical landscapes-higher order hydrologic units comprise the planning unit. At the base level, stand basis-project planning efforts are recognized.

Consequently, for planning projects, a vegetation classification system needs to be in-place. Map polygons and inventory data are required to describe the basic vegetation units. The primary scale that will be addressed in this document is mid-scale planning.

Vegetation Classification

Landscape assessments are often organized hierarchically around geographic and ecological study units. The subsequent example will refer to the 13.1 million acre Blue Mountains project area that encompasses the Wallowa Whitman, Umatilla, and Malheur National Forests. This landscape is divided into ecological strata called potential vegetation types (PVTs). A PVT represents a particular combination of site productivity and disturbance regimes. Unique VDDT state and transition models are designed for each PVT. The Blue Mountains project area has been stratified into eight PVTs that are depicted by separate VDDT models (figure 2).

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E
L      Subalpine Whitebark Pine
E           Cold Dry Mixed Conifer
V                Cool Moist Mixed Conifer
A                     Warm Dry Grand Fir
T                          Warm Dry Douglas-fir
I                               Warm Dry Ponderosa Pine
O                                    Hot Dry Ponderosa Pine
N                                         Woodland Western Juniper
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Figure 2 – Biophysical settings of potential vegetation types within the Blue Mountains project area.

Within each model, combinations of cover type (i.e. tree species dominance) and structural stage (i.e. size class, canopy density, canopy layering) define the state boxes (figure 3).

Existing Cover Type	Size Class	Canopy Cover	Canopy Layers
- One Species Dominance	- Seedling/Sapling (0-5" qmd)	- Non-Tree (0-10 %)	- Single
- Two Species Dominance	- Small Tree (5-10" qmd)	- Open (10-40%)	- Multiple
- Three Species Dominance	- Medium Tree (10-15" qmd)	- Medium (40-70%)	
- Mixed Species Dominance	- Large Tree (15-20" qmd)	- Closed (70%+)	
- Non-Vegetated	- Very Large Tree (20-25" qmd)		
	- Giant Tree (25"+ qmd)		

Figure 3 – Cover type and structural stages that define states in the VDDT models.[1]

Currently, the FVSSTAND post processing program has been configured to report vegetation attributes in accordance with regionally accepted algorithms. Metrics for potential vegetation type, existing dominance type, size class, density class, canopy stories, and stand age are listed by inventory plot or stand polygon for each FVS projection cycle. Several other data items related to stocking are computed such as trees per acre, stand basal area, and stand density index. A complete list of output variables is displayed in Figure 4.

The use of stand age has specific significance within the realm of state and transition models. Stand age is used to index vegetation states and as such needs explicit consideration by model developers. Stand age provides a general measure of important processes of forested landscapes. The FVSSTAND program computes two estimates for stand age: 1) the origin date of the oldest canopy layer; and 2) the origin date of the dominant canopy layer. The origin date of the oldest cohort is an inference of time since last stand replacement disturbance and the best measure for ecological stand age. The origin date of the dominant cohort marks the time since the last major disturbance or otherwise is indicative of general stand age.

The FVSSTAND program also produces a list of vegetation values. This report can be used to substantiate the derivation of the dominance type. Generally, the preponderance of canopy cover, basal area, or tree per acre dictates the assignment of dominance type. The vegetation values report displays the attribute of interest for the top three tree species and genus. Refer to Figure 5 for the auxiliary listing of variables that comprise the vegetation values.

Appendix I provides instructions for retrieving, installing, and running the FVSSTAND program to produce the various vegetation classification output files. Appendix II presents the numeric indices for the Central Rockies FVS Variant to decode tree species and genus for the vegetation values report. Appendix III lists the recognized mixed species dominance types.

The various rule sets used by USFS National Forest Regions to compute the vegetation variables are assembled and reported in this compendium.

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[1] The current vegetation classification system was developed from National Standards (USDA FS 2003) and supplemented with Standards for Mapping of Vegetation in the Pacific Northwest Region (USDA FS 2004). The Preside program provides a flexible interface that allows setting class boundaries beyond the standards specified.

No.	Variable Name	Code Name	Description
01.	ALINE(IC1:IC2)	PLOT_ID	FIA Codes: State/Survey Unit/County/Plot Number
02.	ICYC	CY	FVS Projection Cycle
03.	JAGE	ST_AGE	FIA Stand Age
04.	APVT	PVT	Potential Vegetation Type
05.	ADTYP	DOM_TYPE	Dominance Type: NFS Regional rulesets
06.	VCCT(NA,5,10)	TREES/AC	Trees per acre (including seedlings and stems)
07.	QMDT20	QMD_TOP20	Quadratic-Mean-Diameter: Top 20% by diameter (exclude seeds unless < 10 canopy cover, then seeds +)
08.	QSC	QMD_SIZCL	QMD by 5" interval (i.e. 0-5", 5-10", 10-15", 15-20", 20-25", 25"+)
09.	IDLYR	CAN_SIZCL	Canopy Cover dominant size class: R2Veg Species Calcs, R3 mid-scale mapping
10.	VCCT(NA,5,22)	CAN_COV	Canopy Cover corrected for overlap (including seedlings and stems)
11.	DMCC	CAN_CLASS	Canopy Cover by interval class: NFS Regional rulesets
12.	VSTRCT	CAN_STORY	Canopy Layers/Stories: R6 ruleset; canopy cover per subordinate layers
13.	STORY	BA_STORY	Canopy Layers/Stories: R3 ruleset; basal area per 8" sliding diameter range
14.	VRT	VRT_STORY	Canopy Layers/Stories: R1 ruleset; basal area per size class
15.	STRY	SDI_STORY	Canopy Layers/Stories: R3 ruleset; canopy cover
16.	AVSS	RM_VSS	Rocky Mountain Vegetative Structural Stage: Goshawk guidelines
17.	AFT	FIA_FTYP	Forest Inventory Analysis (FIA) forest cover type
18.	IQMDSA	QMD_AGE	Stand Age of QMD_TOP20
19.	ICSA	CAN_AGE	Stand Age of CAN_SIZCL
20.	VCC(NA,0,10)	SEEDS/AC	Seedlings per acre (trees < 1.0" diameter)
21.	STEMS	STEMS/AC	Trees per acre (trees ≥ 1.0" diameter)
22.	QMDSTM	QMD_STM	Quadratic-Mean-Diameter (trees ≥ 1.0" diameter)
23.	BASTM	BA_STM	Basal Area per Acre (trees ≥ 1.0" diameter)
24.	ISDISM	SDI_SUM	Stand Density Index, Summation method (trees ≥ 1.0" diameter)
25.	ITLYR	CAN_SZTMB	Canopy Cover dominant size class: R2 HSS size classes, R3 timberland types, R4 SWIE size classes
26.	IWLYR	CAN_SZWDL	Canopy Cover dominant size class: R3 woodland types
27.	BAWD	BA_WT_DIA	Basal area weighted diameter (including seedlings and stems)
28.	BSC	BWD_SIZCL	Basal area weighted diameter size class
29.	BAWH	BA_WT_HGT	Basal area weighted height (including seedlings and stems)
30.	AVAR	G_VARIANT	FVS Geographic Base Model Variant
31.	IPRES	PROJ_YEAR	FVS Projection Year

Figure 4 – Vegetation classification variables reported by the FVSSTAND post processing program.

No.	Variable Name	Code Name	Description
01.	'DOM TYPE: '	Dom_Type:	Vegetation Classification Component Label
02.	ALINE(IC1:IC2)	Plot_ID	Plot/Stand/Point identification number
03.	ICYC	Cy	FVS Projection Cycle
04.	ADTYP	DomType	Existing Vegetation Dominance Type (according to Regional specifications)
05.	VCCT(NA,5,10)	Trees/Ac	Trees per acre (including seedlings and stems)
06.	VCCT(NA,5,13)	BA/Ac	Basal Area per acre (including seedlings and stems)
07.	VCCT(NA,5,22)	Cover/Ac	Canopy Cover corrected for overlap (including seedlings and stems)
08.	ATTRIB	Attr	Basis for Dominance Type (i.e. Canopy Cover, Basal Area, Trees)
09.	VCCT(NC,5,KK)	Soft_Attr	Softwood species contribution to Attribute basis
10.	VCCT(ND,5,KK)	Hard_Attr	Hardwood species contribution to Attribute basis
11.	VCCT(NA,5,KK)	Val_Attr	All species contribution to Attribute basis
12.	SCC1	Spc1_Attr	Primary species contribution to Attribute basis
13.	SCC2	Spc2_Attr	Secondary species contribution to Attribute basis
14.	SCC3	Spc3_Attr	Tertiary species contribution to Attribute basis
15.	XSCC1	Spc1_%	Primary species contribution to Attribute on a percentage basis
16.	XSCC2	Spc2_%	Secondary species contribution to Attribute on a percentage basis
17.	XSCC3	Spc3_%	Tertiary species contribution to Attribute on a percentage basis
18.	IS1	Spc1	Primary species FVS tree species number (FVS Variant specific)
19.	IS2	Spc2	Secondary species FVS tree species number (FVS Variant specific)
20.	IS3	Spc3	Tertiary species FVS tree species number (FVS Variant specific)
21.	GCC1	Gen1_Attr	Primary genus contribution to Attribute basis
22.	GCC2	Gen2_Attr	Secondary genus contribution to Attribute basis
23.	GCC3	Gen3_Attr	Tertiary genus contribution to Attribute basis
24.	XGCC1	Gen1_%	Primary genus contribution to Attribute on a percentage basis
25.	XGCC2	Gen2_%	Secondary genus contribution to Attribute on a percentage basis
26.	XGCC3	Gen3_%	Tertiary genus contribution to Attribute on a percentage basis
27.	IG1	Gen1	Primary genus tree genus index number
28.	IG2	Gen2	Secondary genus tree genus index number
29.	IG3	Gen3	Tertiary genus tree genus index number
30.	IPRES	Proj_Year	FVS Projection Year

Figure 5 – Vegetation values variables reported by the FVSSTAND post processing program.

R1 – Northern Region Vegetation Classification

Dominance Types – Elemental {DOM_TYPE}

Lifeform is a vegetation classification system based on plant morphology, size, life span, and woodiness. When lifeform is derived from photo/image interpretation, abundance is determined using species canopy cover. The setting must contain at least 10% canopy cover to be classified as tree lifeform. For inventory data, the setting must have at least 20 square feet of basal area or at least 100 trees per acre to be classified as tree lifeform. FVS vegetation classification methods follow inventory data protocols.

Elemental dominance type provides the most detailed information about species composition in a setting. In order for a setting to have a single-species elemental dominance type, one species must comprise at least 60% abundance (i.e., photo: canopy cover; inventory: basal area or trees per acre) of the total abundance. If not classified as a single-species type, and two species comprise at least 80% of the relative abundance with each species comprising more than 20%, the setting is classified a two-species type. If a setting does not meet the criteria for a single-species or two-species type, and three species comprise at least 80% of the abundance and each of those three species has at least 20%, the setting is classified a three-species type. If none of these conditions are met, the setting is classified based on the abundance of tolerant and intolerant tree species.

Key 4 – Tree elemental dominance type. (Note: XXXX = current Region 1 preferred *PLANTS Database* code for a tree species (e.g., ABLA, PIPO).

Lead	Argument - Based on Relative Abundance (i.e., canopy cover, basal area, or trees per acre)	Tree Elemental Dominance Type Code
EDT1	Abundance of single most abundant tree species $\geq$ 60% of total tree abundance	XXXX
EDT1	Abundance of single most abundant tree species < 60% of total tree abundance	Go to EDT2
EDT2	Abundance of two most abundant tree species $\geq$ 80% of total tree abundance, each individually >	XXXX-XXXX in order of abundance
EDT2	Abundance of two most abundant tree species < 80% of total tree abundance	Go to EDT3
EDT3	Abundance of three most abundant tree species $\geq$ 80% of total tree abundance, each individually > 20% of total tree abundance	XXXX-XXXX-XXXX in order of abundance
EDT3	Abundance of three most abundant tree species < 80% of total tree abundance	Go to EDT4
Logic is similar to tree lifeform subclass for remainder of key		
EDT4	Abundance of all hardwood trees $\geq$ 40% of total relative tree abundance	HMIX
EDT4	Abundance of all hardwood trees < 40% of total relative tree abundance	Go to EDT5
EDT5	Abundance of all hardwood and shade-intolerant conifer trees $\geq$ 50% of total relative tree abundance	IMIX
EDT5	Abundance of all hardwood and shade-intolerant conifer trees < 50% of total relative tree abundance	TMIX

Elemental dominance type is the finest thematic resolution that can be depicted in the Region 1 existing vegetation classification system. Although it is feasible to classify inventory data to elemental dominance type, it is not feasible to map it using remote sensing techniques and when it is needed, it is typically mapped manually. There are currently over 840 coniferous forest elemental dominance types identified in Region 1. Therefore, they are not listed in this document.

Note, if more than one species has the same abundance, then the species chosen is based on the following tie-breaking criteria (in this order): largest basal area weighted average diameter calculated for each species; largest basal area weighted average height; or alphabetical based on PLANTS species code.

% Species Composition						Elemental Dominance Type	Rule applied
ABLA	PICO	PIEN	PSME	POPUL	POTR5		
5	25	5	65	0	0	PSME	PSME comprises $\geq$ 60% of the attribute
10	32	10	48	0	0	PSME-PICO	PSME + PICO comprise $\geq$80% of the attribute with each species contributing >20% of the total, PSME is most dominant
7	57	6	30	0	0	PICO-PSME	PSME + PICO comprise $\geq$80% of the attribute with each species contributing >20% of the total, PICO is most dominant
15	0	30	10	45	0	HMIX	Does not meet 1, 2 or 3 species dominance type rules. Hardwood species $\geq$ 40%
15	20	10	25	0	30	IMIX	Does not meet 1, 2 or 3 species dominance type rules. Hardwood species < 40% but Hardwood species and Shade-intolerant species >= 50%
25	0	30	10	20	15	TMIX	Does not meet 1, 2 or 3 species dominance type rules. Hardwood species and Shade-intolerant species < 50%

Tree Size Class {BWD_SIZCL, BA_WT_DIA, BA_WT_HGT}

Tree size is a classification of the predominant diameter class of live trees within a setting. It is defined in the *Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant, 2005) as a classification of the mean diameter at breast height calculated as either quadratic mean diameter or basal area-weighted average diameter. Quadratic mean diameter (QMD) is the diameter of a tree of average basal area. Basal area weighted average diameter (BAWAD) is the average diameter of the live trees weighted by their basal area. BAWAD is not greatly influenced by small trees. Although QMD is larger than the arithmetic mean diameter of

a stand, it is generally smaller than BAWAD. Table 6 compares QMD with BAWAD for 3 settings. Notice the influence that numerous small trees have on quadratic mean diameter, but not on basal area-weighted average diameter.

Table 6 – Average tree size calculation examples

Trees per acre (TPA)	Diameter Breast Height (DBH)	Basal Area (BA) [(DBH$_2$ * 0.005454) * TPA]	BA* DBH	TPA * DBH$_2$	Quadratic Mean Diameter (QMD) [SQRT (Total TPA * DBH$_2$ / Total TPA)]	Basal area weighted ave diameter (BAWAD) [Sum(Tree BA*DBH)/ Total BA]
Example 1:						
1000	1	5.5	5.5	1000.0		
0	5	0.0	0.0	0.0		
0	10	0.0	0.0	0.0		
100	15	122.7	1840.7	22500.0		
0	20	0.0	0.0	0.0		
0	25	0.0	0.0	0.0		
1100		128.2	1846.2	23500.0	4.6	14.4
Example 2:						
100	1	0.5	0.5	100.0		
0	5	0.0	0.0	0.0		
0	10	0.0	0.0	0.0		
100	15	122.7	1840.7	22500.0		
0	20	0.0	0.0	0.0		
0	25	0.0	0.0	0.0		
200		123.3	1841.3	22600.0	10.6	14.9
Example 3:						
0	1	0.0	0.0	0.0		
500	5	68.2	340.9	12500.0		
0	10	0.0	0.0	0.0		
0	15	0.0	0.0	0.0		
0	20	0.0	0.0	0.0		
20	25	68.2	1704.4	12500.0		
520		136.4	2045.3	25000.0	6.9	15.0

Since management questions typically are concerned with the larger, dominant and co-dominant trees in a setting, and basal area-weighted average diameter is influenced, to a greater extent, by larger trees, it was selected by the R1 Vegetation Council to be used in the Region's existing vegetation classification system. Although basal area-weighted average diameter is used when assessing tree size class on inventory data, canopy cover-weighted average diameter estimates are used when assessing tree size by photo/image-interpretation methods.

Settings that have two stories, or a bi-modal distribution of trees, could have an assigned tree size class that is not found in the setting. This can be seen in Table 6, Example 3.

The Region 1 existing vegetation classification tree size classes are shown in table 7.

Table 7 – Tree size (diameter at breast height) classes.

| Base-level	Mid-level	Broad-level
0.0–5.0"	0.0–5.0"	
5.0–10.0"	5.0–10.0"	
10.0–15.0"	10.0–15.0"	Tree
15.0–20.0"		
20.0-25.0"	15.0"+	
25.0"+		

Computational methods for deriving basal area weighted average height are similar to those of basal area weighted average diameter. Total tree height is the basis.
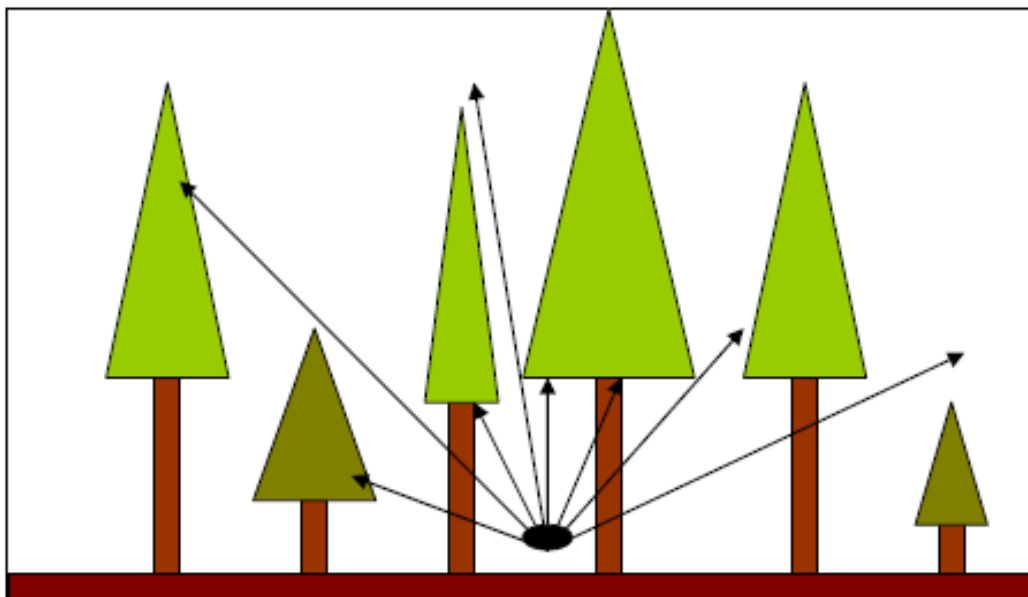
Tree Canopy Cover {CAN_CLASS}

