Appendix D. Vegetation Classifications and Descriptions

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Introduction

This appendix describes in detail the vegetation classifications upon which many plan components are built, forming the basis for many forest plan components related to vegetation and wildlife habitat.

Data Sources

The vegetation classifications used for forest plan revision, as described in this appendix, are designed for consistent use across the best available data for the HLC NF, based on the R1 Classification System (Barber, Bush, & Berglund, 2011). This approach ensures that consistent and reliable information is available for analysis and monitoring through the life of the revised forest plan.

Forest Inventory and Analysis

The sources of data for quantifying existing vegetation are Forest Inventory and Analysis (FIA) plots and FIA intensified grid plots. FIA is a national inventory of forest ecosystem data derived from field sample locations distributed systematically across the U.S., regardless of ownership or management emphasis (Bush, Berglund, Leach, Lundberg, & Zeiler, 2006). Data collection standards are strictly controlled and the sample design and collection methods are scientifically designed and repeatable. FIA provides a statistically-sound representative sample to provide unbiased estimates at broad- and mid-levels. Plots have been permanently established and are re-measured on a regular basis (currently every 10 years).

The National FIA grid covers all national forest system lands on the HLC NF. The FIA grid has been intensified by four times (4x) on the HLC NF, using protocols compatible with the National FIA grid. The sample at the time of plan revision is not complete for the Rocky Mountain Range GA, nor does it cover the portion of the Elkhorns GA on the Beaverhead-Deerlodge National Forest. On GAs where the 4x intensification is completed, these plots are added to the base FIA to create an enhanced analysis dataset.

FIA and FIA intensified grid data is the primary data source used for monitoring and evaluation of vegetation conditions over time. FIA and FIA intensified grid data are summarized in the Region 1 Summary Database, which is an access database that includes statistical reporting functions and derived attributes or classifications consistent with the R1 Classification System (Barber, Berglund, & Bush, 2009; Bush et al., 2006).

Region 1 Vegetation Map

The Region 1 existing vegetation mapping system (R1 VMap) (Barber et al., 2011) is the source for classification and spatial mapping of existing vegetation. R1 VMap is derived from National and Regional remote sensing protocols, using a combination of satellite imagery and airborne acquired imagery, with refinement and verification through field sampling. The product is assessed for accuracy, with a known and quantifiable level of uncertainty. Though the product is inherently less accurate and detailed than plot sampling, it allows for an analysis of the spatial distribution of vegetation. It was designed to allow consistent applications of vegetation classification and map products across all land ownerships (Barber et al., 2009; Barber et al., 2011; Berglund, Bush, Barber, & Manning, 2009).

The VMap version used was produced in 2014 based on 2011 imagery and represents our best current spatial estimate for vegetation components including lifeform, dominance type, size class, and density class. R1 VMap data is used as a basis for the spatial representation and description of existing vegetation and for the spatial modeling of vegetation conditions over time.

Analytical Vegetation Models

Two analytical models were used in the development of the revised forest plan:

• The Spectrum model was used to project alternative forest management scenarios, schedule vegetation treatments and provide outcomes, based upon a variety of input parameters, such as management objectives and budget limitations. Spectrum also is used to project timber harvest acres and volumes over time under different management scenarios.

• The SIMPPLLE model (SIMulating Patterns and Processes at Landscape scaLEs) was used to simulate fire, insect and disease disturbances over time, and the interaction of these disturbances with vegetative succession and treatments. SIMPPLLE was used to conduce the natural range of variation analysis which formed the basis for the development of vegetation desired conditions. The SIMPPLLE model provides for spatial analysis of future management activities as scheduled through the Spectrum model.

Broad potential vegetation types

Lands across the HLC NF are grouped into broad potential vegetation types, based on climatic and site conditions. Potential vegetation types serve as a basis for description of ecological conditions across the forest. These groups are useful in understanding the various ecosystems, their potential productivity, natural biodiversity, and processes. Potential vegetation types are essentially assemblages of habitat types, which are aggregations of ecological sites of like biophysical environments (such as climate, aspect, and soil characteristics) that produce plant communities of similar composition, structure and function (Mueggler & Stewart, 1980; Pfister, Kovalchik, Amo, & Presby, 1977). The vegetation communities that would develop over time given no major disturbances (the climax plant community) would be similar within a habitat type or potential vegetation type. It is assumed that potential vegetation types generally remain constant. A consistent hierarchy of broad potential vegetation type developed for the Northern Region (Milburn, Bollenbacher, Manning, & Bush, 2015) is used, as shown in Table 1.

