USDA Natural Resources
Conservation Service

Ecological site F022AF002CA
Frigid, Sandy, Or Loamy Outwash

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General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 022A–Sierra Nevada and Tehachapi Mountains

Major Land Resource Area 22A, Sierra Nevada Mountains, is located predominantly in California and a small section of western Nevada. The area lies completely within the Sierra Nevada Section of the Cascade-Sierra Mountains Province. The Sierra Nevada range has a gentle western slope, and a very abrupt eastern slope. The Sierra Nevada consists of hilly to steep mountains and occasional flatter mountain valleys. Elevation ranges between 1,500 and 9,000 ft throughout most of the range, but peaks often exceed 12,000 ft. The highest point in the continental US occurs in this MLRA (Mount Whitney, 14,494 ft). Most of the Sierra Nevada is dominated by granitic rock of the Mesozoic age, known as the Sierra Nevada Batholith. The northern half is flanked on the west by a metamorphic belt, which consists of highly metamorphosed sedimentary and volcanic rocks. Additionally, glacial activity of the Pleistocene has played a major role in shaping Sierra Nevada features, including cirques, arêtes, and glacial deposits and moraines. Average annual precipitation ranges from 20 to 80 inches in most of the area, with increases along elevational and south-north gradients. Soil temperature regime ranges from mesic, frigid, and cryic.

LRU "F" Northeast Mixed Conifer: This LRU includes the drier eastside forests of the northern Sierra Nevada that occur north of Bridgeport, the eastern, lower elevations of the Tahoe area, and the northern extent of the Sierra near Susanville, most closely corresponding to EPA ecoregion 5f. Elevations are typically between 5,000 and 8,000 feet. The frost free season is between 50 and 100 days, MAAT is between 40 and 48 degrees F, and MAP is typically between 17 and 35 inches, but may range higher in the northernmost section. This LRU exists in the rain

shadow formed by the Sierra Nevada Crest, and consequently has much lower precipitation than equivalent elevations on western slopes. Soil temperature regimes are mostly frigid, with some cryic. Soil moisture regimes are xeric.

Classification relationships

Smith, Sydney. 1994. Ecological Guide to Eastside Pine Associations. USDA Forest Service, Pacific Southwest Region. R5-ECOL-TP-004. PIPO-ABCO/PUTR-ARPA-STOC1

Forest Alliance = *Pinus jeffreyi* – Jeffrey pine forest; Association = tentatively *Pinus jeffreyi*/Arctostaphylos patula. (Sawyer, John O., Keeler-Wolf, Todd, and Evens, Julie M. 2009. A Manual of California Vegetation. 2nd ed. California Native Plant Society Press. Sacramento, California.)

Ecological site concept

This ecological site is found on gently sloping outwash, primarily on the eastern side of Lake Tahoe where precipitation is relatively low. Elevations range from 6,200 to 7,500 feet. Slopes are typically between 0 and 15 percent. Soils are very deep, and are derived from predominately granitic parent material. This exposed, dry environment with coarse soils that have low water holding capacity supports an open canopy Jeffrey pine (*Pinus jeffreyi*) forest with an open understory of low shrub cover. Greenleaf manzanita (Arctostaphylos patula), prostrate ceanothus (Ceanothus prostratus) and whitethorn ceanothus (Ceanothus cordulatus) are the most common shrubs. Coarse soils and low precipitation does not support an extensive herbaceous understory, and forbs and grasses are relatively sparse on this site.

Associated sites

F022AE007CA	**Frigid, Sandy, Moraines And Hill Slopes** Occurs on adjacent moraines and hillslopes with greater precipitation and sandy, moderately deep to very deep soils. The vegetation is white fir (Abies concolor) - Jeffrey pine (Pinus jeffreyi) forest.
F022AE013CA	**Frigid, Loamy, Volcanic Mountain Slopes** Occurs on adjacent mountain slopes with moderately deep to deep soils derived from andesite. The vegetation is a white fir (Abies concolor) - mixed conifer forest. Jeffrey pine (Pinus jeffreyi), sugar pine (Pinus lambertiana) and incense cedar (Calocedrus decurrens) are all important species.
F022AE025CA	**Loamy Moist Outwash** This site occurs on adjacent valley bottoms on outwash and on old river and lake terraces with very deep, gently sloping soils formed in alluvium. The vegetation is a mixed conifer forest of white fir (Abies concolor), Jeffery pine (Pinus jeffreyi) and sugar pine (Pinus lambertiana). The understory is diverse, and Utah serviceberry (Amelanchier utahensis) and thimbleberry (Rubus parviflorus) are common shrub species.
F022AF003CA	**Frigid, Loamy, Fragipan, Outwash** Occurs on adjacent very deep soils from outwash and alluvium from mixed sources. Soils have a weak fragipan at 12 to 65 inches. The vegetation is dense Sierra lodgepole pine (Pinus contorta var. murrayana) forest with sparse grasses in the understory.
F022AF005CA	**Frigid, Deep To Very Deep, Sandy-Loamy Mountain Slopes** Occurs on adjacent north-facing mountain slopes. Jeffrey pine (Pinus jeffreyi) and white fir (Abies concolor) co-dominate.
F022AX100CA	**Frigid, Sandy, Moist, Outwash Fan** This site occurs on gently sloping outwash with very deep, poorly drained soils formed in alluvium from glacial outwash fans. The vegetation is a Sierra lodgepole pine (Pinus contorta var. murrayana) forest with a productive understory of willows and forbs.
R022AX105CA	**Steep Mountain Drainageways** Occurs on steep mountain drainageways with very deep, frigid, sandy, aquic, alluvial soils, along Rosgen B or A type channels. A complex of community types is present. Aspen (Populus tremuloides), Lemmon's willow (Salix lemmonii) and thinleaf alder (Alnus incana spp. tenuifolia) are characteristic species.