In the Region 1 existing vegetation classification system, the term canopy cover is used to describe the proportion of the forest floor covered by the vertical projection of the tree crowns. The term canopy closure is used to describe the proportion of the sky hemisphere obscured by vegetation when viewed from a single point on the ground. This differentiation between terms is not universal and many publications use the terms interchangeably. Figures 1, 2, and 3 illustrate that canopy closure and canopy cover are not synonymous. However, the term "canopy from above" (USDA FSDD, 2008) is used synonymously with canopy cover in Region 1.
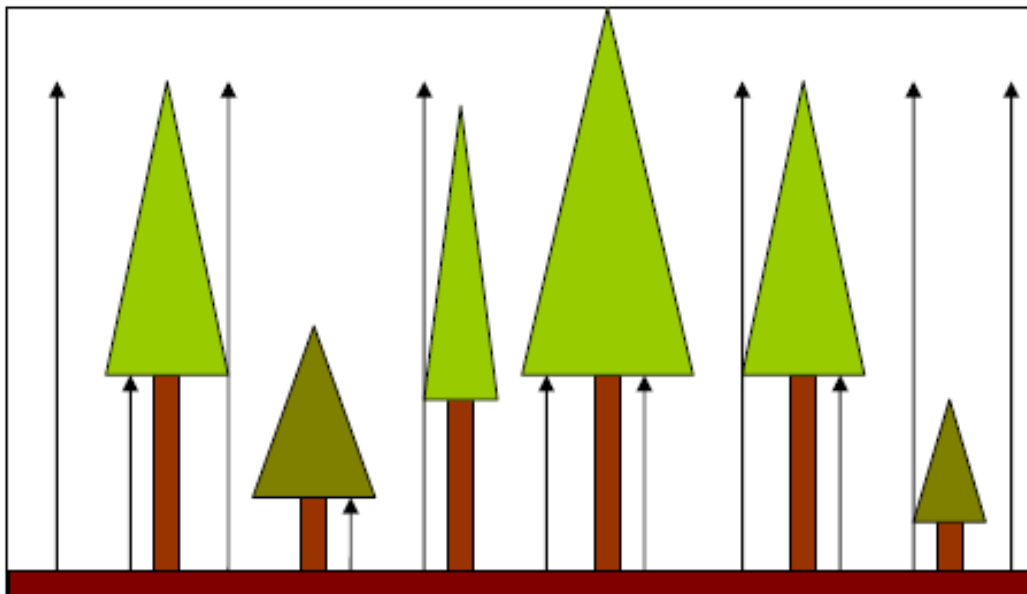
Figure 1. – Illustration of canopy cover measured from the ground.
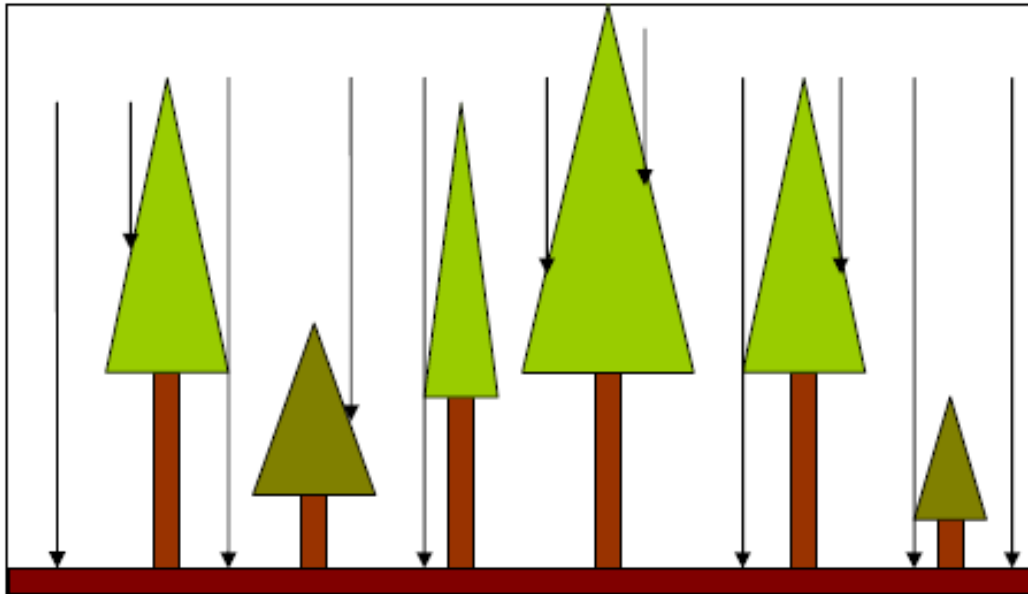
Figure 2. – Illustration of canopy cover measured from aerial photography or satellite-based remote sensing imagery.

Figure 3. – Illustration of canopy closure.

In the Region 1 existing vegetation classification system, canopy cover classes are a slight modification from national guiding documents which contain conflicting groups; the *National Vegetation Classification (NVC) System* (FGDC NVC, 2008) and the *Forest Service Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant, 2005). Brohman and Bryant (2005) use a system with 10-percent class breaks, while NVC has a break at 25%. We have chosen to adopt the 25% break as it best meets Region 1 business needs. Also, Brohman and Bryant's (2005) guidelines range from 0% to 100%, using 10-percent breaks. It is very uncommon to find canopy cover in excess of 70% in Region 1 and therefore the classes reflect that condition. Table 5 provides a summary of the acknowledged canopy cover classes.

Table 5 – Tree canopy cover classes at multiple levels.

Base-level	Mid-level	Broad-level
0.0–10%	0-10%	Tree
10-25%	10-25%	
25-40%	25-40%	
40-50%	40-60%	
50-60%		
60-70%	60%+	
70-100%		

Tree Vertical Structure {VRT_STORY}

Structure depicts the number of vertical layers of tree lifeform present in a setting. The structure algorithm is a custom algorithm developed by Region 1 based on field review and validation by the R1 Vegetation Council. At this point, it is only applied to inventory data and is not currently depicted on Region 1 map products. There are five vertical structure classes: single story (1), two-story (2), three-story (3), continuous vertical structure (C), and NONE which indicates not enough trees are present to assess.

In order for vertical structure to be derived from inventory data, the setting must have at least 20 square feet of basal area or 100 trees per acre. Otherwise, the vertical structure is labeled as NONE. If a setting has less than 20 square feet of basal area but at least 100 trees per acre, a single story class is assigned. Initially, every setting with greater than or equal to 20 square feet of basal area is classified as having one layer of vertical structure. Additional vertical structure classes are then potentially assigned to the setting based on the percent of the total basal area found in each of the following diameter classes: 0-4.9", 5.0-9.9", 10.0-14.9", 15.0-19.9", 20.0-24.9", 25.0"+.

The structure algorithm is performed in the following rule order and tables 8, 9, and 10 and figures 4, 5, and 6 give examples of how these rules are applied:

1. For any 3 consecutive diameter classes ordered largest to smallest, if the first (largest) and third (smallest) diameter class each have at least 2% of the total basal area, and if the percent of basal area in the first and third diameter class are at least 1.8 times larger than the proportion of basal area in the middle diameter class then, add a layer.
2. For any 4 consecutive diameter classes ordered from largest to smallest, if the middle 2 diameter class proportions are within 10% of each other, and the smallest and largest diameter classes each have at least 2% of the basal area, and each have at least 90% of the sum of the middle 2 diameter classes proportions then, add a layer.
3. If layer still equals 1 and at least 5 consecutive classes have $\geq 2\%$ of the total basal area, then vertical structure is continuous.
4. If layer equals 1 and the 3 smallest (0-4.9, 5.0-9.9, 10.0-14.9) diameter classes have $\geq 2\%$ of the total basal area, then vertical structure is continuous.

Vertical Structure Example 1.

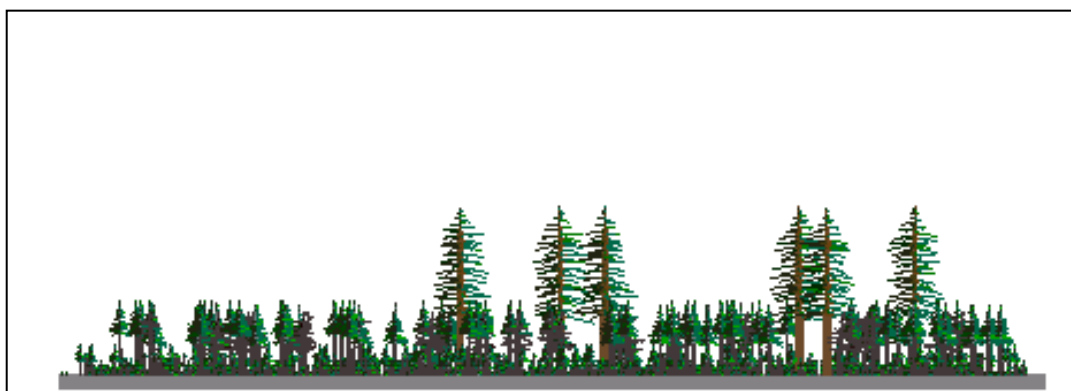| Percent Live Basal Area by Diameter Class					
0-5"	5-10"	10-15"	15-20"	20-25"	25+"
0	50	50	0	0	0
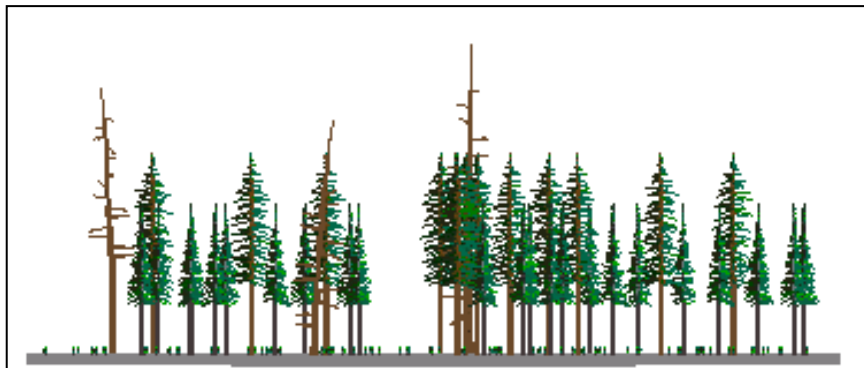
Figure 4. – Stand Visualization of Example 1.

Since the vertical structure algorithm only assess live tree structure, the presence of large snags in example 1 does not affect the determination of structural class. This example does not qualify for any of the vertical structure class rules and therefore it is classified as a single layer (1) setting.

Vertical Structure Example 2.

| Percent Live Basal Area by Diameter Class					
0-5"	5-10"	10-15"	15-20"	20-25"	25+"
25	50	0	0	25	0

Figure 5. – Stand Visualization of Example 2.

In this example, the middle 2 diameter classes both have a percent of basal area within 10% of each other (they are both zero). The class with the largest diameter (20-25" at 25%) and the class with the smallest diameter (5-10" at 50%) both have a percent basal area greater than 90% of the two middle classes (90% of zero equals zero). Therefore this stand is classified as a two layered (2) setting.

Vertical Structure Example 3.

Percent Live Basal Area by Diameter Class					
0-5"	5-10"	10-15"	15-20"	20-25"	25+"
4	27	42	20	7	0
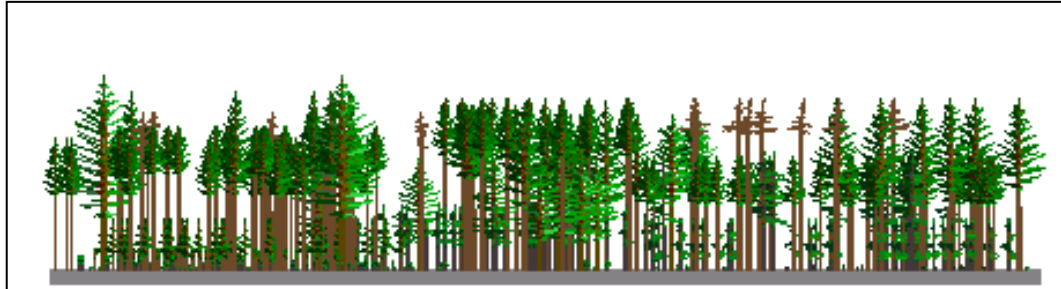
Figure 6. – Stand Visualization of Example 3.

In example 3, five consecutive diameter classes have greater than or equal to 2% of the total basal area. Therefore this stand is classified as continuous (C).

The graphic on the following page displays the vegetation classification system embedded within the Forest Vegetation Simulator for Region 1.

USFS Northern Region
Vegetation Classification System

DOMINANT LIFEFORM – SPECIES MIX
One-species dominance
Two-species dominance
Three-species dominance
Mixed-species dominance
Non-vegetated

SIZE CLASS*
9/N – Nonstocked		* Trees/Acre**
0/R – Seedling	0 - .1" dia	0 - 100 tpa (nonstocked)
1/E – Sapling	.1 - 5" dia	100+ tpa (softwoods)
2/S – Small Tree	5 - 10" dia	100+ tpa (hardwoods)
3/M – Medium Tree	10 - 15" dia	** dia ≤ 0.1" & hgt < 4.5' = R
4/L – Large Tree	15 - 20" dia	dia > 0.1" & hgt ≥ 4.5' = E
5/V – Very Large Tree	20 - 25" dia	
6/G – Giant Tree	25"+ dia	

CANOPY COVER
0 – Sparse	0 - 10%
1 – Low	10 - 25%
2 – Open	25 - 40%
3 – Moderate	40 - 60%
4 – Closed	60%+

VERTICAL STRUCTURE
0 – Nonstocked
1 – Single Story
2 – Two Story
3 – Three Story
4 – Continuous Story

References:

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R2 – Rocky Mountain Region Vegetation Classification

Overview – R2Veg

The R2VEG map typically consists of relatively homogeneous polygons based on existing vegetation characteristics. The composition of a polygon, as described by basic data collected from photo interpretation or field verification are: lifeform, layer, species, size, and cover percent. These attributes need to be summarized so that polygons may be "labeled" for GIS analysis.

Dominance Types – Species Calcs {DOM_TYPE}

The standard regional calculations are loaded into the table, R2VEG_DATA_CALCS. One calculation record per polygon is stored. Cover percent information is based on the following lifeforms or ground surface cover groups:

Tree	**Forb**
Shrub	**Barren**
Grass	**Water**

Based on the cover percent information, a lifeform or ground surface characteristic of T, S, G, F, B, or W is assigned to the polygon. If the cover percent of trees meets the SAF criterion of 25% or greater, then the polygon lifeform is assigned as TREE. If trees do not meet this criterion, then the lifeform for the polygon is assigned based on the majority cover percent. For the purpose of this calculation, grass & forbs are combined and barren & water are combined. If the lifeform is assigned as grass/forb, then either grass or forb is assigned to the polygon based on the majority of cover. Once a lifeform has been assigned to the polygon, several other calculations are made depending on the lifeform.

A species mix is assigned based on the species that make up "Dominant Life Form – Ground Surface Cover" (DLF_GSC) only. The species mix consists of up to three plant codes such as PIEN:ABLA:POTR5 or BOUTE:MUHLE. Species are listed in order of plurality of cover percent totals.

In order for a setting to have a single-species dominance type, one species must comprise at least 75% canopy cover abundance of the diagnostic layer. If not classified as a single-species type, and two species comprise at least 75% canopy cover abundance with each species comprising more than 25% proportionally of the total canopy cover, the setting is classified a two-species type. If a setting does not meet the criteria for a single-species or two-species type, and three species comprise at least 75% canopy cover abundance and each of those three species has at least 25% proportionally of the total canopy cover, the setting is classified a three-species type. If none of these conditions are met, the setting is classified using broader mixed species classes.

Tree Size Class {CAN_SIZCL}

Record the sizes of tree and shrub lifeforms, using either the tree or shrub lifeform size classes in the Table below. The diameters associated with each size class are interpreted from the height

and crown structure, unless measured in the field. Shrub size classes are based on actual heights. Do not include seedlings unless they are the dominant vegetation or make up a significant portion of the crown cover. The diameter of woodland tree species, including pinyon pine and juniper is estimated at root collar. Size class U (unknown) for shrubs should not be used for new surveys.

Tree Size Class	Description
E	Established seedlings. Mostly comprised of individuals 0.0 - 0.9 inches in diameter at ground level or root collar.
S	Small. Individuals 1.0 - 4.9 inches in diameter measured at diameter at breast height. Woodland species are measured at the root collar (DRC).
M	Medium. Individuals are 5.0 - 8.9 inches in diameter measured at diameter at breast height. Woodland species are measured at the root collar.
L	Large. Individuals are 9.0-15.9 inches in diameter measured at diameter at breast height. Woodland species are measured at the root collar.
V	Very Large. Individuals are 16.0 inches and larger in diameter measured at diameter at breast height. Woodland species are measured at the root collar.

Shrub Size Class	Description
S	Small. Shrubs are less than 2.5 feet tall.
M	Medium. Shrubs are 2.5-6.4 feet tall.
L	Large. Shrubs are greater then 6.4 feet tall.

Here are the calculation steps:

1. Calculate the total cover percent by each size class for the polygon lifeform (LF_GCS).
2. Group the size classes into small, medium, or large and determine the majority based on the total cover percent calculated for that size within the lifeform.
3. If the LF_GSC is trees, then split out the S (small) into E or S. Split L (large) into Large or Very Large based on the majority cover percent.

Tree Crown Cover {CAN_CLASS}

Let's clarify R2 terminology for cover percent.

"Canopy Cover" refers to cover percent uncorrected for overlap
"Crown Cover" refers to cover percent corrected for overlap

The basis for the cover percent calculation is trees greater than or equal to one-inch in diameter. The basis for the tree crown cover classes is derived from the Wildlife Habitat Structural Stage (HSS) guidelines as follows:

Record the Habitat Structural Stage as observed in the field –

   1T Grass-Forb, Previously Trees
   1M Grass-Forb, Not Previously Trees (Natural Meadow)
   2T   Shrub-Seedling, Previously Trees
   2S   Shrub-Seedling, Not Previously Trees
   3A Sapling-Pole, Crown cover percent < 40

3B Sapling-Pole, Crown cover percent >= 40 and < 70
3C Sapling-Pole, Crown cover percent >= 70
4A Mature and Over Mature, Crown cover percent < 40
4B Mature and Over Mature, Crown cover percent >= 40 and < 70
4C Mature and Over Mature, Crown cover percent >= 70
5   Old Growth, Forest Criteria and Documentation usually determined by a scoring system

Tree Vertical Structure – Layering Calcs {CAN_STORY}

Determine the number of canopy layers present within the lifeform (e.g. layers within all trees and/or layers within all shrubs); then record the layer number that the line entry of trees or shrubs falls in. Use codes in the table below. Tree and shrub lifeforms must have a minimum of one layer and not more than three layers. A layer must contain at least 10 percent of the crown cover within the component. (e.g. If three layers are visible and the trees in the middle layer do not equal 10 percent crown cover, the middle height trees should be placed in the layer that is closest to its height.) If there is less than 10 percent crown cover for a tree species and no other layers of that same species, record information for that layer.

Code	Layer
0	Unknown (SHRUBS ONLY)
1	Top layer
2	Middle layer
3	Bottom layer

The purpose of this calculation is to distinguish a polygon with a single layer of trees or shrubs from polygons of multiple layers. Note that the layering calculation is specific to the calculated Lifeform Ground Surface Cover (LF_GSC). Layering is coded 1, 2, or 3 for shrubs or trees. It is possible to have 3 layers of trees and 3 layers of shrubs.

1. Sum the polygon cover percents by layer for the lifeform.
2. A layer is considered if the total cover percent >=10. If there are two or more layers for the lifeform with >=10 percent cover then code the polygon as M for multiple layers. Otherwise code as S for a single layer.

The graphic on the following page displays the vegetation classification system embedded within the Forest Vegetation Simulator for Region 1.

USFS Rocky Mountain Region
Vegetation Classification System

DOMINANT LIFEFORM – SPECIES MIX
One-species dominance
Two-species dominance
Three-species dominance
Mixed-species dominance
Non-vegetated

SIZE CLASS*
N – Nonstocked		* Trees/Acre**
E – Establishment	0 - 1" dia	0-150 tpa (nonstocked)
S – Small Tree	1 - 5" dia	150-300 tpa (softwoods)
M – Medium Tree	5 - 9" dia	300+ tpa (hardwoods)
L – Large Tree	9 - 16" dia	** dia < 1.5" = E
V – Very Large Tree	16"+ dia	dia ≥ 1.5" = S

CROWN COVER
0 – Sparse	0 - 10%
1 – Open	10 - 40%
2 – Moderate	40 - 70%
3 – Closed	70%+

CANOPY LAYERS
0 – Nonstocked
1 – Single Story
2 – Multiple Story

Auxiliary Field – R2 Wildlife Habitat Structural Stage (HSS) {CAN_SZTMB}

The Book entitled "Managing Forested Lands for Wildlife" published by the Colorado Division of Wildlife in 1987 and developed in cooperation with the U.S. Department of Agriculture, Forest Service, Rocky Mountain Region, set the initial criteria for calculating habitat structural stage. These criteria were modified slightly over time to better fit with the available data collected for Region 2 and were incorporated into the RMRIS system.

Code	Structural Stage	Tree Size Class	Diameter Range for Most Trees	Crown Cover %
1m	Grass-Forb	Nonstocked	Not formally trees (nft)	0-10
1t	Grass-Forb	Nonstocked	Formally trees (ft)	0-10
2s	Shrub-Seedling	Established	Less than 1 inch, nft	11-100
2t	Shrub-Seedling	Established	Less than 1 inch, ft	11-100
3a	Sapling-Pole	Small, medium	Trees mostly 1-9 inches	11-40
3b				41-70
3c				71-100
4a	Mature	Large, very large	Trees mostly 9 inches +	11-40
4b				41-70
4c				71-100
5	Old Growth*	Large, very large	Varies	

Initially density classes were based on total crown cover from a 0 to 100% scale. Later on, the Regional Office developed a method to determine density classes using stand exam data based on average maximum density curves. Photo interpreted data used crown cover percent to determine the A, B or C density classes and the stand exam data used cover type, basal area and diameter.