Table 1. Potential vegetation type classification for habitat types found on the HLC NF

<table>
<tr><th>Region 1 Broad Potential Vegetation Type</th><th>Region 1 Habitat Type Groups</th><th>Region 1 MT Potential Vegetation Type</th><th>Habitat Type Code</th></tr>
<tr><td rowspan="13">Warm Dry Forest</td><td>Hot Dry</td><td>pifl</td><td>000, 040, 050, 051, 052, 070, 0903, 0913, 0923, 0933, 0943, 0953</td></tr>
<tr><td rowspan="6">Warm Dry</td><td rowspan="2">pipo</td><td>100, 110, 130, 140, 141, 142, 160, 161, 162</td></tr>
<tr><td>1034, 1044, 1000325, 1000335, 1000345, 1000355, 1000375, 1054, 1064, 150</td></tr>
<tr><td>psme1</td><td>200, 210, 220, 230, 2054, 3904</td></tr>
<tr><td>psme2</td><td>311, 380</td></tr>
<tr><td>psme3</td><td>321</td></tr>
<tr><td>pipo</td><td>180, 181, 182</td></tr>
<tr><td rowspan="4">Mod Warm Dry</td><td>pipo</td><td>170, 171, 172, 190</td></tr>
<tr><td>picea</td><td>430</td></tr>
<tr><td>psme2</td><td>2404, 250, 260, 261, 262, 263, 280, 281, 282, 283, 292, 310, 312, 313</td></tr>
<tr><td>psme3</td><td>360, 320, 322, 323, 324, 330, 350, 370, 340</td></tr>
<tr><td>Mod Warm Mod Dry</td><td>psme2</td><td>290, 291, 293</td></tr>
</table>

Region 1 Broad Potential Vegetation Type	Region 1 Habitat Type Groups	Region 1 MT Potential Vegetation Type	Habitat Type Code
Cool Moist Forest	Cool Moist	abla2	600, 620, 621, 622, 623, 624, 625, 660, 661, 662670, 671, 673, 740
		picea	400, 420, 421, 422, 460, 461, 462, 470, 0046, 4724, 4754
	Cool Wet	abla1	610, 630, 635, 636, 637, 650, 651, 652, 653, 654, 655, 631, 632
		picea	410, 440, 480
	Cool Mod Dry to Moist	abla2	663
		abla3	640, 691, 693, 700, 720, 750, 770, 780, 790, 791, 792, 690, 607, 745
		picea	450
		pico	900, 910, 920, 930, 950, 9604
Cold Forest	Cold	abla3	672, 692, 694, 731, 732, 733,
		abla4	674, 730, 800, 810, 820, 830, 831, 832
		pico	925, 940
	Timberline	pial	850, 870, 890
Xeric Grassland	Bluebunch Wheatgrass	drygrass	Ref 199: 015, 016, 017, 020, 065; Ref 115: 200, 500, 800; Ref 103: 47130, 47131, 47132, 47140, 47141, 47142, 47143, 47144, 47145, 47146; Ref 114: 100005, 100006, 10010, 100021, 100054, 100055
Mesic Grassland	Western Wheatgrass	agrsmi	Ref 114: 100001. Ref 115: 100
	Fescue	fesida	Ref 199: 18, 39; Ref 615: GB5917, GB5922; Ref 103: 47003, 47004, 47120, 47121, 47122, 47123, 47124, 47125, 47126, 47127; Ref 114: 100023
		fessca	Ref 199: 19; Ref 103: 47110, 47111, 47112, 47113, 47114, 47115
Mesic Shrubland	Mesic Shrubland	potfru	Ref 199: 34; Ref 103: 46620, 46621, 46622, 46623
		mesic shrub	Ref 199: 030; Ref 110: 030, 031; Ref 112: 156, 157, 158, 159, 160, 161 Ref 115: 2000, 2100; Ref 114: 100052, 100056; Ref 615: SM19
Xeric Shrubland/ Woodland	Low Shrubland	sage1	Ref 199: 031; Ref 103: 46600, 46601, 46602, 46603
	Mountain Shrubland	sage4	Ref 199: 033; Ref 103: 46611, 46612, 46613
	Xeric Sagebrush	sage3	Ref 199: 032
		sage2	Ref 115: 1100, 1200; Ref 103: 46610, 46614; Ref 114: 100014, 100015
	Xeric Shrubland	dry shrub	Ref 103: 46201, 46301, 46630, 46632, 46633; Ref 114: 100028; Ref 115: 1400; Ref 199: 035; Ref 615: SD49
		rhus	Ref 199: 036, 037; Ref 103:46640, 46641, 46642; Ref 114: 100046, 100047, 10048
		sage5	Ref 114: 100013; Ref 115: 1000
	Salt Desert Shrub	saltshrub	Ref 199: 038; Ref 115: 1300; Ref 103: 46650, 46651, 46652; Ref 114: 100049, 100050.
	Juniper Woodland	juniper	Ref 102: 151, 152; Ref 114: 100029, 100030; Ref 199: 50
Riparian/ Wetland	Aspen Woodland	poptre	Ref 102: 351, 356; Ref 112: 117, 118, 119, 120, 121; Ref 114: 100040; Ref 199: 078
	Riparian Shrub	ripshrub	Ref 112:030, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 150, 151, 152, 153, 154, 155, SW1117, SW5112, SW5113; Ref 199:071, 072, 073, 074