Similar sites

F022AE025CA	**Loamy Moist Outwash** This site occurs in the "AE" LRU, which receives greater precipitation. White fir (Abies concolor) co-dominates with Jeffrey pine (Pinus jeffreyi) and the understory reflects increased soil moisture, with thimbleberry (Rubus parviflorus) and creeping snowberry (Symphoricarpos mollis) dominant species.
F022AF004CA	**Frigid, Shallow To Deep, Sandy Mountain Slopes** This site occurs on south-facing mountain slopes. This is an open forest dominated by low cover of Jeffrey pine (Pinus jeffreyi). Antelope bitterbrush (Purshia tridentata) is a dominant shrub in the understory with greenleaf manzanita (Arctostaphylos manzanita).
F022AE007CA	**Frigid, Sandy, Moraines And Hill Slopes** This site occurs in the "AE" LRU, which receives more precipitation, allowing white fir (Abies concolor) to co-dominate with Jeffrey pine (Pinus jeffreyi).
F022AF005CA	**Frigid, Deep To Very Deep, Sandy-Loamy Mountain Slopes** This site occurs on mountain slopes. The forest is composition is similar, but this site has greater potential for white fir (Abies concolor) and incense cedar (Calocedrus decurrens).
F022AF006CA	**Loamy Frigid Metamorphic Slopes** This site occurs on mountain slopes developed from metamorphic soils. White fir (Abies concolor) co-dominates with Jeffrey pine (Pinus jeffreyi), and the understory composition reflects greater soil moisture holding capacity, with creeping snowberry (Symphoricarpos mollis) and wax currant (Ribes cereum)dominant species.

Table 1. Dominant plant species

Tree	(1) *Pinus jeffreyi*
Shrub	(1) *Arctostaphylos patula* (2) *Ceanothus prostratus*
Herbaceous	(1) *Pedicularis semibarbata* (2) *Kelloggia galioides*

Physiographic features

This ecological site is on hillslopes on outwash terraces on slopes ranging from 0 to 30 percent, but typically below 15 percent, and at elevations ranging from 6,220 to 7,460 feet. It is found on all aspects, but is generally oriented on northwest to southwest facing aspects. Runoff class is very low to medium.

Table 2. Representative physiographic features

Landforms	(1) Outwash terrace (2) Hill
Flooding frequency	None
Ponding frequency	None
Elevation	6,220–7,460 ft
Slope	0–30%
Ponding depth	0 in
Water table depth	0 in

Climatic features

The average annual precipitation ranges from 19 to 43 inches, mostly in the form of snow in winter (November through April). The average annual air temperature ranges from 41 to 46 degrees Fahrenheit. The frost-free (>32F) season is 40 to 110 days and the freeze-free (>28F) season is 70 to 160 days.

Table 3. Representative climatic features

Frost-free period (average)	75 days

Freeze-free period (average)	115 days
Precipitation total (average)	31 in

Influencing water features

This ecological site is not influenced by wetland or riparian water features.

Soil features

The soils associated with this ecological site are very deep, and formed in glacial outwash and alluvium from predominately granitic parent materials. They are well to somewhat excessively drained with moderately rapid to rapid permeability. The soil moisture regime is typic xeric and the soil temperature regime is frigid. Surface rock fragments are generally not present. Surface textures are loamy coarse sand, gravelly loamy coarse sand, gravelly coarse sandy loam and coarse sandy loam. Partially decomposed litter (Oi horizon) overlies the mineral surface horizons. Subsurface textures include loamy coarse sand, gravelly, very gravelly, and extremely gravelly loamy coarse sand, gravelly coarse sand, extremely cobbly sandy loam, gravelly coarse sandy loam, and stratified fine sandy loam silty clay. Subsurface rock fragments smaller than 3 inches in diameter range from 0 to 53 percent by volume, and larger fragments range from 0 to 30 percent (for a depth of 0 to 56 inches). The soils correlated to this site include Christopher (Mixed, frigid Dystric Xeropsamments), Gefo (Sandy, mixed, frigid Humic Dystroxerepts), Inville (Loamy-skeletal, isotic, frigid Ultic Haploxeralfs), and Jabu (Coarse-loamy, mixed, superactive, frigid Ultic Haploxeralfs).