Measures of Stand Density

AMD	CROWN COVER %	DENSITY GROUP
0 - 9%	0 - 9%	Grass/Forbs
10-39%	10-39%	A (Low)
40 - 59%	40-69%	B(Medium)
60+ %	70+ %	C(High)

Average Maximum Density (AMD)
Percent AMD is based on 3 variables which are measured in the field in order to rank a stand as a percentage of Average Maximum Density

STAND BASAL AREA (1"+)
STAND DIAMETER (1"+)
TREES PER ACRE (1"+)

Crown Cover Percent (CCP)
Crown Cover Percent is derived from photo interpretation and verified in the field.

Note that in R2Veg, "Tree Cover" is generally determined when there is 25% crown cover of trees but in some cases, tree cover may be calculated when there is as low as 10% crown cover of trees. In R2Veg, the *formerly trees* category in the R2Veg_Poly table is equivalent to the RMRIS non-stocked category. This field is used to make the split between 1M and 1T and 2S and 2T.

The Rocky Mountain Research Station (Carl Edminster and Todd Mower) developed some stocking curves for Region 2. One of the uses of those curves was to divide stands into three density classes. Some correlation was done in the Regional Office to determine the appropriate breaking points for the A, B and C classes. Less than 10 % AMD (average maximum density) was also used to determine if a stand was non-stocked. Do not confuse 10% AMD with 10% crown cover as they are not the same.

AVERAGE MAXIMUM DENSITY RELATIONSHIPS
REGIONS 2 AND 3

SPRUCE-FIR
    BA = 1266.41679 * TPA ** (-0.20378) — AMD curve
    BA = 156.39149 * QMD ** 0.33857
    TPA = 28673.6 / (QMD ** 1.66143)
    lnTPA = 10.26373 - 1.66143 * lnQMD
    lnQMD = 6.17766 - 0.60189 * lnTPA

ASPEN
    BA = 867.20046 * TPA ** (-0.14831)
    BA = 184.64207 * QMD ** 0.25831
    TPA = 33852.9 / (QMD ** 1.74169)
    lnTPA = 10.42978 - 1.74169 * lnQMD
    lnQMD = 5.98832 - 0.57416 * lnTPA

LODGEPOLE PINE
    BA = 1034.50864 * TPA ** (-0.18860)
    BA = 150.39622 * QMD ** 0.31735
    TPA = 27574.4 / (QMD ** 1.68265)
    lnTPA = 10.22464 - 1.68265 * lnQMD
    lnQMD = 6.07653 - 0.59430 * lnTPA

DOUGLAS-FIR/MIXED CONIFER
    BA = 765.32045 * TPA ** (-0.17642)
    BA = 129.41134 * QMD ** 0.29992
    TPA = 23726.8 / (QMD ** 1.70008)
    lnTPA = 10.07436 - 1.70008 * lnQMD
    lnQMD = 5.92583 - 0.58821 * lnTPA

PONDEROSA PINE
    BA = 762.26977 * TPA ** (-0.20487)
    BA = 101.67281 * QMD ** 0.34007
    TPA = 18641.0 / (QMD ** 1.65992)
    lnTPA = 9.83312 - 1.65992 * lnQMD
    lnQMD = 5.92384 - 0.60244 * lnTPA

PINYON-JUNIPER
    BA = 1280.03629 * TPA ** (-0.32750)
    BA = 60.57489 * QMD ** 0.49341
    TPA = 11106.1 / (QMD ** 1.50659)
    lnTPA = 9.31525 - 1.50659 * lnQMD
    lnQMD = 6.18301 - 0.66375 * lnTPA

where
    BA = stand basal area (sq. ft. per acre)
    TPA = trees per acre
    QMD = diameter (inches) of the tree of average basal area
    ln = natural logarithm
    and all values are based on trees 1-inch d.b.h. and larger

References:

Habitat Structural Stage, From RMRIS to R2VEG, October 2004.
http://fsweb.sanjuan.r2.fs.fed.us/gis/resource_gis.shtml

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R2VEG Users Guide, February 2005. http://fsweb.sanjuan.r2.fs.fed.us/gis/r2veg.shtml

RMSTAND: Data Processing and Interpretation. June 1993.

http://fsweb.r2.fs.fed.us/rr/stand_exam/veg_user_guide/indexcvug.shtml

R3 – Southwest Region Vegetation Classification

Overview – R3 Existing Vegetation

Dominances types are defined by the species or genera of greatest abundance, usually the most abundant components of the uppermost canopy layer of the existing plant community. The vegetative components that define the unit are always of the same life form so that it is first necessary to identify the dominant life form of the community – the NVC *order* (National Vegetation Classification System – Grossman *et al* 1998). Once the life form has been established the subclass is identified (e.g., 'evergreen tree') before going on to name the community by species or genera of the chief components. Occasionally individual components are not abundant enough to label the community so that the community is relegated to one of several mixed types. The subclass is needed for identifying mixed dominance types. The Southwestern Region has standardized five categories of dominance types.

- One-species
- Two-species
- One-genus
- One-species/one-genus
- Two-genus
- Mixed

Dominance Types – Key {DOM_TYPE}

The dominance type key guides the identification of dominance types including all possible mixed types. The key is dichotomous and is broken into three sections to be keyed in sequence – order, subclass, and dominance type. Dominance types are ultimately named and labeled by the user according to the most abundant components. A given dominance type is named using the current *PLANTS Database* species or genus codes (USDA NRCS 2004) (http://plants.usda.gov/). Dominance types with more than one component are separated by an underscore and placed in alphabetical order by their code for consistency (e.g., JUMO_PIED); otherwise, it is possible to have confusion between identical dominance types that have been named differently within the same data set (e.g., JUMO_PIED and PIED_JUMO). As a result, the order of the components within a name bears no significance to abundance or priority. Also, it is best to determine up front what tree species are to be designated shade tolerant or shade intolerant, and to designate life form if possible for species in question.

For tree- and shrub-dominated communities with low overstory cover (<30% canopy cover of trees or shrubs), an optional key is available to append codes for understory components (see following 'UNDERSTORY'). The understory key provides a means to identify single-species and single-genus components that occur in high abundance (i.e., >60% relative canopy cover) beneath a limited overstory. Understory taxa are coded as a suffix to the dominance type, indicated by a forward slash followed by the *Plants Database* code for the species or genus identified (e.g., JUMO_PIED/BOGR2). The understory component is included only as adjunct coding so that, for example, a JUMO_PIED dominance type is equivalent to a JUMO_PIED/BOGR2 dominance type. Currently, the understory component is not determined by FVS.

NOTE: Most leads refer to the relative canopy cover within a particular life form. Leads 1-5 refer to the percent canopy cover on an area basis.

NVC ORDER

Lead	Argument	Order Code
1	Tree life form ≥ 10% canopy cover	**T**…tree…go to 6
1	Tree life form < 10% canopy cover	Go to 2
2	Shrub life form ≥ 10% canopy cover	**S**…shrub…go to 8
2	Shrub life form < 10% canopy cover	Go to 3
3	Herbaceous life form ≥ 10% canopy cover	**H**…graminoid/forb…go to 10
3	Herbaceous life form < 10% canopy cover	Go to 4
4	Combined canopy cover of trees, shrubs, and herbs ≥ 10%	**NDL**…no dominant life form
4	Combined canopy cover of trees, shrubs, and herbs < 10%	Go to 5
5	Combined canopy cover of trees, shrubs, and herbs ≥ 1%	**SVG**…sparsely vegetated
5	Combined canopy cover of trees, shrubs, and herbs < 1%	**NVG**…non-vegetated

NVC SUBCLASS

Lead	Argument	Subclass Code
6	Evergreen trees > 75% of total tree canopy cover	**TE**…evergreen tree…go to 11
6	Evergreen trees ≤ 75% of total tree canopy cover	Go to 7
7	Deciduous trees > 75% of total tree canopy cover	**TD**…deciduous tree…go to 11
7	Deciduous trees ≤ 75% of total tree canopy cover	**TX**…mixed evergreen-deciduous tree…go to 11
8	Evergreen shrubs > 75% of total shrub canopy cover	**SE**…evergreen shrub…go to 19
8	Evergreen shrubs ≤ 75% of total shrub canopy cover	Go to 9
9	Deciduous shrubs > 75% of total shrub canopy cover	**SD**…deciduous shrub…go to 19
9	Deciduous shrubs ≤ 75% of total shrub canopy cover	**SX**…mixed evergreen-deciduous shrub…go to 19
10	Perennial herb species ≥ 50% of total herbaceous canopy cover	**HP**…perennial herb…go to 26
10	Perennial herb species < 50% of total herbaceous canopy cover	**HA**…annual herb…go to 26

TREE DOMINANCE TYPE (key to subclass first)

Lead	Argument	Tree Dominance Type Code
11	Canopy cover of single most abundant tree species ≥ 60% of total tree canopy cover	Plants database code for single tree species
11	Canopy cover of single most abundant tree species < 60% of total tree canopy cover	Go to 12
12	Canopy cover of two most abundant tree species ≥ 80% of total tree canopy cover, each individually ≥ 20% of total tree canopy cover	Plants database codes for both tree species, ordered alphabetically and separated by underscore
12	Canopy cover of two most abundant tree species < 80% of total tree canopy cover	Go to 13
13	Canopy cover of single most abundant tree genus ≥ 60% of total tree canopy cover	Plants database code for single tree genus
13	Canopy cover of single most abundant tree genus < 60% of total tree canopy cover	Go to 14
14	Canopy cover of the single most abundant tree species and single most abundant tree genus collectively ≥ 80% of total tree canopy cover, each individually ≥ 20% of total tree canopy cover (most abundant species and most abundant genus mutually exclusive)	Plants database codes for single tree species and single tree genus, ordered alphabetically and separated by underscore
14	Canopy cover of the single most abundant tree species and single most abundant genus collectively < 80% of total tree canopy cover (most abundant species and most abundant	Go to 15

Lead	Argument	Tree Dominance Type Code
	genus mutually exclusive)	
15	Canopy cover of two most abundant tree genera $\geq$ 80% of total tree canopy cover, each individually $\geq$ 20% of total tree canopy cover	Plants database codes for both tree genera, ordered alphabetically and separated by underscore
15	Canopy cover of two most abundant tree genera < 80% of total tree canopy cover or each individually < 20% of total tree canopy cover	Go to 16
	NEED SUBCLASS TO RUN THE FOLLOWING KEY BREAKS	
16	"Deciduous tree" subclass (TD)	**TDMX**…deciduous tree species mix
16	Not "deciduous tree" subclass	Go to 17
17	"Mixed evergreen-deciduous tree" subclass (TX)	**TEDX**…evergreen and deciduous tree species mix
17	Not "mixed evergreen-deciduous tree" subclass	Go to 18
18	Total canopy cover of shade tolerant trees $\geq$ canopy cover of shade intolerant trees	**TETX**…shade tolerant evergreen tree species mix
18	Total canopy cover of shade tolerant trees < canopy cover of shade intolerant trees	**TEIX**…shade intolerant evergreen tree species mix

Tree Size Class {CAN_SIZCL, CAN_SZTMB, CAN_SZWDL}

Tree size is a classification of the predominant diameter class of live trees within a setting. It is defined in the *Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant, 2005) as a classification of the mean diameter at breast height (4.5 feet above the ground) for the trees forming the upper or uppermost canopy layer (Helms 1998). Tree size class is determined by calculating the diameter (usually at breast height) of the tree of average basal area (Quadratic Mean Diameter [QMD]) of the top story trees that contribute to canopy closure, i.e., tree cover as seen from a bird's eye view from above. Top story trees are those trees that receive light from above and at least one side; these are the open grown, dominant, and codominant trees.

Tree size class is derived from estimates of canopy cover for each of the five classes listed below using the following process:

 • Estimate canopy cover to the nearest 1% for size classes that are < 10%.
 • You may estimate canopy cover to the nearest 5% for size classes with canopy cover > 10%.
 • Ensure that the total of all size classes represents the total canopy coverage for the polygon.
 • Ensure that for polygons identified as tree life form, the total of all size classes > 10%, and that for polygons not identified as tree life form, the total of all size classes < 10%.

TLFC	Tree life form canopy cover	All sizes
GTCC	Giant tree canopy cover	> 30.0-in d.b.h.
VLCC	Very large tree canopy cover	20.0–29.9-in d.b.h.
LTCC	Large tree canopy cover	15.0–19.9-in d.b.h.
MTCC	Medium tree canopy cover	10.0–14.9-in d.b.h.
STCC	Small tree canopy cover	5.0–9.9-in d.b.h.
SSCC	Seedlings/saplings canopy cover	< 5.0-in d.b.h.

For mid-scale mapping, medium and large tree size classes are collapsed and are recognized as medium tree. For timberland dominance types, very large and giant tree size classes are merged

and coded as very large tree. For woodland dominance types, large, very large, and giant tree size classes are combined and referred to as large tree.

Tree Canopy Cover {CAN_CLASS}

Tree canopy cover (also called tree canopy closure) is the total non-overlapping tree canopy in a delineated area as seen from above. The sum of all tree canopy cover within a delineated area will not exceed 100 percent. Tree canopy closure below 10 percent is considered a non-tree type.

For the Region 3 existing vegetation classification system, canopy cover classes are a slight modification from the *Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant, 2005). Brohman and Bryant (2005) use a system with 10-percent class breaks, while Region 3 has chosen to adopt broader class boundaries. Table 5 provides a summary of the recognized canopy cover classes.

Table 5 – Tree canopy cover classes.

Technical Groups	Map Unit	Mid-level
0.0 1–10%	Non-Stocked	Sparse
10-20% 20-30%	10-30%	Low
30-40% 40-50% 50-60%	30-60%	Open
60-70% 70-80%	60-80%	Closed
80-90% 90-100%	80%+	

Tree Canopy Layers {BA_STORY}

Canopy layers describe the number of vertical stories present in a setting. The canopy layer algorithm for Region 3 was extracted from R3 Vegetative Structural Stage (R3 VSS) calculation routines for distinguishing between even-aged and uneven-aged stands.

The Vegetative Structural Stage (VSS) rating system for Region 3 was developed in 1992. The basis for the various VSS classes was derived from research in developing "Management Recommendations for the Northern Goshawk in the Southwestern United States" (Reynolds, Graham, and others 1992). VSS is a method of describing the growth stages of a stand of living trees. The Vegetative Structural Stages are based on tree size (diameter) and total canopy cover. The classification system is most useful for even-aged stands with single or multiple stories, but has less utility when applied to either a uniform or groupy uneven-aged (all-aged) stands.

In the original version, a six-class vegetation scheme was used to describe the developmental stages of a forest ecosystem. The six stages are grass-forb/shrub (0 - 1" dbh); seedling-sapling (1 - 5" dbh); young forest (5 - 12" dbh); mid-age forest (12 - 18" dbh); mature forest (18" dbh and larger); and old-growth (meets Regional minimum dbh, age, and number of tree required standards). Stand density index (SDI) is calculated for each forest stage and the stage with the highest density is selected for the classification. SDI is also used to determine the canopy closure class (open; moderately closed; or closed) and whether a stand is single or multiple storied.

In 1998, changes were made to VSS that did away with Old Growth determinations. VSS Class 6 was re-defined to Old Forest and was set for trees that were 24-inches or greater in diameter. VSS Class 5 diameter range was changed to 18 – 23.9". Additionally, a new VSS rating was developed for identifying even-aged stands. The SDI computation was abandoned. Even-aged stands were determined based on the distribution of the basal area. For a stand to be called even-aged, sixty percent or more of the stand basal area had to be found in an eight-inch diameter class. This eight-inch diameter class is a moving range; the process calls for calculating the basal area in the 0-7.9 inch range, then the 1.0-8.9 range, then the 2.0-9.9 range, etc, to the final range of 24-99.9 inches. If 60% or more of the stand basal area is found in any diameter class, the stand is called even-aged. If no eight-inch class has at least 60% of the stand basal area, the stand is then called uneven-aged.

In 2010, while examining this algorithm, it was determined that the 60% threshold provided the benchmark for uneven-aged stands (i.e. three or more storied stands). The VDDT models that were constructed in support of forest plan revision identified either "single" or "multiple" story stands. Multiple storied stands included two or more storied stands. After an intensive investigation and analysis of supporting data, it was found that increasing the benchmark threshold from 60% to 70% allowed isolating two or more storied stands. Basal area favors larger diameter trees. The lower limit threshold of 60% allowed bigger trees to dominant this algorithm and classifies most stands as even-aged. Increasing the basal area threshold tightened the requirement for single storied stands. Thus, two storied are now isolated and better define the multiple story nature regarding canopy layers. The threshold is set at 70% to define the breakpoint between single and multiple storied stands.

USFS Southwestern Region
Vegetation Classification System

DOMINANCE TYPE
 One-species types
 Two-species types
 One-genus types
 One-species/One-genus types
 Two-genus types
 Mixed types

SIZE CLASS

TREE
  1 - Seed/Sap   < 5"
  2 - Small   5 – 10"
  3 - Medium   10 – 20"
  4 - Very Large   20 – 30"
  5 - Giant   ≥ 30"

SHRUB
  1 - Low   < 0.5m
  2 - Medium   0.5-2m
  3 - Tall   ≥ 2m

CANOPY COVER (tree/shrub)
 0 - Sparse –   0-10% CC
 1 - Open –   10-30% CC
 2 - Moderate –   30-60% CC
 3 - Closed –   60-100% CC

CANOPY LAYERS
 0 – Nonstocked
 1 – Single Story
 2 – Multiple Story

R3 – Size Class Breaks

Mid-Scale Mapping	Spruce-Fir Forest	Mixed Conifer Wet	Mixed Conifer Dry	Ponderosa Pine Grass	Ponderosa Pine Gambel Oak	Ponderosa Pine Evergreen Oak	Pinyon-Juniper Woodland	Oak Woodland
0-5"	0-5"	0-5"	0-5"	0-5"	0-5"	0-5"	0-5"	0-5"
5-10"	5-10"	5-10"	5-10"	5-10"	5-10"	5-10"	5-10"	5-10"
10-20"	10-20"	10-20"	10-20"	10-20"	10-20"	10-20"	10"+	10"+
20-30"	20"+	20"+	20"+	20"+	20"+	20"+		
30"+								

Auxiliary Field – R3 Vegetative Structural Stage (VSS) {R3_VSS, SDI_STORY}

On February 3, 2000, R3 staffs met to discuss changes to the VSS rating system. It was agreed that changes were necessary in order for some of the cover types to be rated properly. It was also agreed that the original grouping of cover types could be modified into different groupings that shared similar characteristics. The original six cover type groups were re-arranged into four groups. Results of this meeting are shown in Table 3.

Table 3 – Vegetative Structural Stages Classes by Forest Cover Types
Diameter and Cover Type Groupings as Modified 3/2000

Cover Types	1	2	3	4	5***	6
1. Ponderosa Pine, Southwestern White Pine, Misc Softwoods, Douglas Fir, White Fir, Limber Pine, Engelmann Spruce-Subalpine Fir, Engelmann Spruce, Blue Spruce, Bristlecone Pine, Corkbark Fir, Aspen	0 – 0.9"	1.0 – 4.9"	5.0 – 11.9"	12.0 – 17.9"	18.0 – 23.9"	24"+
2. Cottonwood, Arizona Cypress, Gambel Oak (tree form*)	0 – 0.9"	1.0 – 4.9"	5.0 – 9.9"	10.0 – 14.9"	15"+	N/A
3. Willow, Misc Hardwoods, Gambel Oak (shrub form**)	0 – 0.9"	1.0 – 2.9"	3.0 – 4.9"	5.0 – 6.9"	7"+	N/A
4. Pinyon-Juniper, Juniper, Rocky Mtn Juniper	0 – 0. 9"	1.0 – 2.9"	3.0 – 4.9"	5.0 – 10.9"	11"+	N/A

* Gambel Oak tree form exists on the following Forests in R3: - Apache-Sitgreaves - Cibola (Magdalena & Mt. Taylor districts only) - Coconino - Coronado - Gila - Kaibab (south districts) - Lincoln - Prescott - Tonto	** Gambel Oak shrub form exists on the following Forest in R3: - Carson - Cibola (except the Magdalena and Mt. Taylor districts) - Kaibab (North Kaibab district) - Santa Fe	*** For Forest Cover Type groups 2, 3 and 4, VSS There are only 5 VSS classes.