Region 1 Broad Potential Vegetation Type	Region 1 Habitat Type Groups	Region 1 MT Potential Vegetation Type	Habitat Type Code
	Wetland Graminoid	ripgrass	Ref 615: MW19; Ref 199: 021, 061, 070; Ref 112: 200, 201, 202, 203, 204, 205, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, MD3111, MM1912, MM2912, MM2914, MM2915, MM2917, MM2920, MS31111, MW3912, MW4911, MW4912. Ref 103: 47100, 47101
	Riparian Deciduous Tree	ripdecid	Ref 102: 301; Ref 110: 20; Ref 112: 103, 104, 105, 106, 110, 111, 112, 113, 114, 115, 116, 122, 123, 124, 125, 130; Ref 114: 100024; Ref 199: 60, 71, 72, 73, 74, 79
Alpine	Alpine Herbaceous	alpine	Ref 113: 001,002, 003,004,005, 006, 009, 010, 012, 013, 015, 016, 018, 019, 022, 023, 024, 025, 026, 027, 028, 029; Ref 199: 080, 081, 084
	Alpine Shrub		Ref 113: 007, 008, 011, 014, 017, 020, 021; Ref 199: 087
Sparse	Sparse	Sparse	Ref 101: 010

Table 2 provides the acres and proportion of each Region 1 broad potential vegetation type that occurs in the GAs on the HLC NF.

Table 2. Percent of broad potential vegetation types on NFS lands on the HLC NF[1]

Broad Potential Vegetation Type	Total HLC NF	Big Belts	Castles	Crazies	Divide	Elkhorns HLC/ All[3]	High-woods	Little Belts	Rocky Mtn	Snowies	Upper Black-foot
Warm Dry Forest	41%	72%	54%	45%	52%	35%/49%	68%	46%	17%	45%	37%
Cool Moist Forest	31%	12%	17%	26%	27%	12%/2%	3%	32%	48%	44%	39%
Cold Forest	24%	11%	20%	26%	17%	32%/39%	3%	18%	32%	5%	23%
Xeric Grassland[2]	0	<1%	0%	0%	0%	0%/0%	0%	<1%	0%	0%	0%
Mesic Grassland[2]	<1%	3%	2%	0%	2%	16%/0%	3%	1%	<1%	0%	<1%
Mesic Shrubland[2]	<1%	0%	0%	0%	0%	0%/0%	6%	<1%	<1%	2%	0%
Xeric Shrub/Wood -land[2]	<1%	<1%	6%	2%	0%	4%/4%	18%	<1%	0%	0%	0%
Riparian/ Wetland[2]	<1%	0%	0%	0%	0%	0%/0%	0%	<1%	0%	0%	0%
Alpine[2]	0%	0%	0%	0%	0%	0%/0%	0%	0%	0%	0%	0%
Sparse	2%	<1%	2%	0%	1%	2%/6%	0%	1%	2%	4%	3%

[1] Data is from the R1 Summary Database, based Forest Inventory and Analysis and Forest Inventory and Analysis Intensified Grid plot data. Base Forest Inventory and Analysis ("Hybrid 2011" dataset) is used forestwide and for the Rocky Mountain Range GA. Intensified grid data "F12F15 Partial IntGrid 4x Hybrid 2016 Combined") is used for all other GAs because they have a completed intensified inventory. Values are rounded to the nearest whole number. Plots that have been impacted by fire and harvest are included in estimates, because these events would not change the PVT.
[2] Rare types or those distributed in small patches are not well captured by grid data, but are anecdotally known to occur.
3 The HLC NF portion of the Elkhorns is represented by intensified grid data. The entire Elkhorns (all) is represented by base FIA data ("Hybrid 2011") and includes the portion of the GA on the Beaverhead-Deerlodge NF.

Cover Type

Cover types are assemblages of existing vegetation that occur at any one point in time. They are groupings of dominance types that simplify analysis for the broad scale. Dominance types describe the most common plant species present, giving an indication of the relative abundance of species. Dominance type and therefore cover type describe assemblages of plant species, rather than an individual species, although they are named after the most dominant species present. Information on how dominance types are determined is found in Barber and others (2011).

The classification of cover type includes both forested and nonforested communities. There are eight coniferous cover types on the HLC NF and four non-forested cover types as shown in Table 3, based on the work of Milburn and others (2015). Currently non-forested cover types are not classified in the R1 Summary Database; therefore, for the quantitative analysis all nonforested cover types are lumped together. The western larch mixed conifer cover type is only present in the Upper Blackfoot GA (in negligible amounts) and is therefore excluded from forestwide estimates.

Table 3. Cover type classification for dominance types found on the HLC NF

Cover Type	Description and Species Associations	Region1 Vegetation Map: DomMid40
Ponderosa Pine	This cover type includes sites dominated by ponderosa pine, juniper, and/or limber pine. A minor component of Douglas-fir may be present. Ponderosa pine is found on a narrow elevation band between non-forested types and Douglas-fir forests. This cover type usually grows on the warm dry broad potential vegetation type.	MX-PIFL2, MX-PIPO, or MX-JUNIP1
Dry Douglas-fir	This cover type is found on dry sites dominated by Douglas-fir, with potential components of ponderosa pine, limber, or juniper. This cover type occurs primarily on the warm dry broad potential vegetation type.	(IMIX or MX-PSME) AND (PVT = pifl, pipo, psme1, or psme3)
Mixed Mesic Conifer	This cover type encompasses moist sites dominated by Douglas-fir which can be mixed with lodgepole pine, western larch, and/or subalpine fir/spruce. This type is found on sites more moist and productive than the dry Douglas-fir type. This cover type is found on both warm dry and cool moist broad potential vegetation groups.	TMIX or [(MX-PSME or IMIX) AND (PVT is not pifl, pipo, psme1, or psme3)]
Western larch Mixed Conifer	These sites are dominated by western larch, with components of Douglas-fir, lodgepole pine, and/or spruce. This type would commonly be found on the cool moist broad potential vegetation type, and is only present on the Upper Blackfoot GA.	MX-LAOC
Lodgepole Pine	This type is dominated by lodgepole pine with minor components of other species. This cover type can occur on any forested broad potential vegetation group.	MX-PICO
Aspen/ Hardwood	This cover type includes areas dominated by aspen or cottonwood, often with shrubs such as willow and alder. This type often occurs in association with riparian and moist upland areas and can be found in any forested broad potential vegetation group.	HMIX, MX-POPUL, or MX-POTR5
Spruce/fir	This cover type describes where subalpine fir and/or Engelmann spruce dominate, with minor components of other species. These are often climax forests. This cover type most often occurs on the cool moist or cold broad potential vegetation group.	MX-ABLA or MX-PIEN
Whitebark pine	The whitebark pine cover type occurs at the high elevations, most commonly on the cold broad potential vegetation group but sometimes in cool moist. Minor components of subalpine fir, spruce, or lodgepole pine may be present.	MX-PIAL
Grass	Grass can dominate the xeric and mesic grassland broad potential vegetation groups, and some dry forest types. Plant communities include forb mixes; rough fescue; Idaho fescue; western wheatgrass; bluebunch	Grass-Dry; Grass-Bunch; Grass-Singlestem