Each VSS class is accompanied by the letter A, B, or C, to indicate **canopy density category**. The canopy density category is based on *stand density index* value for the stand and the percent of maximum SDI the stand contains. The following is a breakdown of that canopy density category:

A- open less than 25% of maximum SDI for the designated covertype (see table below)

B- mod closed between 25-47% of maximum SDI for the designated covertype (see table)

C- closed greater than 47% of maximum SDI for the designated covertype (see table)

Species	SDI_{max}
White fir	830
Douglas-fir	595
Ponderosa pine	450
Oak woodland	460
Pinon-Juniper	465
Misc. Softwoods	450
Misc. Hardwoods	400
Juniper Woodland	344

An SDI_{max} of 450 for stands classified as ponderosa pine means that a maximum of 450 10-inch trees can exist on a site regardless of site productivity. Any further addition of trees above this maximum value means that trees will die as a result of tree-to-tree competition. The SDI_{max} value is larger for shade tolerant species such as the true firs. The smaller the SDI_{max} value, the more seral or shade intolerant the tree species is.

VEGETATIVE STRUCTURAL STAGE DESCRIPTION

The vegetative structural stage describes the forest successional stage, canopy cover, and stories.

CODE   DESCRIPTION

Code	Description
1	Grass-forb/shrub
2A	Seedling/sapling, open canopy
2B	Seedling/sapling, moderately closed canopy
2C	Seedling/sapling, closed canopy
3ASS	Young forest, open canopy, single story
3AMS	Young forest, open canopy, multiple story
3BSS	Young forest, moderately closed canopy, single story
3BMS	Young forest, moderately closed canopy, multiple story
3CSS	Young forest, closed canopy, single story
3CMS	Young forest, closed canopy, multiple story
4ASS	Mid-aged forest, open canopy, single story
4AMS	Mid-aged forest, open canopy, multiple story
4BSS	Mid-aged forest, moderately closed canopy, single story
4BMS	Mid-aged forest, moderately closed canopy, multiple story closed
4CSS	Mid-aged forest, canopy, single story
4CMS	Mid-aged forest, closed canopy, multiple story
SASS	Mature forest, open canopy, single story
5AMS	Mature forest, open canopy, multiple story
5BSS	Mature forest, moderately closed canopy, single story
5BMS	Mature forest, moderately closed canopy, multiple story closed
5CSS	Mature forest, canopy, single story
5CMS	Mature forest, closed canopy, multiple story
6BSS	Old-growth, moderately closed canopy, single story
6BMS	Old-growth, moderately closed canopy, multiple story
6CSS	Old-growth, closed canopy, single story
6CMS	Old-growth, closed canopy, multiple story

DESCRIPTION

LEGEND

Structural Stage:
    1 Grass-Forb/Shrub
    2 Seedling/Sapling
    3 Young Forest
    4 Mid-aged Forest
    5 Mature Forest
    6 Old-growth

Canopy Closure:
    A 0-39 Percent, Open
    B 40-59 Percent, Moderately Closed
    C 60+ Percent, Closed
Stories:
    SS Single Story
    MS Multiple Story

VEGETATIVE STRUCTURAL STAGE CALCULATIONS

STRUCTURAL STAGES

VSS 1 is determined:

when
$$\frac{\text{Total Stand SDI}}{\text{Maximum SDI for Forest Type}} \times 100 = \overline{}$$
<10% or Basal Area
is < 20. (Forest type is not set if BA
is less than 20)

VSS 6 is determined:

when
The number of trees and stem diameter are equal to or
greater than the stated number for the forest type. The
stated stem size and number of trees are the Regional old-
growth minimums.

VSSs 2, 3, 4, and 5 are determined:

when
$$\frac{\text{Total Stand SDI}}{\text{Maximum SDI for Forest Type}} \times 100 \text{ is } \geq 10\%$$

and VSS 6 number of tree and stem diameters are < the
numbers stated; the class with the highest calculated
square foot basal area is the assigned structural stage.
The calculated basal area for each VSS includes all tree
species.

CANOPY COVER

Canopy cover is determined:

when
$$\frac{\text{Total Stand SDI}}{\text{Maximum SDI for Forest Type}} \times 100 = 10 \text{ to } \leq 30\% \text{ then}$$
A is assinged meaning Open, 0 to 39% canopy cover

when
$$\frac{\text{Total Stand SDI}}{\text{Maximum SDI for Forest Type}} \times 100 = >30 \text{ to } \leq 47\% \text{ then}$$
B is assinged meaning Moderately Closed, 40 to 59 % cover

when
$$\frac{\text{Total Stand SDI}}{\text{Maximum SDI for Forest Type}} \times 100 = >47\% \text{ then}$$
C is assinged meaning Closed, 60+% canopy cover

STORIES

Stories are determined:

when
$$\frac{\text{SDI for Selected VSS}}{\text{Total Stand SDI}} \times 100 = \geq 60\% \text{ then}$$
SS is assinged meaning Single Story

when
$$\frac{\text{SDI for Selected VSS}}{\text{Total Stand SDI}} \times 100 = < 60\% \text{ then}$$
MS is as singed meaning Multiple Story

R3 Forest Cover Types
And Associated Max SDI

RMRIS

Cover Type	Despcription	Max SDI
TSF	Spruce-Fir	670
TES	Engelmann Spruce	670
TDF	Douglas-Fir	595
TWF	White Fir	830
TBS	Blue Spruce	670
TBC	Bristlecone Pine	700
TPP	Ponderosa Pine	450
TLI	Limber Pine	700
TWP	Southwestern White Pine	450
TOS	Miscellaneous Softwoods	450
TAA	Aspen	600
TCW	Cottonwood	420
TPJ	Pinon-Juniper	465
TOW	Oak Woodland	460
TOH	Miscellaneous Hardwoods	400
TAZ	Arizona Cypress	400
TJW	Juniper Woodland	344
TMQ	Mesquite	344
TRJ	Rocky Mountain Juniper	344

Auxiliary Field – Stand Age {QMD_AGE, CAN_AGE}

Stand age provides a general measure and indication of important processes and functions of forested landscapes. Each successional stage provides habitat and is important for particular plants and animals. Stand age often coincides with certain structural dynamics but can also be an important measure in and of itself for habitation or colonization by particular organisms. At particular phases of succession, for instance, stands take on elements of decadence important for certain wildlife species.

FVS estimates the average age of each canopy layer based on tree data synthesized for respective strata. With this information, stands can then be characterized by 1) the origin date of the oldest canopy layer (QMD_AGE) and by 2) the origin date of the dominant canopy layer (CAN_AGE). The origin date of the oldest cohort is an inference of time since last stand replacement disturbance and the best metric for ecological stand age. The origin date of the dominant cohort could mark the time since the last major disturbance or otherwise indicated general stand age.

References:

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R4 – Intermountain Region Vegetation Classification

Vegetation Formations

Vegetation Formations are analogous to lifeform communities. All cover values in the Intermountain Region used to key Vegetation Formation are computed in terms of *absolute cover*. Absolute cover of a plant species is the proportion of a plot's area included in the perpendicular downward projection of the species. Because plant canopies can overlap each other, absolute cover values can add up to more than 100%. Essentially, absolute cover is the sum of the crown area of all plant species (i.e. canopy cover uncorrected for crown overlap).

In the Vegetation Formation key, tree cover includes both regeneration and overstory sized trees, so that young stands of trees are classified as forest.

1a		All vascular plants total < 1% canopy cover…………………………………….....	**Non_Vegetated (NONVEG)**
1b		All vascular plants total ≥ 1% canopy cover……………………………………....	2
	2a	All vascular plants total < 10% canopy cover……………………………………….	**Sparse Vegetation (SPARSE)**
	2b	All vascular plants total ≥ 10% canopy cover……………………………………….	3
3a		Trees total ≥ 10% canopy cover……………………………………………………...	4
3b		Trees total < 10% canopy cover……………………………………………………...	5
	4a	Stand located above continuous forest line and trees stunted (< 5m tall) by harsh alpine growing conditions……………………………………………………...	**Shrubland (SHRUB)**
	4b	Stand not above continuous forest line; trees not stunted…………………….…....	**Forest (FOREST)**
5a		Shrubs total ≥ 10% canopy cover…………………………………………………….	**Shrubland (SHRUB)**
5b		Shrubs total < 10% canopy cover…………………………………………………….	6
	6a	Herbaceous vascular plants total ≥ 10% canopy cover……………………………	7
	6b	Herbaceous vascular plants total < 10% canopy cover……………………………	8
7a		Total cover of graminoids ≥ total cover of forbs…………………………………….	**Grassland (GRASS)**
7b		Total cover of graminoids < total cover of forbs…………………………………….	**Forbland (FORB)**
	8a	Trees total ≥ 5% canopy cover……………………………………………………....	**Sparse Tree (SP TREE)**
	8b	Trees total < 5% canopy cover……………………………………………………....	9
9a		Shrubs total ≥ 5% canopy cover……………………………………………………..	**Sparse Shrub (SP SHRUB)**
9b		Shrubs total < 5% canopy cover…………………………………………………....	10
	10a	Herbaceous vascular plants total ≥ 5% canopy cover……………………………..	**Sparse Herb (SP HERB)**
	10b	Herbaceous vascular plants total < 5% canopy cover……………………………..	**Sparse Vegetation (SPARSE)**

Note that the absolute canopy cover must equal or exceed ten percent to be classified as a forest vegetation formation. Values less than ten percent are classified as Non_Vegetated.

Dominance Types {DOM_TYPE}

Forest Dominance Types should be keyed out based on overstory canopy cover by tree species (couplet 3). Plots lacking such data or lacking an overstory layer should be keyed out using total cover by species (couplet 4). If a plot does not key out using overstory cover, then it may be keyed using total tree cover.

Key Leads:

1a		Plot data includes overstory cover for each tree species………………………….	2
1b		Plot data includes only total cover for each tree species………………………….	4
	2a	Overstory trees total ≥ 10% absolute canopy cover……………………………….	3
	2b	Overstory trees total < 10% absolute canopy cover……………………………….	4
3a		One tree species is the most abundant in the overstory…………………….......	**Go to instruction 1**
3b		Two or more tree species are equally abundant in the overstory……………….	**Go to instruction 2**
	4a	One tree species is the most abundant in total cover…………………….......	**Go to instruction 1**
	4b	Two or more tree species are equally abundant in total cover…………………..	**Go to instruction 2**

Instructions:

1. The dominance type name is that of the most abundant tree species.   The code for the dominance type can be found using Table 1. Find the name of the most abundant tree in column 2 and move to column 3 for the dominance type code.

2. When two or more tree species are equal in abundance find their names in column 2 of Table 1; the species listed first in table one is used to assign the dominance type. Move from the first of the species in column 2 to column 3 to find the dominance type code.

For FVS computations, absolute canopy cover values are rounded to the nearest one percent. In situations where two or more tree species result in the same absolute canopy cover, Table 1 will be used to resolve ties.

Table 1. Most Abundant Tree and Indicated Dominance Types.

Tree species are listed in order of information value ("rank"), which is used to break ties when two species are equally abundant.

(1) Rank	(2) Most Abundant Tree		(3) Dominance Type Code
1	*Populus angustifolia*	narrowleaf cottonwood	POAN3
2	*Populus balsamifera* ssp. *trichocarpa*	black cottonwood	POBAT
3	*Populus fremontii*	Fremont cottonwood	POFR2
4	*Populus* X *acuminata*	lanceleaf cottonwood	POAC5
5	*Populus deltoides*	eastern cottonwood	PODE3
6	*Fraxinus velutina*	velvet ash	FRVE2
7	*Salix amygdaloides*	peachleaf willow	SAAM2
8	*Salix fragilis*	crack willow	SAFR
9	*Acer negundo*	boxelder	ACNE2
10	*Picea pungens*	blue spruce	PIPU
11	*Populus tremuloides*	quaking aspen	POTR5
12	*Larix occidentalis*	western larch	LAOC
13	*Pinus albicaulis*	whitebark pine	PIAL
14	*Pinus longaeva*	Great Basin bristlecone pine	PILO
15	*Pinus flexilis*	limber pine	PIFL2

16	*Pinus jeffreyi*	Jeffrey pine	PIJE
17	*Pinus washoensis*	Washoe pine	PIWA
18	*Pinus ponderosa*	ponderosa pine	PIPO
19	*Pinus contorta* ssp. *murrayana*	Murray lodgepole pine	PICOM4
20	*Pinus contorta*	lodgepole pine	PICO
21	*Pinus monticola*	western white pine	PIMO3
22	*Pseudotsuga menziesii*	Douglas-fir	PSME
23	*Calocedrus decurrens*	incense cedar	CADE27
24	*Picea glauca*	white spruce	PIGL
25	*Picea engelmannii*	Engelmann spruce	PIEN
26	*Abies magnifica*	California red fir	ABMA
27	*Abies concolor*	white fir	ABCO
28	*Abies grandis*	grand fir	ABGR
29	*Tsuga mertensiana*	mountain hemlock	TSME
30	*Abies lasiocarpa*	subalpine fir	ABLA
32	*Yucca brevifolia*	Joshua tree	YUBR
33	*Juniperus californica*	California juniper	JUCA7
33	*Cercocarpus ledifolius*	curlleaf mountain mahogany	CELE3
34	*Juniperus occidentalis*	western juniper	JUOC
35	*Juniperus scopulorum*	Rocky Mountain juniper	JUSC2
36	*Juniperus osteosperma*	Utah juniper	JUOS
37	*Pinus edulis*	two-needle pinyon	PIED
38	*Pinus monophylla*	singleleaf pinyon	PIMO
39	*Quercus gambelii*	Gambel oak	QUGA
40	*Quercus kelloggii*	California black oak	QUKE
41	*Acer grandidentatum*	bigtooth maple	ACGR3

Tree Size Class {BWD_SIZCL, BA_WT_DIA, BA_WT_HGT}

Currently, the Northern Region (R1) specifications for tree size will implemented for the Intermountain Region (R4). Accordingly, tree size is will be defined as the predominant diameter class of live trees within a setting. The *Existing Vegetation Classification and Mapping Technical Guide* (Brohman and Bryant, 2005) cites the mean diameter at breast height calculated as either quadratic mean diameter or basal area-weighted average diameter to determine tree size class. Quadratic mean diameter (QMD) is the diameter of a tree of average basal area. Basal area weighted average diameter (BAWAD) is the average diameter of the live trees weighted by their basal area. BAWAD is not greatly influenced by small trees. Although QMD is larger than the arithmetic mean diameter of a stand, it is generally smaller than BAWAD. Since management questions typically are concerned with the larger, dominant and co-dominant trees in a setting, and basal area-weighted average diameter is influenced, to a greater extent, by larger trees, it was selected by the R1 Vegetation Council to be used in their existing vegetation classification system.

The Region 4 existing vegetation classification tree size classes are shown in Table 2.

Table 2 – Tree Size Classes.

Size Class	BA wgt DIA
Seed/Sap	0.0–5.0"
Small Tree	5.0–10.0"
Medium Tree	10.0–15.0"
Large Tree	15.0–20.0"
Very Large Tree	20.0–25.0"
Giant Tree	25.0"+

Computation methods for deriving basal area weighted average height are similar to those used for basal area weighted average diameter. Rather than tree diameter, total tree height is used as the basis.

Tree Canopy Cover {CAN_CLASS}

Crown cover corrected for overlap is used to determine stand density. Currently, Region 4 recognizes four canopy cover classes as displayed in Table 3.

Table 3 – Tree Cover Classes.

Cover Class	Crown Cover
Sparse	0–10%
Open	10–40%
Moderate	40–70%
Closed	70–100%

Tree Vertical Structure {VRT_STORY}

Currently, Region 4 uses Region 1's methods for determining canopy layering. Structure depicts the number of vertical layers of tree lifeform present in a setting. The structure algorithm is a custom algorithm developed by Region 1 based on field review and validation by the R1 Vegetation Council. It is only applied to inventory data; not map products. There are five vertical structure classes: single story (1), two-story (2), three-story (3), continuous vertical structure (C), and NONE which indicates not enough trees are present to assess.

In order for vertical structure to be derived from inventory data, the setting must have at least 20 square feet of basal area or 100 trees per acre. Otherwise, the vertical structure is labeled as NONE. If a setting has less than 20 square feet of basal area but at least 100 trees per acre, a single story class is assigned. Initially, every setting with greater than or equal to 20 square feet of basal area is classified as having one layer of vertical structure. Additional vertical structure classes are then potentially assigned to the setting based on the percent of the total basal area found in each of the following diameter classes: 0-4.9", 5.0-9.9", 10.0-14.9", 15.0-19.9", 20.0-24.9", 25.0"+.

The structure algorithm is performed in the following rule:

1. For any three consecutive diameter classes ordered largest to smallest, if the first (largest) and third (smallest) diameter class each have at least two percent of the total basal area, and if the percent of basal area in the first and third diameter class are at least 1.8 times larger than the proportion of basal area in the middle diameter class then, add a layer.
2. For any four consecutive diameter classes ordered from largest to smallest, if the middle two diameter class proportions are within 10% of each other, and the smallest and largest diameter classes each have at least two percent of the basal area, and each have at least 90% of the sum of the middle two diameter class proportions then, add a layer.
3. If layer still equals one and at least five consecutive classes have greater than or equal to two percent of the total basal area, then vertical structure is continuous.
4. If layer equals one and the three smallest (0-4.9, 5.0-9.9, 10.0-14.9) diameter classes have greater than or equal to two percent of the total basal area, then vertical structure is continuous.

USFS Intermountain Region
Vegetation Classification System

DOMINANCE TYPE
One-species dominance
Non-vegetated

SIZE CLASS*

N – Nonstocked		* Trees/Acre**
R – Seedling	0 - .1" dia	0 - 100 tpa (nonstocked)
E – Sapling	.1 - 5" dia	100+ tpa (softwoods)
S – Small Tree	5 - 10" dia	100+ tpa (hardwoods)
M – Medium Tree	10 - 15" dia	** dia ≤ 0.1" & hgt < 4.5' = R
L – Large Tree	15 - 20" dia	dia > 0.1" & hgt ≥ 4.5' = E
V – Very Large Tree	20 - 25" dia	
G – Giant Tree	25"+ dia	

CANOPY COVER
0 – Sparse   0 - 10%
1 – Open   10 - 40%
2 – Moderate   40 - 70%
3 – Closed   70%+

VERTICAL STRUCTURE
0 – Nonstocked
1 – Single Story
2 – Two Story
3 – Three Story
4 – Continuous Story

<u>Auxiliary Field – Southwest Idaho Ecogroup Tree Size</u> {CAN_SZTMB}

As presented by the Southwest Idaho Ecogroup (SWIE: Payette, Boise, and Sawtooth National Forests) to the Intermountain Regional Office, the first tree size class that contains 10 percent or more canopy cover (corrected for overlap), in descending order from largest to smallest, receives the designation. If no one tree size class contains at least ten percent canopy cover, the cumulative sum, from largest to smallest, that eclipses the ten percent canopy cover threshold is declared the tree size class.

<u>References:</u>

R4 Vegetation Formation and Forest Dominance Type Keys, April 28, 2009.

Southwest Idaho Ecogroup (SWIE): Payette, Boise, and Sawtooth National Forests, document presented to Intermountain Regional Office, September 25, 2008.

R6 – Pacific Northwest Region Vegetation Classification

Dominance Types – Key {DOM_TYPE}

Dominance types are existing plant communities designated by their most abundant species (Jennings et al. 2002). For the Pacific Northwest Region, three broad categories of dominance types are recognized: forest, sparse forest, and non-forest (DeMeo et al. 2005). Dominance types are defined within these three broad groups, guided by the following rule set:

Defining the groups:

1. Non-forest types have less than 10 percent areal tree canopy cover.
2. Sparse forest types have tree canopy cover in the range of 10-30 percent.
3. Forest types have tree canopy cover greater than 30 percent.

Determining the diagnostic layer:

1. For forest types, trees are the diagnostic layer.
2. For sparse forest types, at least one tree species is diagnostic, but this may be combined with shrubs, grasses, herbs, bryophytes and/or lichens, provided these species meet the abundance criteria below.
3. For non-forest types, the diagnostic layer is the first layer (1-shrub, 2-herbaceous, or 3-nonvascular) that exceeds 10% vegetative cover.

Determining whether the dominance type is single species or multiple species:

1. Single species types occur when one species comprises at least 75 percent, proportionally, of the diagnostic layer.
2. In multiple-species (mixed) types, no one diagnostic species comprises 75 percent of the cover. Named species comprise at least 25 percent, proportionally, of the diagnostic layer.
3. If no species comprises at least 25 percent proportionally of the diagnostic layer, user broader classes such as mixed deciduous forest, etc.

Naming the dominance types:

1. In single species types, the type can be named after that species. Examples: Mountain hemlock, Low sagebrush, Idaho fescue.
2. Sparse forest types are not single species types as named elements are expected for more than one diagnostic layer.
3. In multiple species (mixed) types, for a species to occur in the name, it must comprise at least 25 percent, proportionally, of the diagnostic layer. In forested types, named species must be trees, but in sparse forest and non-forest, they can come from any layer. Examples: Engelmann spruce-subalpine fir, Western juniper-big sagebrush-bluebunch wheatgrass, Bitterbrush-Idaho fescue.
4. No more than 3 species may be included in the name of a dominance type.
5. If only a single species achieves the 25% proportion of the layer to be named then name the dominance type for that species followed by the word mix. Examples: Douglas Fir mix, Bitterbrush mix,

6. Mixed types may be named after lifeforms rather than species, when no species exceed 25%. For forest and shrub types, use deciduous and evergreen thresholds as follows:
   a. If 75% of the diagnostic layer consists of evergreen species, identify it as Mixed evergreen forest or Mixed evergreen shrubs.
   b. If 75% of the diagnostic layer consists of deciduous species, identify it as Mixed deciduous forest or Mixed deciduous shrubs.
   c. If the mixture of evergreen and deciduous in the layer is between 25% and 75% (not a or b above) then identify as Mixed evergreen-deciduous forest or Mixed evergreen-deciduous shrubs.
7. Mixed types may also name specific types of communities. Examples: Alpine meadow
8. Sparse forest types combine naming from the different diagnostic layers. Examples: Western Juniper-Big Sagebrush-Bluebunch wheatgrass, Ponderosa Pine-Mixed evergreen Shrubs.
9. For non-forest types where neither shrubs or herbaceous layers exceed 10% cover, name as follows:
   a. If bryophytes exceed 10% cover, the dominance type is Mosses
   b. If lichens exceed 10% cover, the dominance type is Lichens
   c. If no layer exceeds 10% vegetative cover, the dominance type is named Sparsely Vegetated if vegetative cover is greater than zero and Nonvegetated, if vegetative cover is zero.

Dominance types will be stewarded regionally in order to avoid duplication and confusion. Cutoff levels for all the above can be adjusted by Region Office-Forest consensus, if found to be impractical in practice

Currently, the Forest Vegetation Simulator (FVS) tracks only tree species. Generally, shrubs, grasses, herbs, bryophytes and/or lichens are not modeled by FVS. Thus, dominance types are exclusively tree based. NRCS Plants Codes are used to identify tree species. In multiple-species types, NRCS Plants Codes are listed in descending order relative to tree species canopy cover.

Tree Size Class {QMD_TOP20, QMD_SIZCL}

Typically, average tree size class is thought of as the quadratic mean diameter (QMD) of the overstory trees (dominant and codominant crown classes). This rule is easy to apply for the inventory cycle when tree *crown class* has been recorded. However, tree crown class is not an attribute that is updated during an FVS projection. Therefore, a rule is needed to characterize average tree size at any point during a projection that is akin to QMD of the overstory component of the treelist.

Several rulesets have been proposed based on differing tree attributes with differing thresholds to use as a proxy for tree crown class. An extensive test of these various rulesets was performed and the results are presented in the "Auxiliary Analysis" section of this text. Suffice it to say that currently for the Pacific Northwest Region, the Quadratic Mean Diameter (QMD) of the top 20 percent of the treelist by diameter (i.e. DBH), with a minimum of 20 trees, is being used to determine the appropriate tree size class (Jahns 2006).

To compute QMD_TOP20, the FVS treelist is sorted in descending order by tree diameter. *Seedlings are excluded from this calculation* (i.e. diameter = 0.1") unless the diagnostic attribute is based on "trees per acre" (i.e. tree canopy cover less than 10 percent). The top 20 percent by tree diameter of the treelist, given at least 20 trees, is used to determine the respective quadratic mean diameter.

Recognized tree size classes are as follows:

SizeClass_dbh_	AgeGroup
0:(<1)	0:nonfor
1:(1-5)	1:ssap
2:(5-10)	2:smtree/pole
3:(10-15)	3:medtree
4:(15-20)	4:lgetree
5:(>20)	5:vlgtree

Tree Canopy Cover {CAN_CLASS}

VDDT is a *State and Transition Model* which is being used for forest planning in the Pacific Northwest Region to predict changes in patterns of vegetation over time. It has the ability to provide annual acreage summaries of the occurrence of each vegetative state from the effects of succession, disturbance, or management activities. With each transition from one vegetative state to the next, outputs such as live tree stocking, harvest volume, snags produced, or total stand carbon can be tallied and summed over the analysis period.

In the development of VDDT models all of the possible vegetation states need to be defined. For example, the Colville-Okanogan-Wenatchee (COW) model development team wanted to make the states congruent with the classification of the current vegetation so that present estimates could be easily compared with future estimates to detect trends. The current vegetation classification was developed from an array of satellite images to standards of resolution defined in the National Standards (USDA FS 2003) modified and supplemented with Standards for Mapping of Vegetation in the Pacific Northwest Region (USDA FS 2004).

The National Standards proposed a resolution of vegetation that was far more detailed than necessary to address plan revision issues. Assessments indicate that substantial accuracy was sacrificed by classifying so finely. These standards were set, however, to allow for flexibility in aggregation of vegetation variables into appropriate classes. When considering aggregation, the model development team consulted the regional species viability team for advice on an appropriate level. That team provided the classification that would be used in VDDT model development.

The following table displays the vegetation states that are used in VDDT. Each cell within the table represents an individual vegetation state.

CC/QMD	Structure	0-4.9"	5-9.9"	10-14.9"	15-19.9"	20+"
10-40%	Single					
	Multiple					
40-70%	Single					

	Multiple
70+%	Single
	Multiple

For COW, canopy closures were compressed into three forest classes. Recall that non-forest types have less than 10 percent areal tree canopy cover. Size classes were compressed into five based on quadratic mean diameter of the overstory trees to approximate the satellite image classification. Where diameter data was available, tree size class was based on the quadratic mean diameter of the largest 20% of the trees, with a minimum of 20 trees. When diameter data is absent, the largest trees that contribute 25% of the total canopy closure was used. Structure classification is not aggregated from the National Standards. Structure is considered multiple storied when any layer below the dominant canopy constitutes 25% of the total canopy closure and have at least 10% absolute canopy closure.

Recognized tree canopy cover classes are as follows:

CoverClass	DensityGroup
0-10%	0:nonfor
10-40%	1:open
40-70%	2:moderate
70%+	3:dense

Tree Canopy Layers {VRT_STORY}

Structure depicts the number of vertical layers of tree lifeform present in a setting. Several code schemes were tested against observed field calls from R6 Current Vegetation Survey data (Max et al. 1996). The Vertical Structure algorithm developed by Region 1 based on their field review and validation by the R1 Vegetation Council proved most consistent. Review to the R1 – Northern Region Vegetation Classification System, Tree Vertical Structure for details regarding this algorithm.

Recognized tree canopy layers are as follows:

CoverLayer	StoryGroup
0	0:nonstk
1	1:single
2	2:multiple

USFS Pacific Northwest Region
Vegetation Classification System

DOMINANCE TYPE
 One-species dominance
 Two-species dominance
 Three-species dominance
 Mixed-species dominance
 Non-vegetated

SIZE CLASS
 0 – Nonstocked   0 - 1" qmd
 1 – Seed/Sap   1 - 5" qmd
 2 – Small Tree   5 - 10" qmd
 3 – Medium Tree   10 - 15" qmd
 4 – Large Tree   15 - 20" qmd
 5 – Very Large Tree   20"+ qmd

CANOPY COVER
 0 – Sparse   0 - 10%
 1 – Open   10 - 40%
 2 – Moderate   40 - 70%
 3 – Closed   70%+

CANOPY LAYERS
 0 – Nonstocked
 1 – Single Story
 2 – Multiple Story

Auxiliary Field – R6 Canopy Structure {CAN_STORY}

As surmised from the Colville-Okanogan-Wenatchee Forest Plan Revision, canopy structure was considered multiple storied when any layer (i.e. tree size class) below the dominant canopy layer constitutes 25 percent of the total canopy closure and has at least 10 percent absolute canopy closure. Otherwise, canopy structure would be designated as single storied. Non-forest types having less than 10 percent areal tree canopy cover were considered non-stocked.

Auxiliary Analysis – Screening CVS Plots

Current Vegetation Survey (CVS) plots are cross-walked to VDDT Potential Vegetation Types (PVT) model groups by their Ecoclass code. Within a plot, an Ecoclass code is recorded at each of the five stake positions. There may be multiple assignments in the field due to a variety of sources:

1. A plot may fall across true ecological boundaries. The boundaries may be along subtle ecological gradients (e.g., different plant associations within the same series) or across abrupt classes (e.g., a plot straddling a boundary between forest and rock)
2. A plot may fall across management boundaries (e.g., a plot straddling a boundary between forest and road, or forest and clearcut)
3. Field recording errors are probably common, because it may be just too difficult for field crews to assign an accurate plant association class at the scale of the subplot (e.g., the field crew may not search beyond a subplot boundary for late-seral species, even if they occur in the vicinity of the plot). However, it is assumed that Plant Association Group (=Subseries) and Series calls are more accurately assigned in the field.

Proposed Rule for FVS modeling based on Ecoclass code

Use any plot that has three or more stake positions in the same PAG(=Plant Association Group=Subseries=first 4 characters of Ecoclass code).

The result is to drop some plots from use in modeling on the assumption that we don't fully understand the source of variation for "highly variable" plots.

1. Using only plots with a majority of stakes in a single series/PAG eliminates confusion about what overall class label to assign to a plot that has multiple classes at the stake level.
2. Allows some variation across series/PAG within plot, but drops plots with "too much" variation.

Auxiliary Analysis – Overstory QMD Rule

QMD of Dominant and Codominant Crown Classes
    Reference (dependent) variable
    QMD of Dominant and Codominant Crown Classes (keeping open-grown-- CC = 1, 2, 3, dropping remnants CC=6)

    Varl=QMD_CC

Tree Diameter Basis (i.e. Don's Rule)
   QMD of top 20% of treelist by DBH, minimum 20 TPA. Also tested at 15%, 25%.
   Varl= QMD_Don_20

Tree Height Basis (i.e. Ryan's Rule)
   QMD of top 25% of treelist by height, minimum 20 TPA. Also tested at 15%, 20%.
   Varl= QMD_Ryan_20

Results
**Best fit appearance and R^2 was obtained using the Don_20% rule.

Then tried transforms vs. raw variables. Results are shown below.

***Conclusion: Log-log transform has best fit (but the Sqrt transform is good, too).

Use Log-log model
   $\ln(Y) = b_1 \ln(X)$
   where
   $Y = QMD\_CC$ $X = QMD\_Don\_20$
   and
   $b_1 = 0.91469$ R-sq = .9906   MSE = .05087

Steps in Classification rule for QMD
   1. Compute $X = QMD\_Don\_20$ (QMD of top 20% of dbh dsn, minimum of 20 tpa)
   2. Compute $\ln(X)$
   3. Multiply $\ln(X)$ by $b_1 = 0.91469$
   4. Back-transform Yhat= $\exp[b_1 \ln(X)]$
   5. Bias correction for log-log model = Yhat * exp(1/2 MSE) = Yhat * 1.0257
   6. Classify the plot based on the Yhat value of QMD

Raw values: Regress QMD_CC on QMD_Don_20

Dependent Variable: QMD_CC

Number of Observations Read	1064
Number of Observations Used	1011
Number of Observations with Missing Values	53

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	131461	131461	21727.7	<.0001
Error	1010	6110.87172	6.05037		
Uncorrected Total	1011	137571			

Root MSE	2.45975	R-Square	0.9556	
Dependent Mean	10.76426	Adj R-Sq	0.9555	
Coeff Var	22.85108			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
QMD_Don_20	1	0.81363	0.00552	147.40	<.0001

R6-8

Regress QMD_CC on QMD_Don_20

QMD_CC = 0.8136 QMD_Don_20

N
1011
Rsq
0.9556
AdjRsq
0.9555
RMSE
2.4597

Residual

Predicted Value of QMD_CC

R6-9
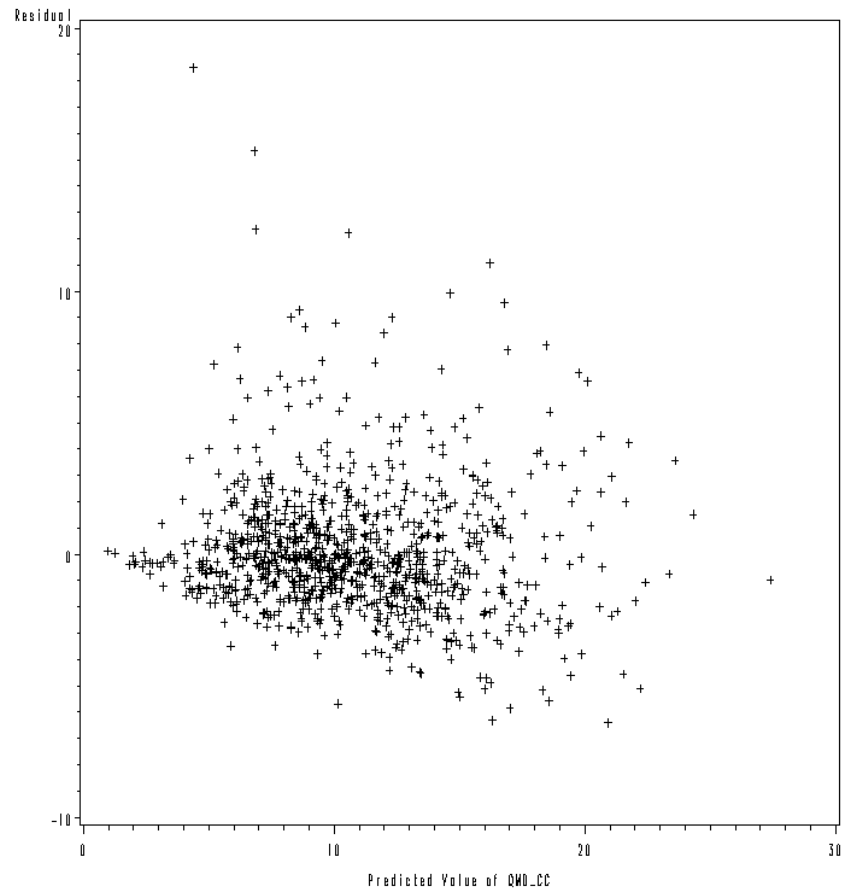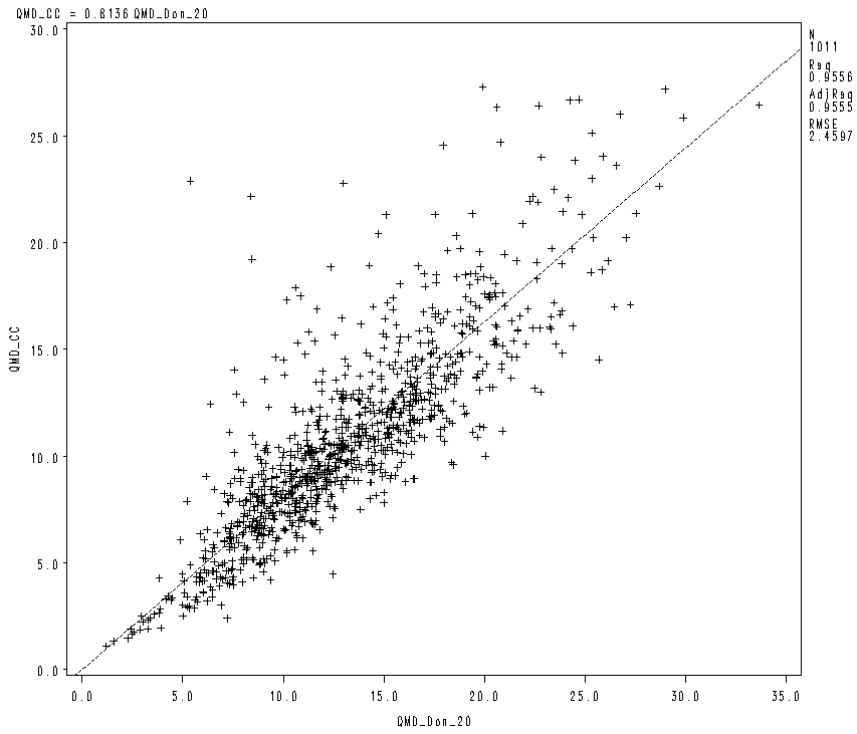
SqRt transform: Regress sqrt(QMD_CC) on sqrt(QMD_Don_20)

Dependent Variable: **sqrt_QMD_CC**

Number of Observations Read   1064
Number of Observations Used   1011
Number of Observations with Missing Values   53

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	10755	10755	84763.6	<.0001
Error	1010	128.14538	0.12688		
Uncorrected Total	1011	10883			

Root MSE	0.35620	R-Square	0.9882	
Dependent Mean	3.20745	Adj R-Sq	0.9882	
Coeff Var	11.10533			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
sqrt_QMD_Don_20	1	0.89999	0.00309	291.14	<.0001

Regress sqrt(QMD_CC) on sqrt(QMD_Don_20)

sqrt_QMD_CC = 0.9 sqrt_QMD_Don_20

N
1011
Rsq
0.9882
AdjRsq
0.9882
RMSE
0.3562

Regress sqrt(QMD_CC) on sqrt(QMD_Don_20)

R6-11
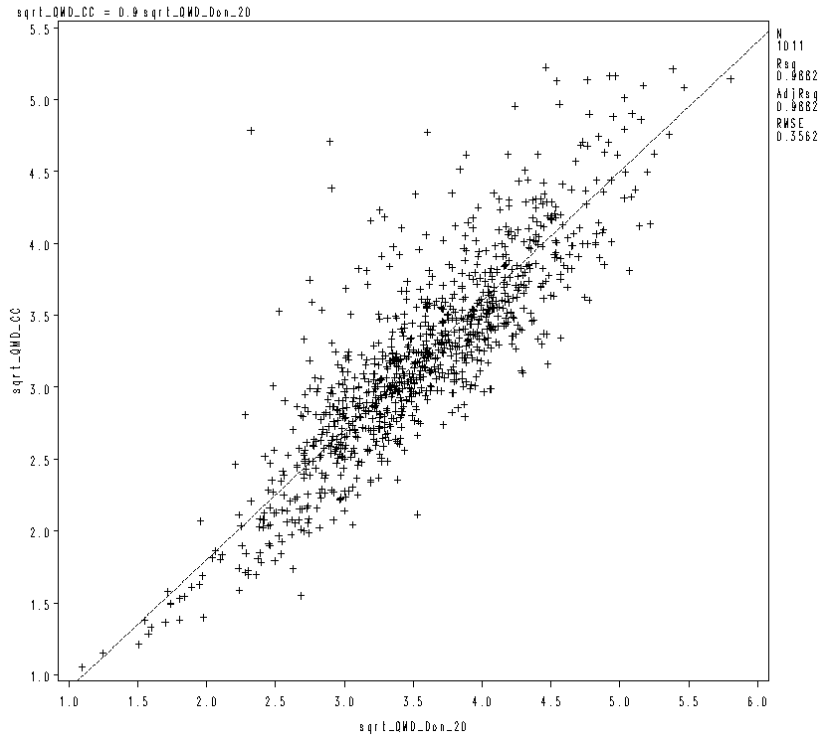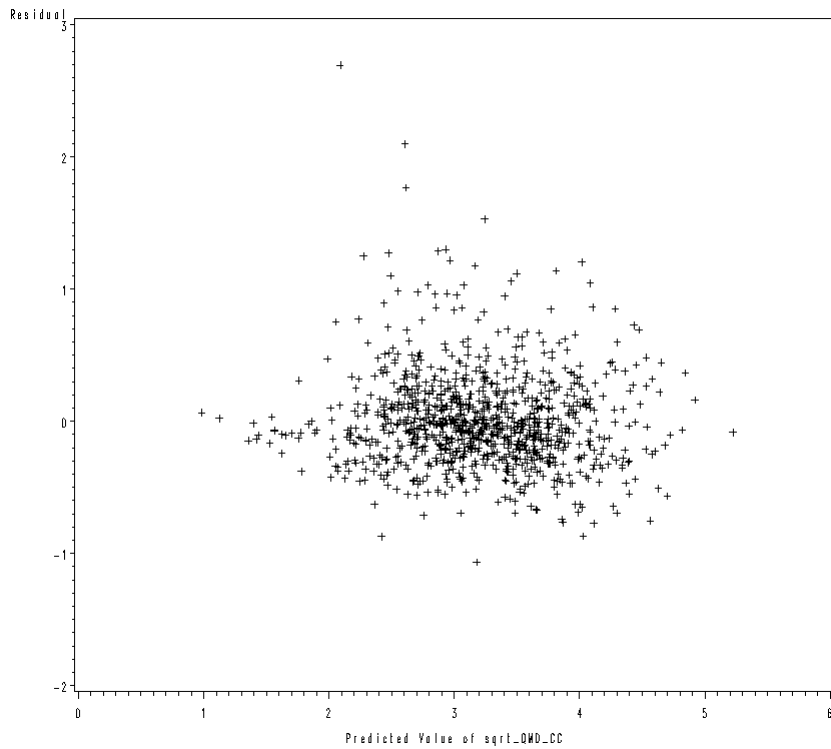
Log-log transform: Regress ln(QMD_CC) on ln(QMD_Don_20)