Cover Type	Description and Species Associations	Region1 Vegetation Map: DomMid40
	wheatgrass, needle-and-thread grass; tufted hairgrass; little bluestem; prairie sandreed; green needle grass; needlegrass; wheatgrass; timothy; crested wheatgrass; blue grama; kentucky bluegrass; buegrass; cool season short grass mix; cool season mid grass mix; warm season mid grass mix; warm season short grass mix; and mixed grass.	
Dry Shrub	The dry shrub cover type occurs on the xeric shrub/woodland broad potential vegetation group, as well as some dry forest sites. Dominant shrubs include sagebrush; antelope bitterbrush; shrubby cinquefoil; skunkbush sumac; curl-leaf mountain mahogany; rabbitbrush; low shrub; saltbush, soapweed yucca sagebrush, and rabbitbrush.	Shrub-Xeric; MX-CELE3 MX-JUNIP, JUNIP
Riparian Grass/shrub	This cover type occurs typically in the riparian/wetland broad potential vegetation group, but also potentially in cool and wet forest habitat types. Common species include willow, alder, mountain brome, smooth brome, dry sedge, wet sede/spikerush/juncus, and annual brome.	Grass-Wet
Mesic Shrub	Mesic shrubs most commonly dominate the mesic shrubland broad potential vegetation group. Species may include chokecherry, plum; rose; snowberry; huckleberry; mallow ninebark; white spirea, and buffaloberry.	Shrub-Mesic
Sparse or Non-vegetated	In addition to the vegetated cover types, some areas on the Forest are categorized as “sparse” (containing little vegetation cover, such scree slopes) or non-vegetated (such as lakes or urban areas). These areas are excluded from the composition analysis	URBAN, WATER, SPARSE

Individual Tree Species Presence

Tree species presence indicates the proportion of an area where there is at least one live tree per acre of a given species, of any size. This measure gives an indication of how widely distributed the species is across the landscape, although it is not necessarily dominant or even common in all the places it occurs. Most forest stands are composed or more than one tree species. As shown above, cover types are named for the dominant tree species representing the group (i.e., the ponderosa pine cover type). However, ponderosa pine as an individual species may also be found in other cover types. Therefore, the estimates for a given cover type are not the same as the distribution of the tree species for which it is named.

There are eleven native tree species found on the HLC NF, although not all occur on every GA: Rocky mountain juniper, limber pine, ponderosa pine, Douglas-fir, lodgepole pine, western larch, aspen, cottonwood, Engelmann spruce, subalpine fir, and whitebark pine.

Size Class

Tree size is an indicator of the structure and age of forests across the landscape. Forest size classes are defined based on the predominant tree diameter in the stand (basal area weighted average diameter). The five size classes are shown in Table 4. Details on how forests are classified into size class can be found in Barber and others (2011). A general association of the size class with tree age and forest successional stage is made based upon knowledge of the successional patterns and structures on the HLC NF.

Table 4. Forest size classes

Size Class	Diameter Range	Description
Seedling/sapling	0 to 5 inches	The seedling/sapling size class represents the early successional stage of development. Forests are dominated by seedlings (less than 4 ½ feet tall) and saplings (less than 5 inches diameter). There may be low numbers of overstory

Size Class	Diameter Range	Description
		larger trees present. Most trees are less than 40 years old and less than 40 feet tall. On sites of lower productivity (higher elevation, poor soils) or in extremely dense stands, trees in in this class may be older because of their slower diameter growth rates.
Small tree	5 to 8.9 inches	Small size class forests are in the mid-successional stage of development, composed mostly of immature trees 5 to 8.9 inches diameter. Typical tree ages range from 40 to 75 years old. They often have a single canopy layer, but two or more layers are not uncommon, depending on disturbance history and site conditions.
Medium tree	9 to 14.9 inches	Medium size class forests are also in the mid-successional stage of development, where trees 9 to 14.9 inches diameter dominate. Vertical structures vary considerably. Tree age varies depending on species composition, site conditions, and stand density, but is typically 75 to 110 years old. On sites with harsher growing conditions or in stands of very high densities and low growth rates, trees in this medium size class might be substantially older.
Large tree	15 to 19.9 inches	Large size class forests are usually older than those in the medium class. Trees 15 to 19.9 inches diameter dominate. Most trees are over 90 years old, and most stands are in the mid or late successional stage of development. There are sites where trees of large tree size classes are substantially younger or much older.
Very large tree	20+ inches	Very large size class forests represent the oldest stands, where trees >=20 inches diameter dominate. The larger trees are typically over 130 years old, and some may be several centuries in age. Forests are in the late successional stage of development, and some correlate to old growth forest. These forests typically have a more complex structure than other successional stages.

Large and Very Large Trees

The large and very large forest size classes described in the previous section reflect areas where large and very large trees occur in relative abundance. However, because forest size class is based on the basal area weighted average diameter of trees across the stand, it does not provide the full picture of the amount or distribution of all large and very large live trees. Large and very large trees may occur in forests dominated by smaller trees and therefore classified into smaller size classes. These components are still important pieces of ecosystem diversity. To address this, two additional indicators are considered:

- trees per acre of large and very large trees per acre
- large and very large tree concentrations

Large and Very Large Live Trees per Acre

This indicator of large and very large trees is simply the average trees per acre present. These trees may be clumped or present as scattered, rare individuals. The trees per acre are estimated by snag analysis group because the presence of these live trees directly correlates to future large snag recruitment. A detailed description of snag analysis groups is provided in the snags section.

Large and Very Large Live Tree Concentrations

Large and very large tree concentrations identify places where large tree components are not necessarily dominant but do occur at certain minimum densities. These minimum densities are defined to reflect quantities more meaningful for wildlife habitat, stand structure, and late seral forest conditions. The presence of these concentrations represent only one aspect of old growth characteristics, so these areas are not necessarily old growth. They are referred to as concentrations or “subclasses” because they can occur in any of the five forest size classes.

The criteria and existing proportion of the large and very large tree subclasses on the HLC NF are displayed in Table 5.

Table 5. Large and very large tree concentration definitions by broad potential vegetation group

Broad potential vegetation type	Large tree concentration criteria	Very large tree concentration criteria
Warm Dry	At least 5 trees per acre > or = 15” diameter	At least 4 trees per acre > or = 20” diameter
Cool Moist	At least10 trees per acre > or = 15” diameter	At least10 trees per acre > or = 20” diameter
Cold	At least 8 trees per acre > or = 15” diameter	At least 8 trees per acre > or = 20” diameter

Density Class and Vertical Structure

Forest density is a measure of the area occupied by trees. The density of trees can influence their growth and vigor as well as susceptibility to disturbances. It can influence the rate of forest succession and the species composition as well as other attributes such as vertical structure (the number of canopy layers). Tree density can be described in numerous ways. For the HLC NF, tree canopy cover is used as the measure of density. Canopy cover is the percentage of ground covered by a vertical projection of the outermost perimeter of the tree crowns, considering trees of all heights.

Canopy cover is low when the stand is in the earliest stage of succession and dominated by seedlings. As trees grow, crowns expand to fill up growing space, and canopy cover gradually increases. Growth of understory trees over time also adds to the canopy cover and vertical structure on many sites as the forest grows into the later successional stages. Disturbances and competition-based mortality can limit tree density. Site productivity also affects canopy cover, with more productive, moist sites supporting higher densities, and harsh sites with poor soils supporting lower densities. Frequent fire, particularly in the warm dry potential vegetation group, can maintain low canopy covers at all stages of forest succession.