Dependent Variable: **ln_QMD_CC**

```
Number of Observations Read                    1064
Number of Observations Used                    1011
Number of Observations with Missing Values       53
```

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	5424.00627	5424.00627	106632	<.0001
Error	1010	51.37516	0.05087		
Uncorrected Total	1011	5475.38143			

Root MSE	0.22554	R-Square	0.9906
Dependent Mean	2.28036	Adj R-Sq	0.9906
Coeff Var	9.89038		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
ln_QMD_Don_20	1	0.91469	0.00280	326.55	<.0001

Regress ln(QMD_CC) on ln(QMD_Don_20)
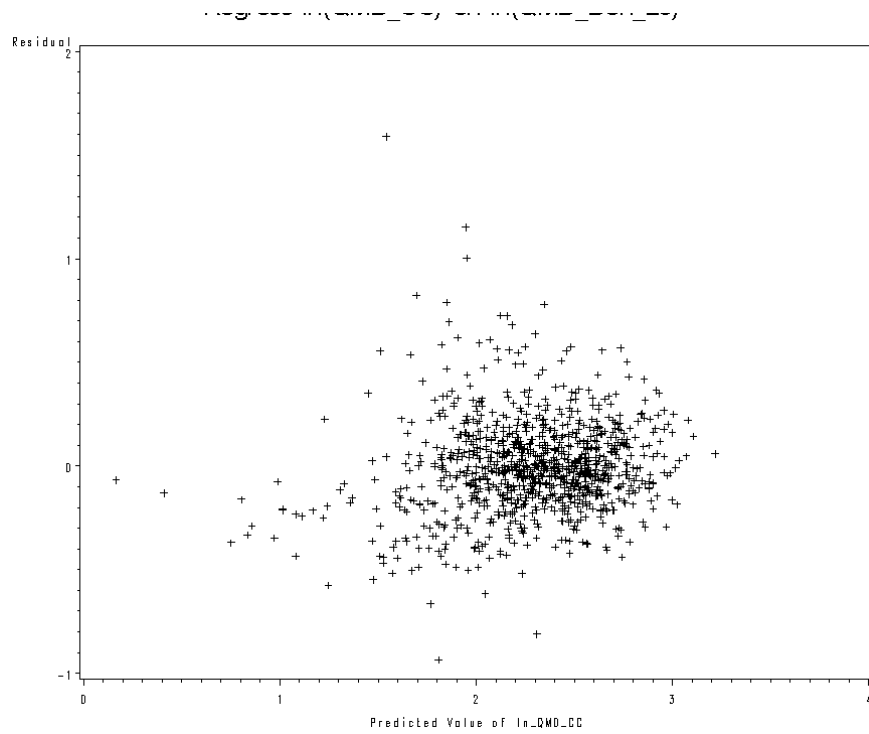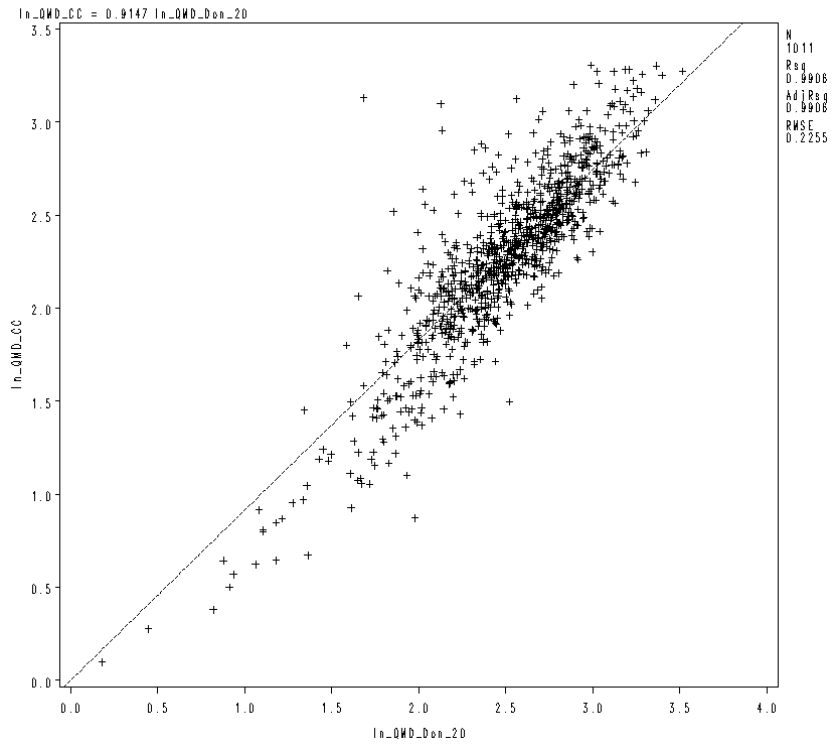
ln_QMD_CC = 0.9147 ln_QMD_Don_20

N
1011
Rsq
0.9906
AdjRsq
0.9906
RMSE
0.2255

ln_QMD_CC (y-axis)

ln_QMD_Don_20 (x-axis)

Regress ln(QMD_CC) on ln(QMD_Don_20)

Residual

Predicted Value of ln_QMD_CC

References:

Brohman, R. and L. Bryant, eds. 2005. Existing Vegetation Classification and Mapping Technical Guide. Gen. Tech. Rep. WO–67. Washington, DC: U.S. Department of Agriculture Forest Service, Ecosystem Management Coordination Staff. 305 p. http://www.fs.fed.us/emc/rig/documents/integrated_inventory/FS_ExistingVEG_classif_mapping_TG_05.pdf

DeMeo, T., E. Uebler, M. Golden, S. Bulkin, J. Alegria, W. McArthur, C. Heider, M. Hemstrom, J. Ohmann, and K. Mellen. 2005. Providing Existing Vegetation Maps: USDA Forest Service, Pacific Northwest Region. Portland, OR: USDA For. Serv. Pacific Northwest Region, unpub. rep. on file, 198 pp.

FGDC NVC. 2008. Federal Geographic Data Committee National Vegetation Classification. FGDC-STD-005-2008 (Version 2). Federal Geographic Data Committee, U.S. Geological Survey, Reston, Virginia, USA. http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation/standards/projects/vegetation/

Jahns, Phil. 2006. Vegetation Projection, Colville and Okanogan – Wenatchee National Forests, Forest Plan Revision. On file.

Max, T.A.; Schreuder, H.T.; Hazard, J.W.; Oswald, D.D; Teply, J.; Alegria, J. 1996. The Pacific Northwest Region vegetation and inventory monitoring system. Res. Pap. PNW-RP-493. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 22 p.

Appendix I
FVSSTAND Support

Software Setup:

Use the following Web link to update your Fvsstand post processing software:

http://www.fs.fed.us/fmsc/fvs/software/postprocessors.php

Follow the "Install" instructions at the bottom of the Web page for Fvsstand. Once installed, include an Fvsstand treelist in your simulation run. Here's how. From within Suppose, use the "Select Outputs" button, select "Base FVS Treelists", pick "Build FVSStand Alone Treelist", then either option for "Inventory Year and All Cycles" or just for "Inventory Year" (exiting conditions). Select "Ok" to include Fvsstand treelist in the simulation run. Make sure to include the Fvsstand program as a post processor. Use the "Select Post Processor" button from the main Suppose window to do so.

The Fvsstand Step Wizard should appear once the simulation has completed. On "Step 2 of 3", click the "Aggregate Method" tab to ensure that the "Time Basis" is chosen. From "Step 3 of 3", under the "Stand Attribute" tab, pick "USFS Region 2" for "Vegetation Classification" computation. These configurations will be saved for subsequent runs of Fvsstand. Once the Fvsstand treelist has been processed, click the "Ok" notification. An activity log window will appear and once it is complete, click the "x" in the upper right corner to prompt for the Fvsstand Print Preview window. You can look at the Yield Reports or Stand Tables to get an idea of what the strata looks like, then select "Finish".

Navigate to your FVS working folder. Find the "{Keyword Filename}_Veg_Class.txt" file. Open this file with your favorite text editor. This report will provide the columns of information pertaining to Regional vegetation classification specifications.

Using FVS to report Dominance Types:

Open Suppose interface. (This assumes that you have already created the FVS files)
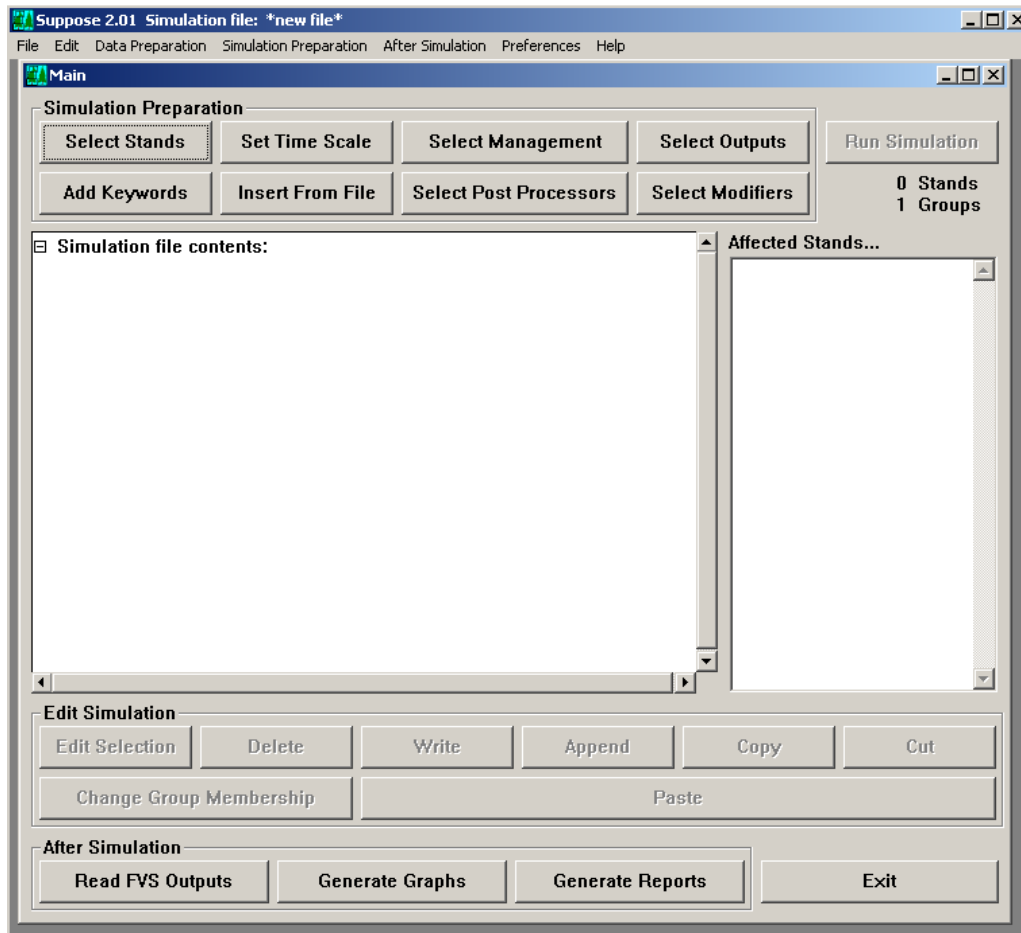
Click Select Stands; then select Browse. Navigate to the data location and select the *.loc file.
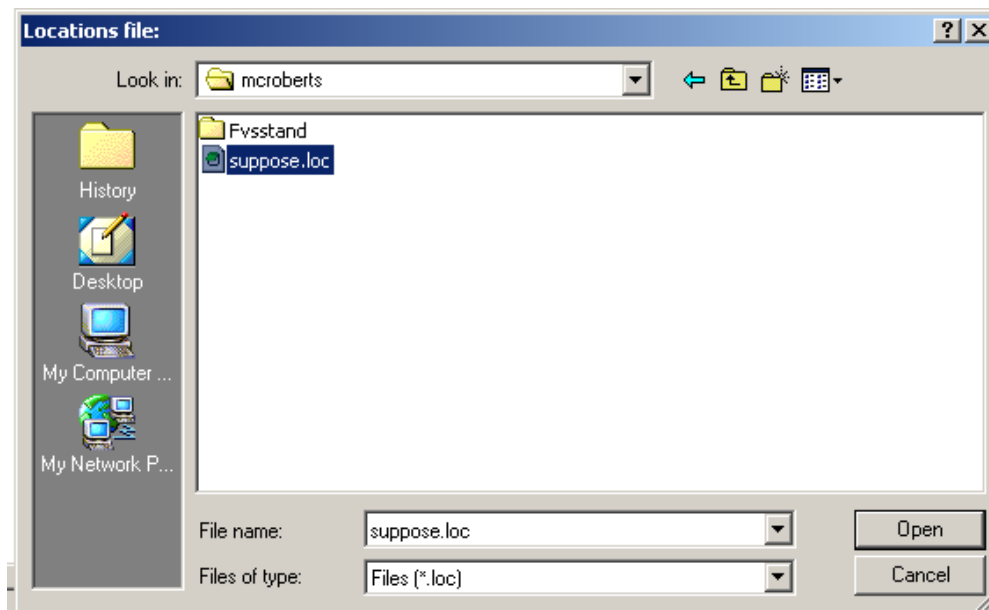
Double click on "All Stands" button to load the data.
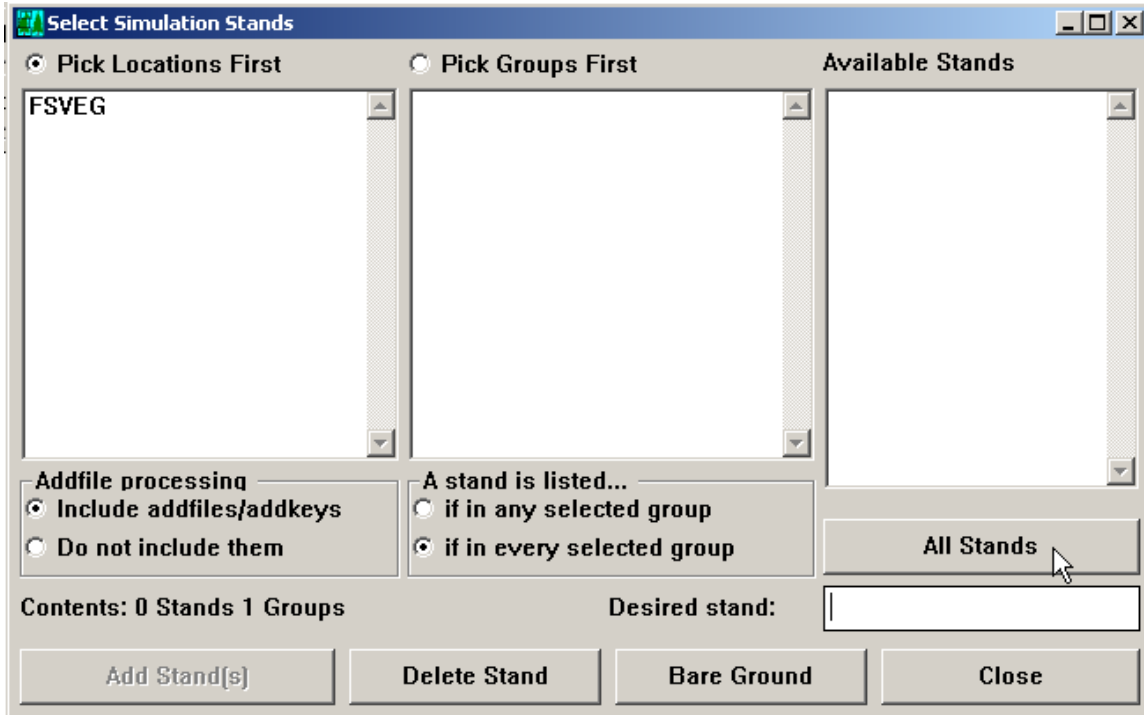
Then click on the "Add ## Stands" button to add the data to the simulation, then "Close".
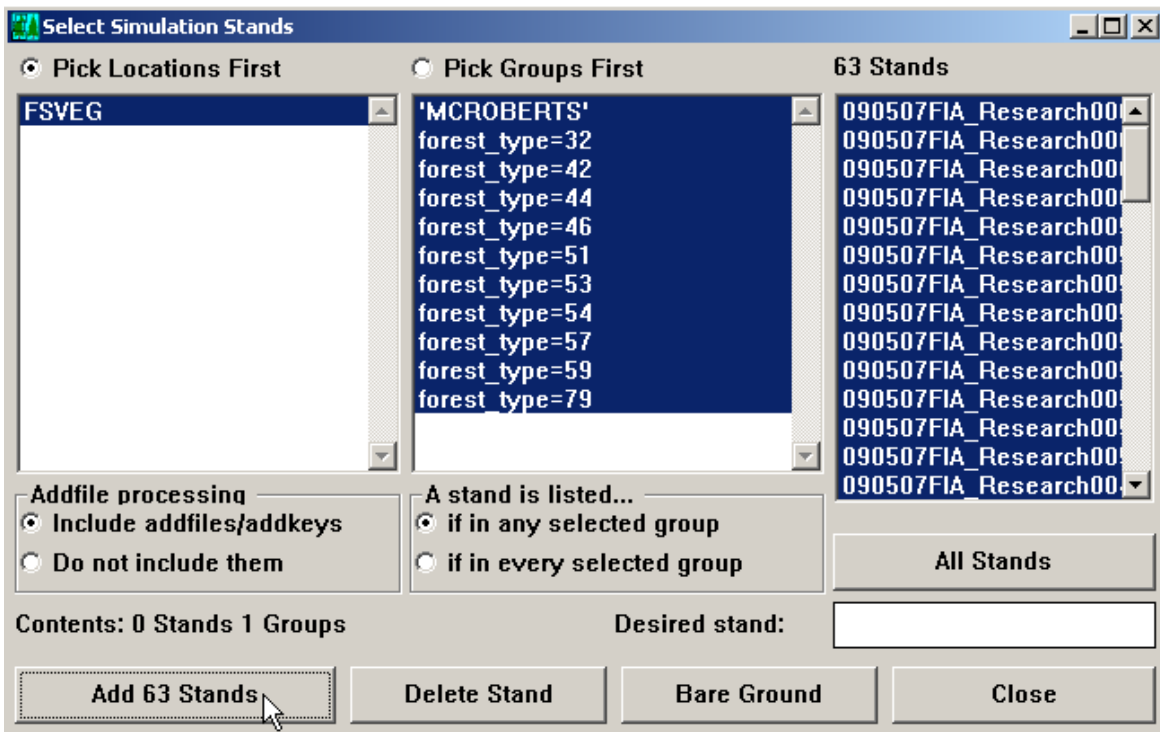
Edit window displaying simulation data.
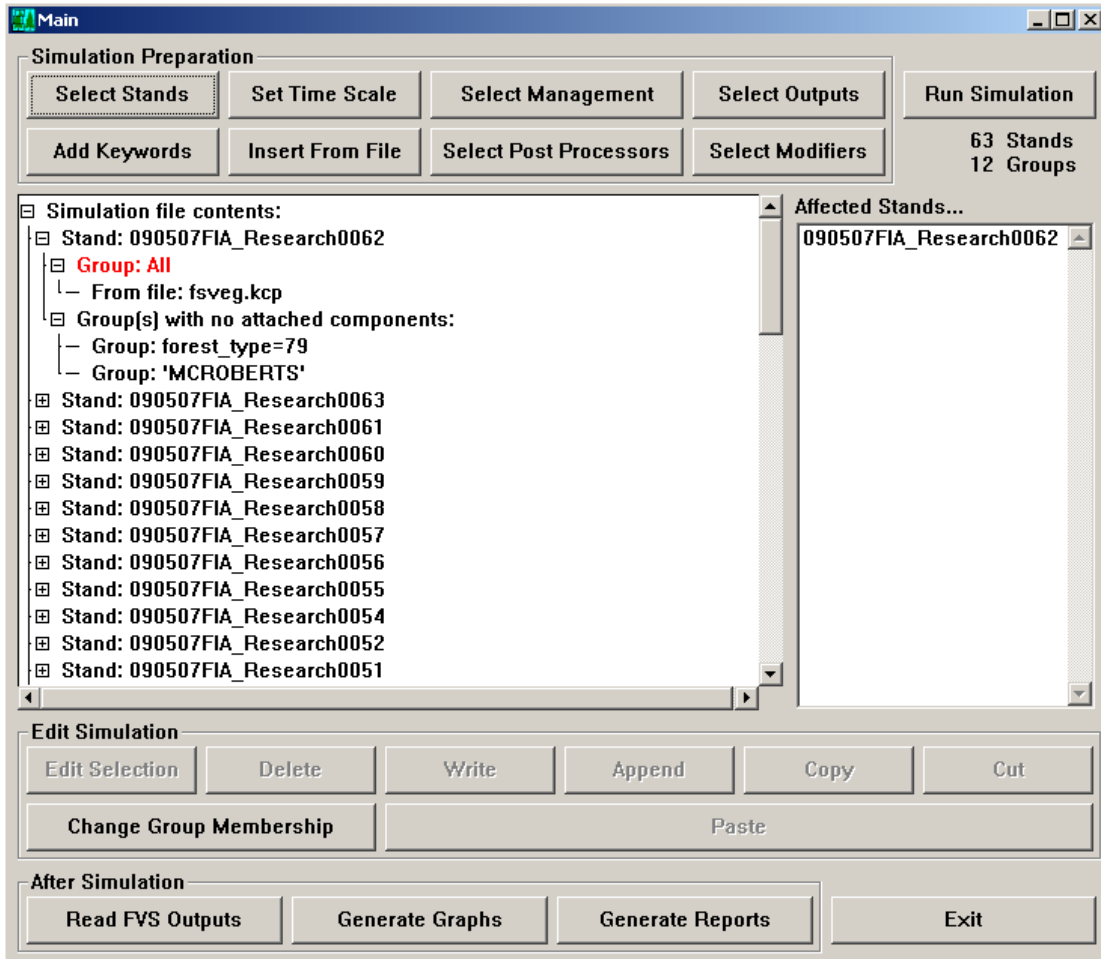
Next, click on "Set Time Scale" and change the ending year 2107 to 2017 or ten years after the starting year and then click "OK"
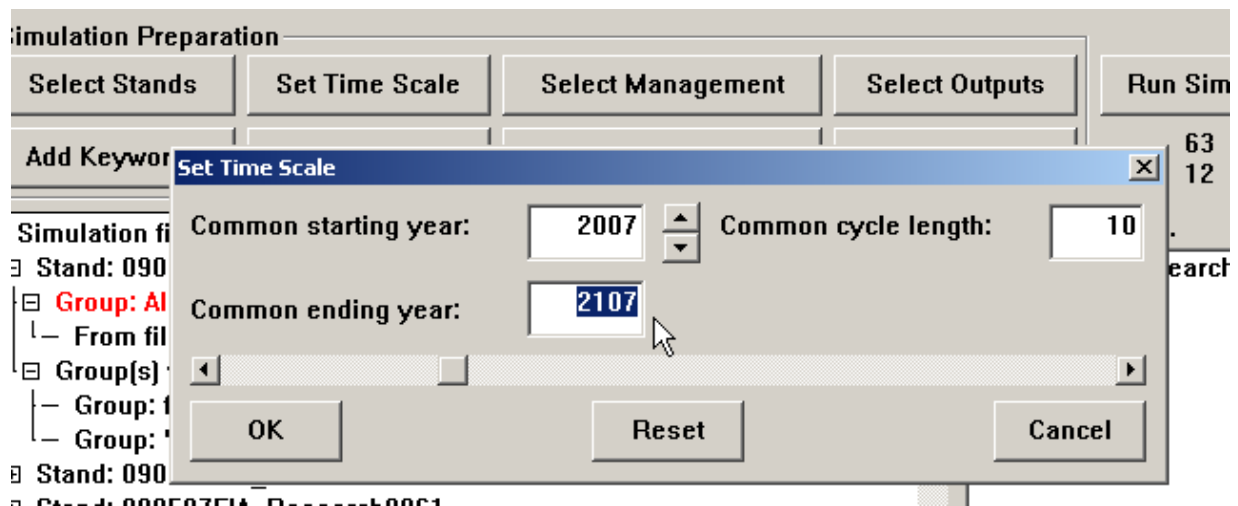
Select "Add Keyword"; then select "FVSStand".
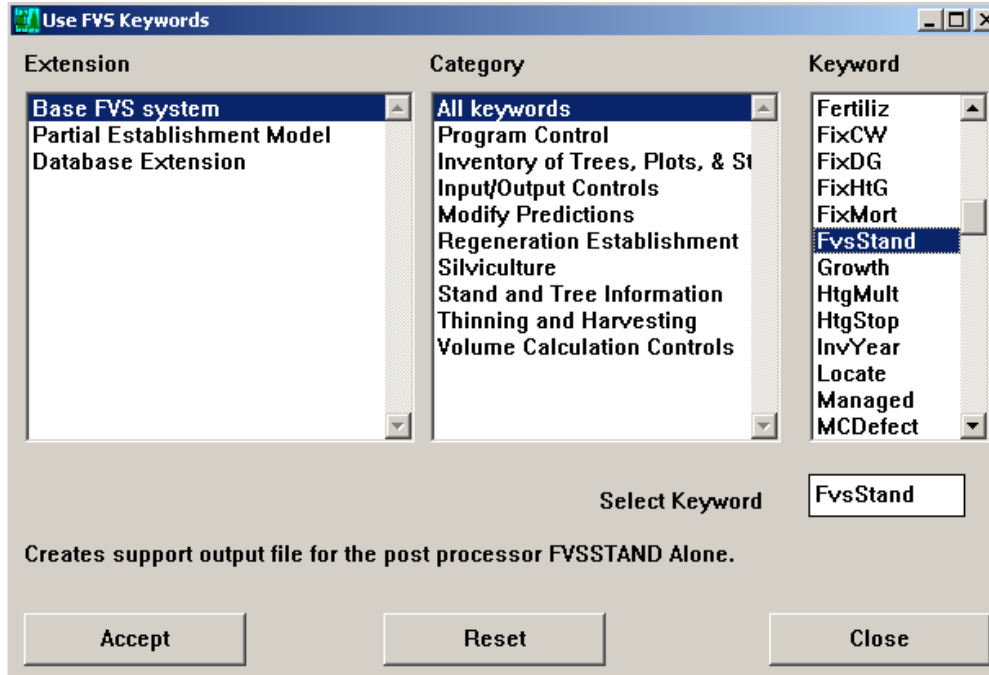
Click "Accept" and then set "Select Year" to 0 and select "Print output only for the Inventory Year" from the drop down menu. Click "OK" and then "Close".