Vertical structure is not a key indicator nor does it have quantitative desired conditions; however, it is described in conjunction with density. Vertical structures is categorized as single-storied (one canopy layer), two-storied (two canopy layers), or multistoried (three or more canopy layers). As with density, vertical structure is driven by succession, individual species traits, and disturbances. Some cover types, such as spruce/fir, naturally develop a continuous canopy made up of multiple layers of shade tolerant species. Other types, such as lodgepole pine, tend to grow in dense, single-storied stands.

The four canopy cover classes and associated vertical structures are described in Table 6.

Table 6. Forest density classes and associated vertical structures

Density Class	Diameter Range	Description
Nonforested	<10%	Areas with less than 10% canopy cover are considered to be nonforested. This class may include open forest savannas or persistent grass/shrub communities that occur on the warm dry broad potential vegetation group. Such sites may have multiple age classes but large, fire resistant and drought tolerant trees such as ponderosa pine are favored. This class also includes areas on any potential vegetation type that has been recently de-forested through disturbance and trees have not yet re-established. Finally, true non-forested communities are included (grasslands, shrublands, riparian/wetlands, and alpine communities).
Low to Medium	10-39.9%	Low and medium tree canopy cover classes represent relatively open forests with 10 to 39.9% canopy cover. This class is common in young forests. In addition, low densities are found in dry forest types at all stages of succession, where site conditions or disturbances maintain low tree density. Cool moist or cold forests may also be in this condition particularly where impacted by disturbances such as mountain pine beetle.
Medium-High	40-59.9%	The medium to high tree canopy cover class represents a more fully stocked forest, a condition which is common in mature moist forests of shade tolerant species. Examples of forests with this density could include mature single-storied lodgepole pine or spruce/fir multistoried stands. Dry forests may also be in this density class particularly where fire has been excluded and understory layers have developed.
High	60%+	The high canopy cover class includes forests with a relatively closed canopy, most often on productive sites. This density class is common in stands with a spruce/fir component in a multi-storied condition. This condition also arises in single-storied lodgepole pine and sometimes Douglas-fir that regenerate to high densities after fire. This condition may also occur in dry forests that have missed natural fire entries and developed layers in the understory.

Snags

A dead tree, from the time it dies until it is fully decomposed, contributes to many ecological processes (Brown, Reinhardt, & Kramer, 2003). Although all snags have value, large snags are of particular importance. Snags are created at broad scales, ranging from single-tree mortality to high severity fires or insect infestations. Snag components are developed based on average snags per acre as well as the distribution of snags. The distribution reflects the percent of the area that contains one or more snags in the size class indicated. Three size classes of snags are assessed:

- medium (10” + diameter at breast height);
- large (15” + diameter at breast height); and
- very large (20”+ diameter at breast height)

When these classes are quantified in the plan components, the smaller size classes contain the snags in the larger classes. For example, the medium snag numbers include all medium, large, and very large snags.

Rather than broad potential vegetation types, the components for snags are classified by ***snag analysis groups***, as defined by Bollenbacher and others (2008). These snag analysis groups are generally consistent with the broad potential vegetation groups (warm dry, cool moist, and cold), except that areas currently dominated by lodgepole pine are addressed separately. This is important for the snag analysis because lodgepole pines are uniquely characterized by their growth, form, and lack of wind firmness (Lotan & Perry, 1983). Consequently, lodgepole pines fail to grow as large as other common tree species on eastside Forests, and therefore do not contribute as many large diameter snags (Bollenbacher et al., 2008).

Old Growth

Old growth is a forest structural condition that can exist during the late successional stage of forest development. The concept of old growth involves not only the age of a forest but also structural and functional characteristics such as large trees, size and spacing variation, large dead standing and fallen trees, broken and deformed tops, bole and root rot, multiple canopy layers, canopy gaps and understory patchiness, cessation in height growth of oldest trees, near zero net productivity, and biochemistry of secondary metabolic products in old trees (Johnson, Miyanishi, & Weir, 1995). This late-stage state of succession is not static and as old growth dies it is replaced by younger forests. The components for old growth are related to the estimated abundance (acres or percent of the area) of this condition on the landscape.