Next, select the "FVSSTAND Alone" post processor. {Don't need "View the Treelist"}
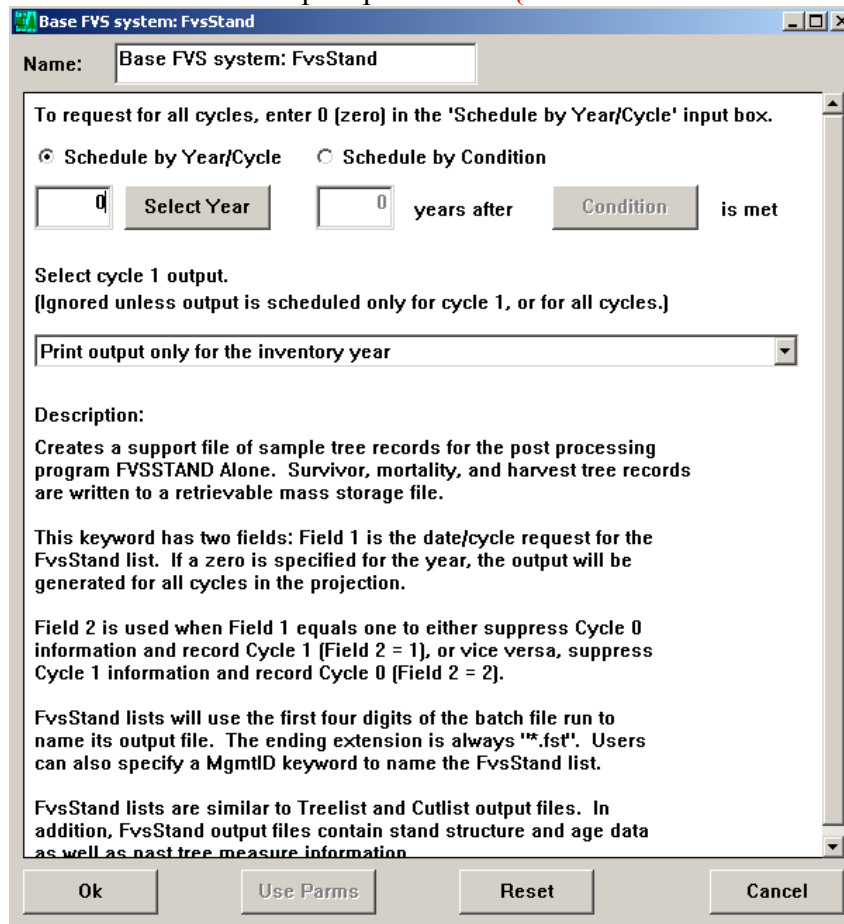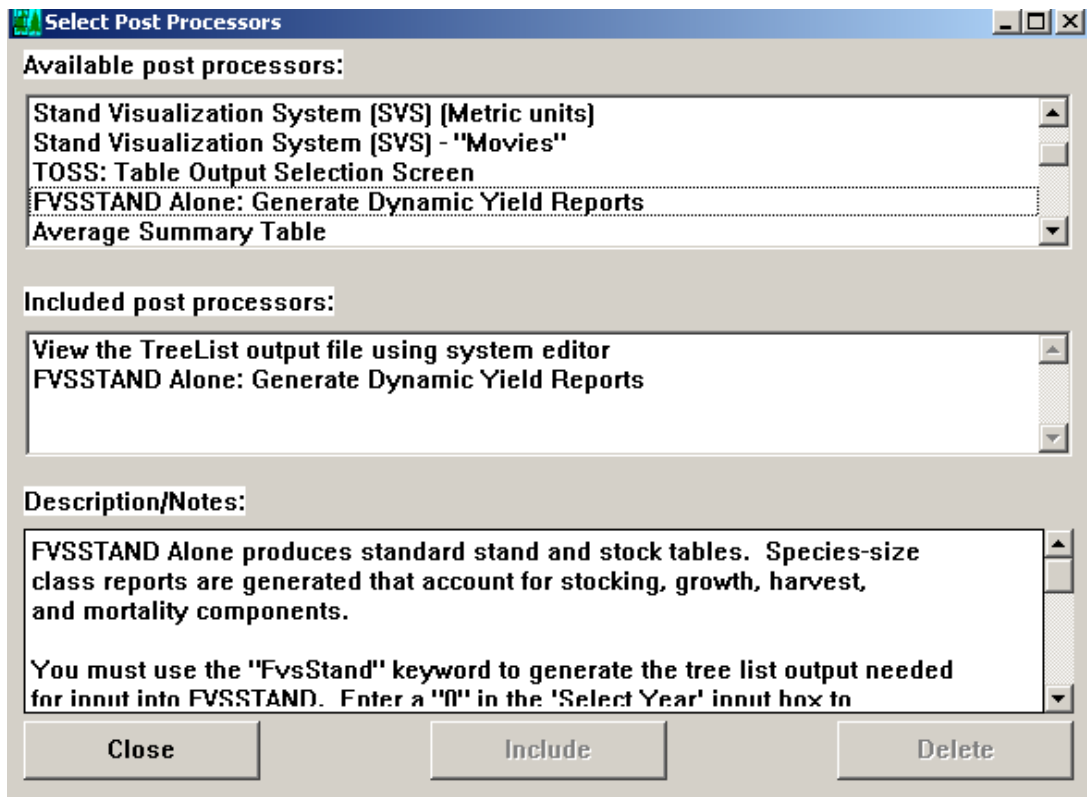
Now, save the simulation to a *.key file for future use.
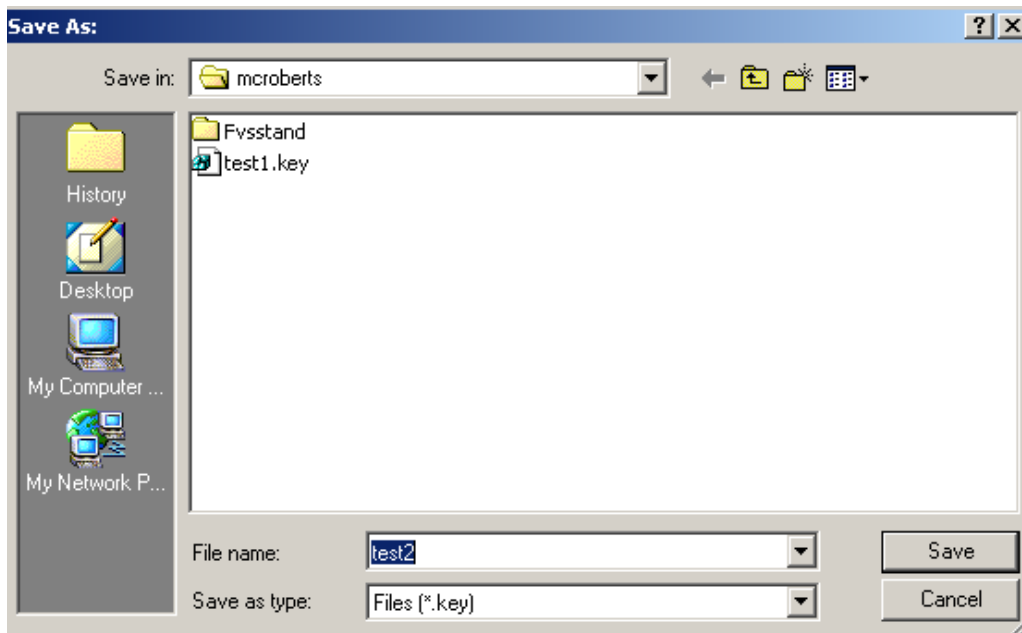
To run the model, click on "Run Simulation" and then "Run".
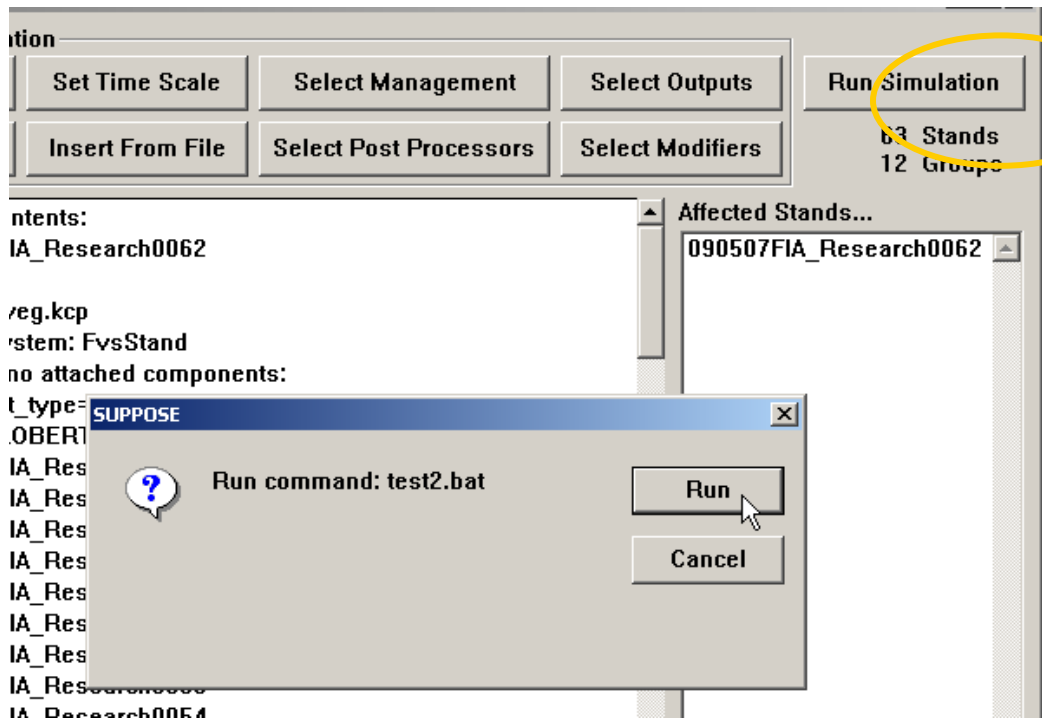
The FVSSTAND Wizard will appear.
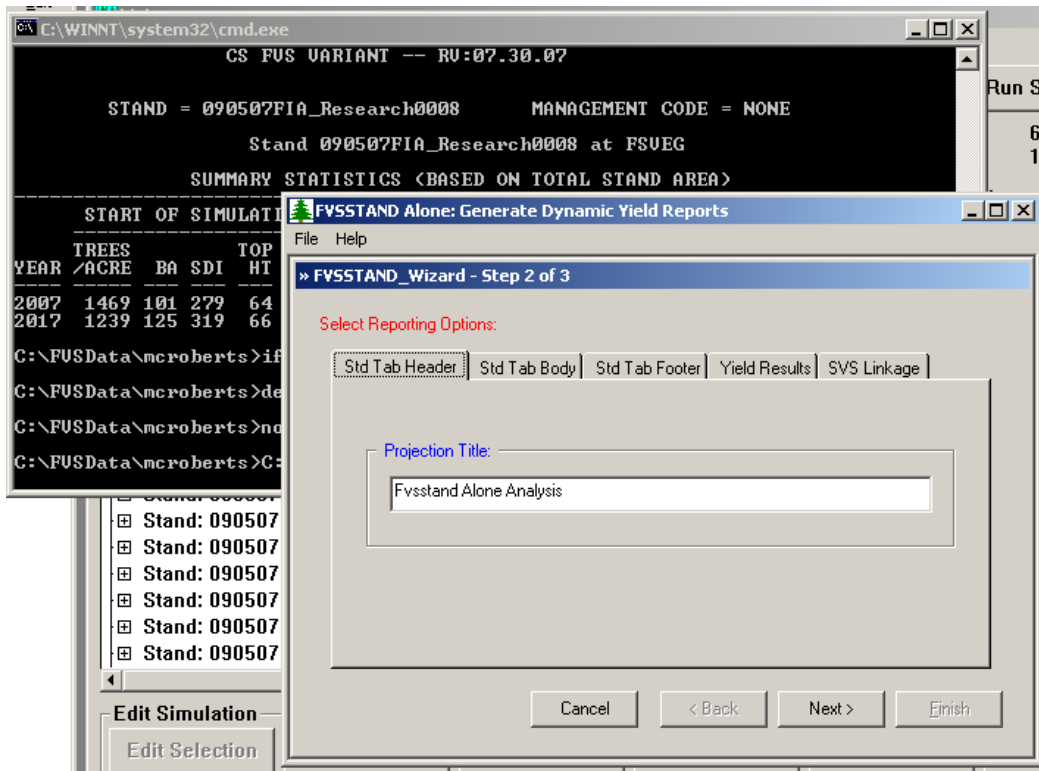
The first time you set up the model, you will need to fill out the second tab and thereafter it will use these numbers.
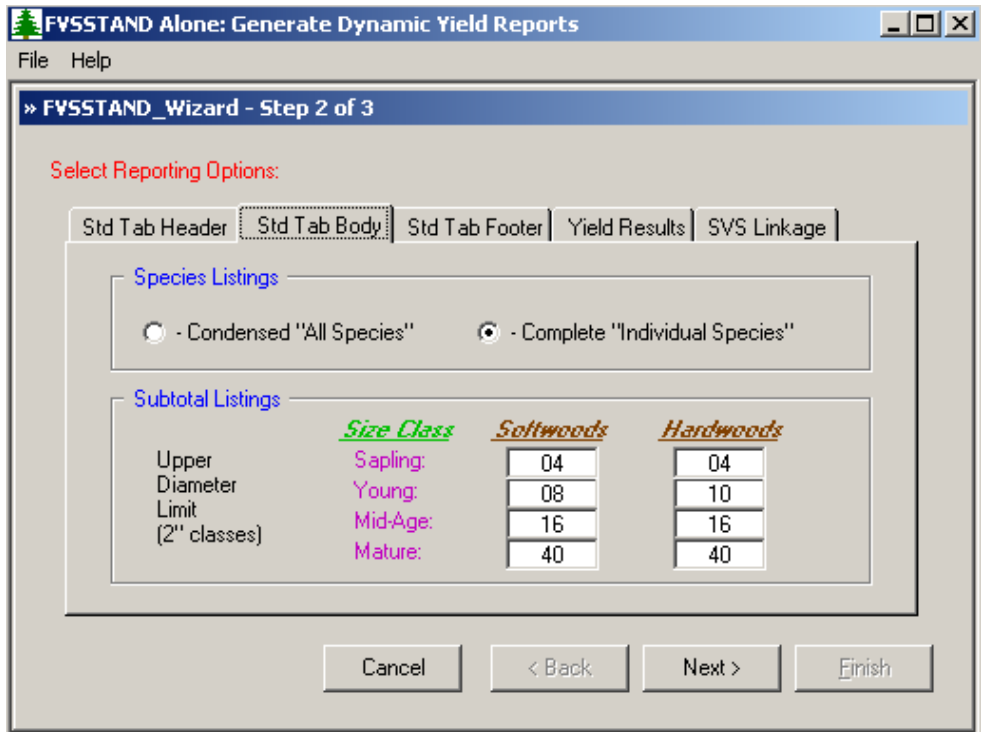
Click the "Next" tab and then "Finish".
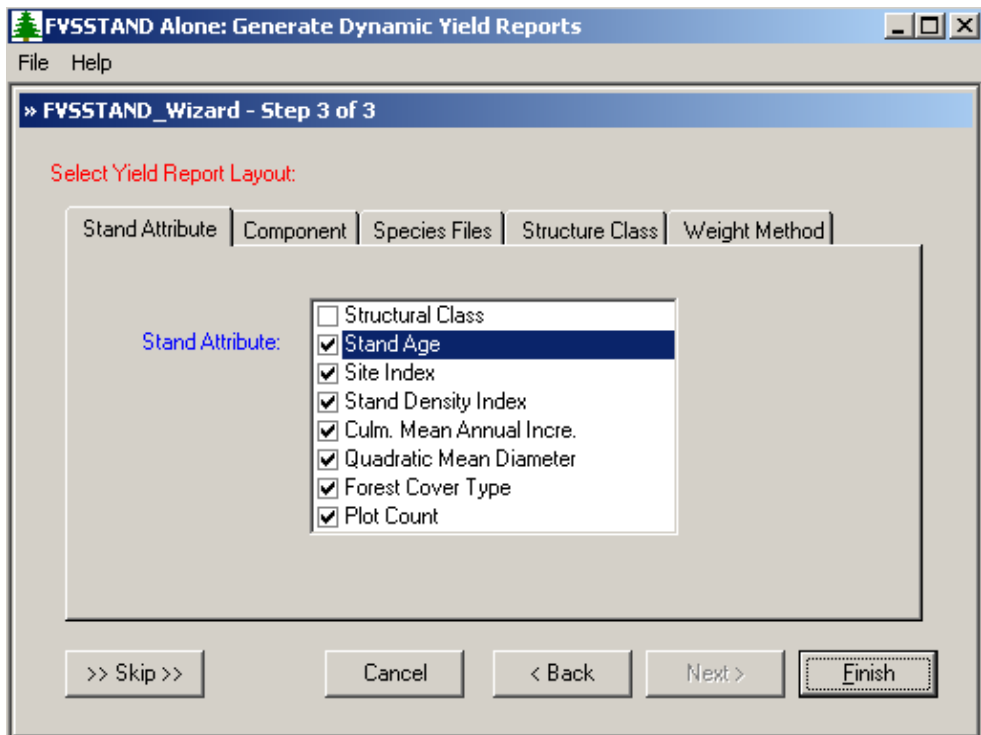
The post processor will link the treelists files. Click "OK".
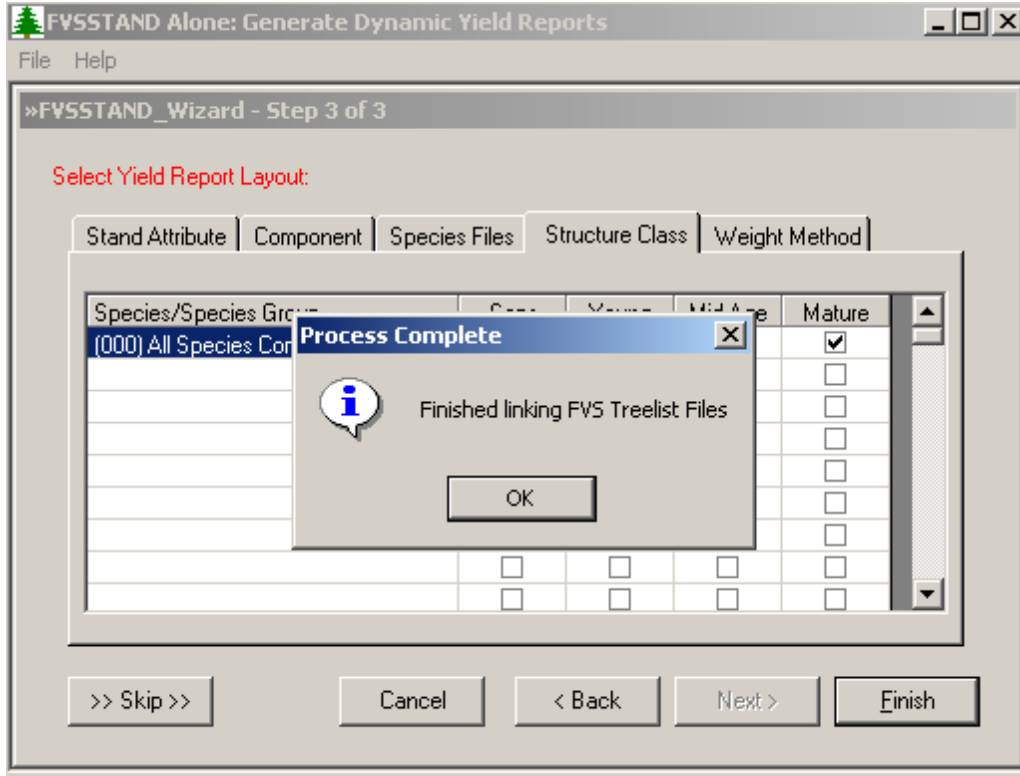
A log file then opens. Click the "X" in the upper right corner of the window to close.
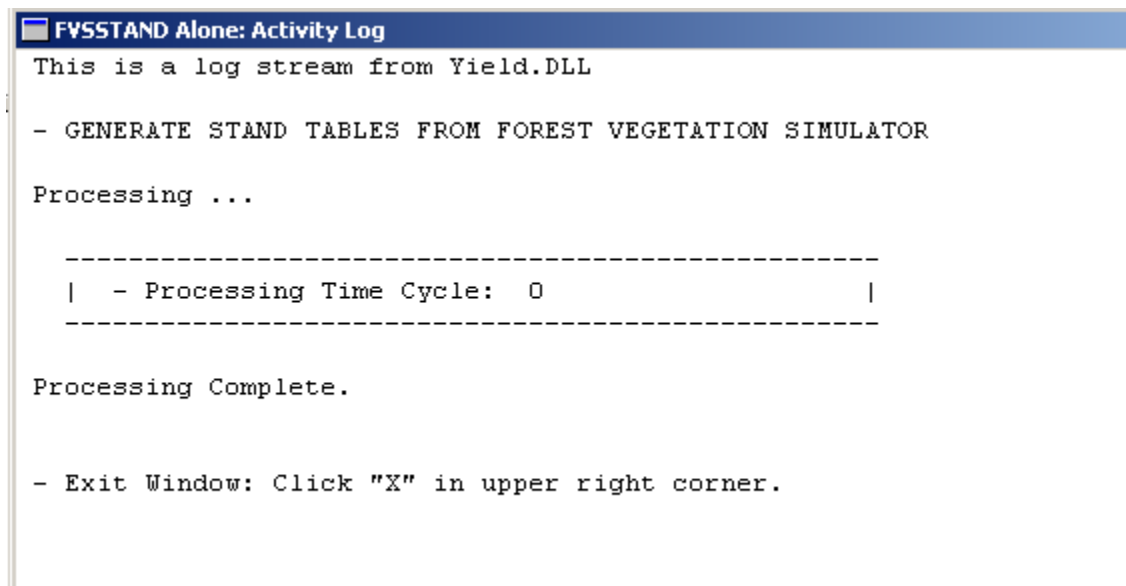
Then, the FVSStand print preview opens. Review the data if needed and then click "Finish".
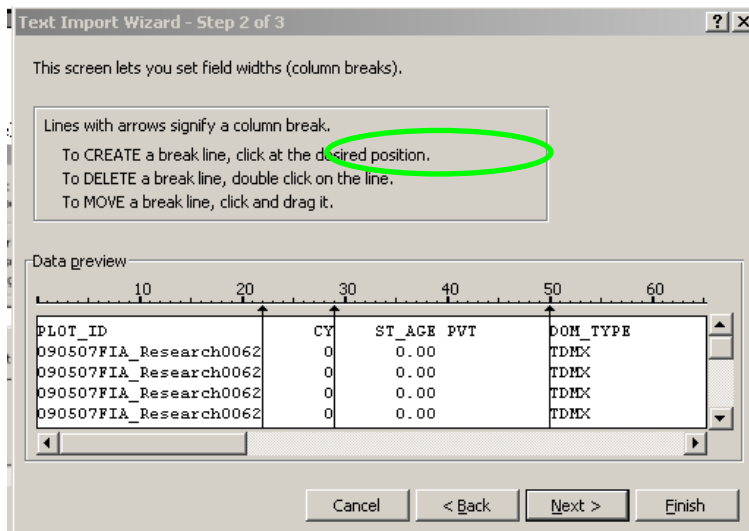