The HLC NF has adopted definitions of old growth developed by the Regional Old Growth Task Force and documented by Green and others (Green et al., 1992). This work contains specific measurable criteria to consistently define old growth. These criteria were developed based on a National definition that old growth forests are ecosystems distinguished by old trees and related structural attributes (Green et al., 1992). The definitions are specific to forest type (dominant tree species) and habitat type group. Key attributes for identification of old growth are age, numbers and diameter of the old tree component within the stand, and the overall stand density. Minimum thresholds have been established for these attributes. Associated characteristics are also defined for each old growth type, though these are not minimum criteria. They include such factors as probabilities of downed woody material and number of snags, number of canopy layers, and number of snags over 9 inches diameter at breast height. Table 7 displays the minimum old growth criteria that apply to the HLC NF.

Table 7. Eastern Montana zone old growth type minimum criteria (Green et al 1992)

Description		Minimum Criteria		
Old growth type[1]	Habitat type group[2]	Minimum age of large trees	Minimum number TPA/DBH	Minimum basal area (ft^2/ac)
1 – DF	A	200	4 ≥ 17”	60
2 – DF	B, C, D, E, F, H	200	5 ≥ 19”	60
3 – DF	G	180	10 ≥ 17”	80
4 – PP	A, B, C	180	4 ≥ 17”	40
5 – PF	A, B	120	6 ≥ 9”	50
6 - LP	A, B, C, D, E, F, G, H, I	150	12 ≥ 10”	50
7 – SAF	C	160	12 ≥ 17”	80
8 – SAF	D, E	160	7 ≥ 17”	80
9 – SAF	F, G, H, I	160	10 ≥ 13”	60
10 – SAF	J	135	8 ≥ 13”	40
11 – WBP	D, E, F, G, H, I	150	11 ≥ 13”	60
12 - WBP	J	135	7 ≥ 13”	40

[1] DF = Douglas-fir; PP = ponderosa pine; PF = limber pine; LP = lodgepole pine; SAF = subalpine fir; WBP = whitebark pine

[2]Habitat type groups are defined in Green et al 1992, and are not equivalent to broad potential vegetation types.

Coarse woody debris

Dead wood plays an important role in protecting soil, enhancing soil development and nutrient cycling, maintaining soil productivity over the long term, providing microsites for regeneration, retaining moisture, supporting soil micro-organisms, and providing habitat for wildlife. Downed wood is derived from snags, as well as from live trees or parts of trees that fall due to wind, during fires, and to other factors. Long, larger diameter downed wood is generally more important for wildlife because it can be used by a greater range of species and provides a stable and persistent structure, as well as better protection from weather extremes. Plan components are built to describe coarse woody debris, or downed wood that is 3” in diameter or greater, measured in tons per acre.

Early successional forest patches

The spatial pattern of forest vegetation is a key ecosystem characteristic because it can affect ecological processes, including wildlife and plant habitat and dispersal; disturbance risk, spread and size; reforestation; watershed health; carbon storage; wildlife habitat quality; and human aesthetic values. Connectivity of forests can be affected by natural factors such as topography, soils, variation in precipitation, and wildfire but can also be affected by human developments and activities. It is also one of the most complex attributes of ecosystems to quantify. The goal of assessing connectivity and pattern is to better understand the mosaic of conditions that make up a resilient landscape.

Many elements of composition and structure could be assessed as a means to understand landscape pattern. The abundance, average and range of sizes of forest openings (transitional and seedling/sapling size classes) have been identified the key ecosystem characteristics to represent landscape pattern.

Openings in the forest, such as those created after a stand-replacing disturbance, are the most distinct and easily detectable structural conditions in a forested landscape. These early successional forests are dominated by grass, forbs, shrubs, and short trees. They are meaningful to wildlife because of their distinctive composition and openness which affects the growth and survival of plants that wildlife depend on, and strong contrast to adjacent mid or late successional forest (e.g. forest “edge”). They also represent the crucial initiation point in forest successional development, the foundation upon which rests the character and pattern of the future forest. For management purposes, it is critical to understand the size of openings expected under a natural disturbance regime.

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