At this point, the simulation is completed. Next open Windows Explorer and navigate to the FVSData Directory that your data is in. Locate and open the file ***_Veg_Class.txt with MS-Excel.
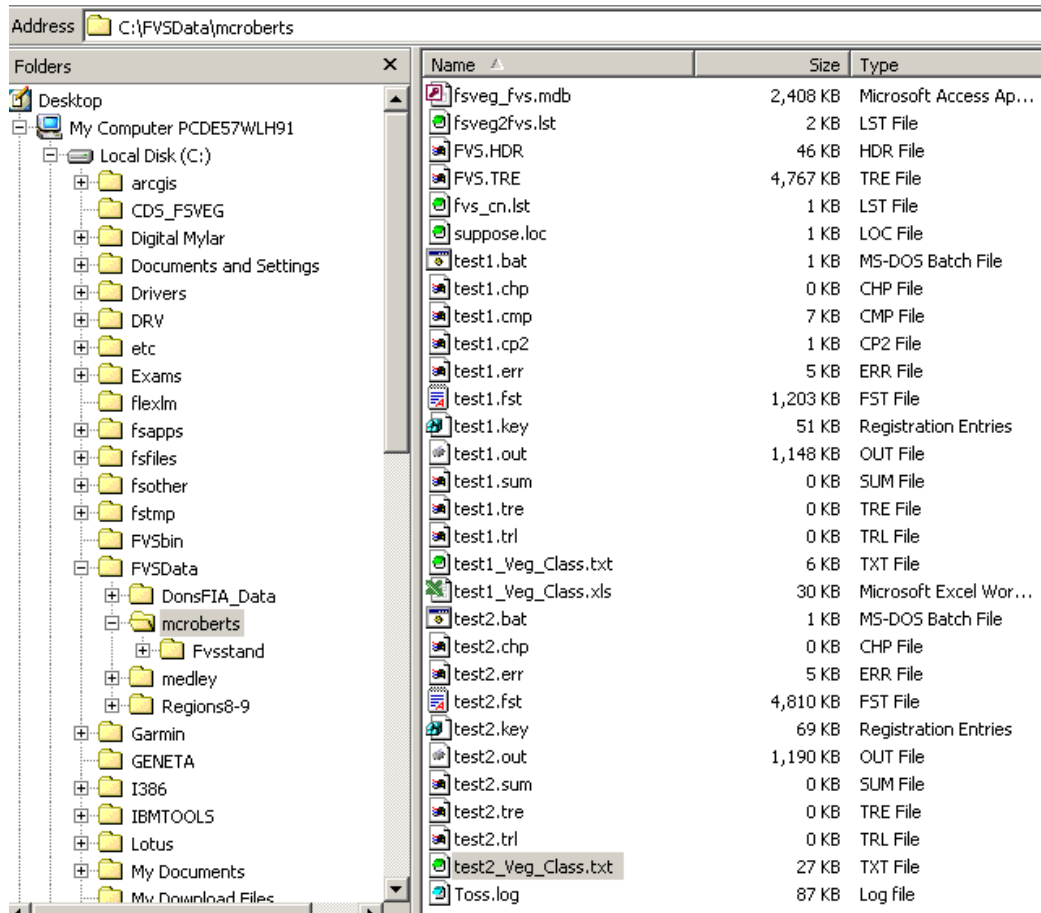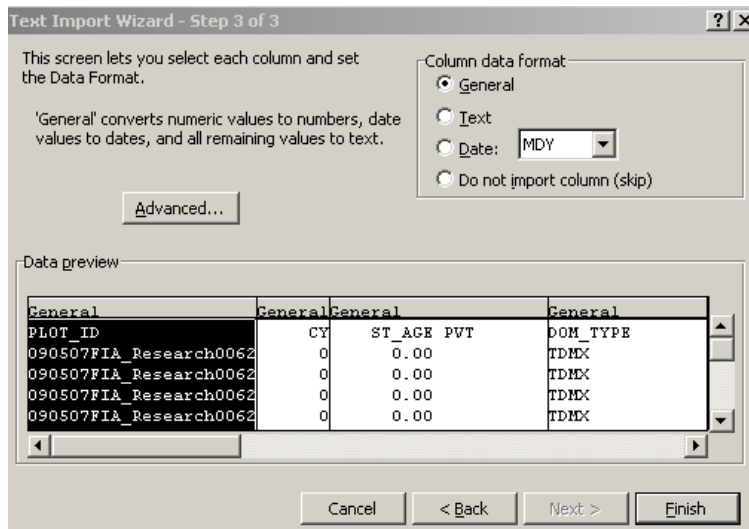
To import the text file, select Fixed Width.
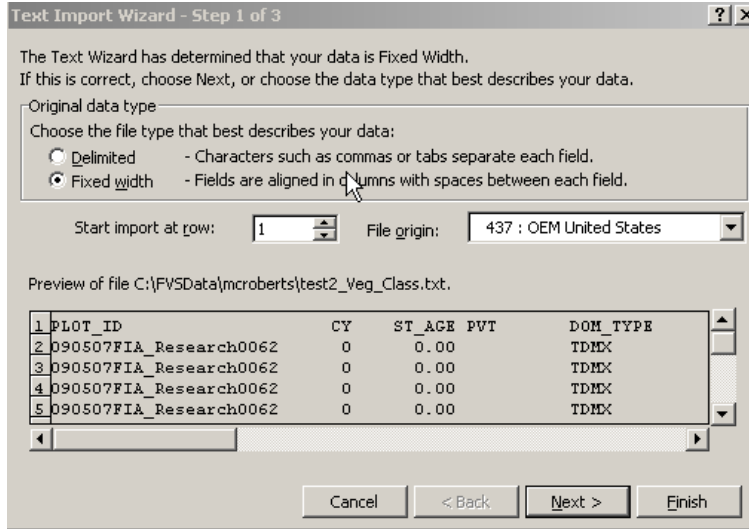
Click Next

Click Finish

This will give you the report that calculates the Dominance Type for the plot/stand.

Appendix II
Tree Species and Genus Indices for Central Rockies Variant

```
!
! --- Species for CR  32   17
001     WF 5    50 (015) White fir              ABCO     ABIES     4
002     GF 4    50 (017) Grand fir              ABGR     ABIES     4
003     CB 2    50 (018) Corkbark fir           ABLAA    ABIES     4
004     AF 1    50 (019) Subalpine fir          ABLA     ABIES     4
005     AJ 29   50 (063) Alligator juniper      JUDE2    JUNIP     2
006     UJ 16   50 (065) Utah juniper           JUOS     JUNIP     2
007     RM 30   50 (066) Rocky Mtn. juniper     JUSC2    JUNIP     2
008     RM 30   61 (057) Juniper sp.            JUNIP    JUNIP     2
009     RM 30   62 (059) Redberry juniper       JUCO11   JUNIP     2
010     ER 32   50 (068) Eastern redcedar       JUVI     JUNIP     2
011     OJ 31   50 (069) Oneseed juniper        JUMO     JUNIP     2
012     WL 8    50 (073) Western larch          LAOC     LARIX     1
013     ES 18   50 (093) Engelmann spruce       PIEN     PICEA     4
014     WS 19   50 (094) White spruce           PIGL     PICEA     3
015     BS 17   50 (096) Blue spruce            PIPU     PICEA     3
016     WB 14   50 (101) Whitebark pine         PIAL     PINUS     3
017     BC 9    50 (102) Bristlecone pine       PIAR     PINUS     2
018     PI 12   50 (106) Pinyon sp.             PIED     PINUS     2
019     LP 11   50 (108) Lodgepole pine         PICO     PINUS     1
020     LM 10   50 (113) Limber pine            PIFL2    PINUS     2
021     SW 15   50 (114) SW white pine          PIST3    PINUS     2
022     CI 36   50 (118) Chihuahua pine         PILEC    PINUS     2
023     PP 13   20 (122) Ponderosa pine         PIPO     PINUS     2
024     PM 33   50 (133) Singleleaf pinyon      PIMO     PINUS     2
025     PD 34   50 (134) Border pinyon          PIDI3    PINUS     2
026     PP 13   60 (136) Blackjack pine         PIPO     PINUS     2
027     PP 13   70 (137) Yellow pine            PIPO     PINUS     2
028     AZ 35   50 (143) Arizona pinyon pine    PIMOF    PINUS     2
029     DF 3    50 (202) Douglas-fir            PSME     PSTSUG    3
030     RC 7    50 (242) Western redcedar       THPL     THUJA     5
031     MH 6    50 (264) Mountain hemlock       TSME     TSUGA     4
032     OS 37   50 (290) Other softwoods        2TE                2
033     PB 28   50 (375) Paper birch            BEPA     BETULA    2
034     PW 22   50 (745) Plains cottonwood      PODEM    POPUL     1
035     AS 20   50 (746) Quaking Aspen          POTR5    POPUL     1
036     NC 21   50 (749) Narrowleaf cottonwood  POAN3    POPUL     1
037     NC 22   71 (740) Cottonwood sp.         POPUL    POPUL     1
038     AW 24   50 (803) Arizona white oak      QUAR     QUERC     2
039     EM 25   50 (810) Emory oak              QUEM     QUERC     2
040     EM 25   83 (829) Mexican blue oak       QUOB     QUERC     2
041     EM 25   84 (846) Gray oak               QUGR3    QUERC     2
042     EM 25   85 (847) Netleaf oak            QURU4    QUERC     2
043     EM 25   86 (850) Oak - evergreen sp.    QUERE    QUERC     2
044     GO 23   50 (814) Gambel oak             QUGA     QUERC     2
045     GO 23   81 (800) Oak - deciduous sp.    QUERD    QUERC     2
046     BK 26   50 (823) Bur oak                QUMA2    QUERC     3
047     BK 26   82 (826) Chinkapin oak          QUMU     QUERC     2
048     SO 27   50 (843) Silverleaf oak         QUHY     QUERC     2
049     OH 38   50 (990) Other hardwoods        2TD                2
```

```
! --- RECOGNIZED GENERA
!
! --- Softwood
001      'ABIES      '
002      'CHAMAE     '
003      'JUNIP      '
004      'LARIX      '
005      'PICEA      '
006      'PINUS      '
007      'PSTSUG     '
008      'TAXOD      '
009      'THUJA      '
010      'TSUGA      '
! --- Hardwood
011      'ACER       '
012      'AESCU      '
013      'AILAN      '
014      'AMELAN     '
015      'BETULA     '
016      'CARPIN     '
017      'CARYA      '
018      'CASTAN     '
019      'CATALP     '
020      'CELTIS     '
021      'CERCIS     '
022      'CORNUS     '
023      'CRATA      '
024      'DIOSPY     '
025      'FAGUS      '
026      'FRAXIN     '
027      'GLEDIT     '
028      'GORDON     '
029      'GYMNOC     '
030      'HALES      '
031      'ILEX       '
032      'JUGLAN     '
033      'LIQUID     '
034      'LIRIOD     '
035      'MACLUR     '
036      'MAGNOL     '
037      'MALUS      '
038      'MORUS      '
039      'NYSSA      '
040      'OSTRY      '
041      'OXYDEN     '
042      'PAULOW     '
043      'PERSEA     '
044      'PLATAN     '
045      'POPUL      '
046      'PRUNUS     '
047      'QUERC      '
048      'ROBIN      '
049      'SALIX      '
050      'SASSA      '
051      'SORBUS     '
052      'TILIA      '
053      'ULMUS      '
```

Appendix III
Mixed Species Dominance Types

Here is how to decipher the Mixed-Species Dominance Types:

TEIX = (T)ree/(E)vergreen/Shade (I)ntolerant/Species Mi(X)
TETX = (T)ree/(E)vergreen/Shade (T)olerant/Species Mi(X)
TDMX = (T)ree/(D)eciduous/(M)i(X)
TEDX = (T)ree/(E)vergreen & (D)eciduous/Species Mi(X)

Additionally, the TDMX type could be (NFS Region specific) subdivided into:

TDIX = (T)ree/(D)eciduous/Shade (I)ntolerant/Species Mi(X)
TDTX= (T)ree/(D)eciduous/Shade (T)olerant/Species Mi(X)