This ecological site has been correlated with the following mapunits and soil components in the Tahoe Basin soil survey area (CA693):

Musym ; MUname ; Compname ; Local_phase ; Comp_pct
7141 ; Inville gravelly coarse sandy loam, 2 to 9 percent slopes, stony ; Inville ; ; 80; Christopher ; Loamy coarse sand ; 10
7142 ; Inville gravelly coarse sandy loam, 9 to 15 percent slopes, stony ; Inville ; ; 80; Christopher ; Gravelly Loamy Coarse Sand ; 4
7143 ; Inville gravelly coarse sandy loam, 15 to 30 percent slopes, stony ; Inville ; ; 80; Christopher ; Gravelly Loamy Coarse Sand ; 4
7441 ; Christopher loamy coarse sand, 0 to 9 percent slopes ; Christopher ; Loamy coarse sand ; 80; Gefo ; gravelly loamy coarse sand ; 10; Jabu ; ; 5
7442 ; Christopher loamy coarse sand, 9 to 30 percent slopes ; Christopher ; Loamy coarse sand ; 80; Gefo ; gravelly loamy coarse sand ; 10; Jabu ; ; 5
7443 ; Christopher gravelly loamy coarse sand, 9 to 30 percent slopes ; Christopher ; Gravelly Loamy Coarse Sand ; 80; Gefo ; gravelly loamy coarse sand ; 10; Jabu ; ; 5
7461 ; Jabu coarse sandy loam, 0 to 9 percent slopes ; Jabu ; ; 80; Christopher ; Loamy coarse sand ; 10; Gefo ; gravelly loamy coarse sand ; 3
7462 ; Jabu coarse sandy loam, 9 to 30 percent slopes ; Jabu ; ; 80; Christopher ; Loamy coarse sand ; 10; Gefo ; gravelly loamy coarse sand ; 3
7444 ; Christopher-Gefo complex, 0 to 5 percent slopes ; Christopher ; Loamy coarse sand ; 45; Gefo ; gravelly loamy coarse sand ; 35; Jabu ; ; 5
7451 ; Gefo gravelly loamy coarse sand, 2 to 9 percent slopes ; Gefo ; gravelly loamy coarse sand ; 80; Christopher ; Loamy coarse sand ; 10; Jabu ; ; 5
7452 ; Gefo gravelly loamy coarse sand, 9 to 30 percent slopes ; Gefo ; gravelly loamy coarse sand ; 80; Christopher ; Loamy coarse sand ; 10; Jabu ; ; 5
7491 ; Oneidas coarse sandy loam, 0 to 5 percent slopes ; ; Jabu ; ; 10 ; Christopher ; Loamy coarse sand ; 3; Gefo ; gravelly loamy coarse sand ; 2
7492 ; Oneidas coarse sandy loam, 5 to 15 percent slopes ; ; Jabu ; ; 10 ; Christopher ; Loamy coarse sand ; 3; Gefo ; gravelly loamy coarse sand ; 2
7011 ; Beaches ; Gefo ; Barrier beach ; 6
7156 ; Jorge-Tahoma complex, 15 to 30 percent slopes ; Inville ; ; 5
7157 ; Jorge-Tahoma complex, 30 to 50 percent slopes ; Inville ; ; 5
7541 ; Ubaj sandy loam, 0 to 9 percent slopes ; Christopher ; Loamy coarse sand ; 5; Gefo ; gravelly loamy coarse

sand ; 3
7222 ; Tahoma-Jorge complex, 2 to 15 percent slopes ; Inville ; ; 5
7483 ; Meeks gravelly loamy coarse sand, 0 to 5 percent slopes, very stony ; Jabu ; ; 5
7481 ; Meeks gravelly loamy coarse sand, 0 to 5 percent slopes, stony ; Gefo ; gravelly loamy coarse sand ; 4
7471 ; Marla loamy coarse sand, 0 to 5 percent slopes ; Christopher ; Loamy coarse sand ; 4; Gefo ; gravelly loamy coarse sand ; 4
7221 ; Tahoma very cobbly sandy loam, 2 to 15 percent slopes, very stony ; Inville ; ; 4
7423 ; Cassenai gravelly loamy coarse sand, 30 to 50 percent slopes, very stony ; Christopher ; Gravelly Loamy Coarse Sand ; 2
7422 ; Cassenai gravelly loamy coarse sand, 15 to 30 percent slopes, very stony ; Christopher ; Gravelly Loamy Coarse Sand ; 2
7421 ; Cassenai gravelly loamy coarse sand, 5 to 15 percent slopes, very stony ; Christopher ; Loamy coarse sand ; 1; Christopher ; Gravelly Loamy Coarse Sand ; 1
7484 ; Meeks gravelly loamy coarse sand, 5 to 15 percent slopes, extremely bouldery ; Jabu ; ; 1
7485 ; Meeks gravelly loamy coarse sand, 15 to 30 percent slopes, extremenly bouldery ; Jabu ; ; 1
7486 ; Meeks gravelly loamy coarse sand, 30 to 70 percent slopes, extremely bouldery ; Jabu ; ; 1

Table 4. Representative soil features

Parent material	(1) Outwash–granodiorite
Surface texture	(1) Loamy coarse sand (2) Gravelly coarse sandy loam (3) Coarse sandy loam
Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	1.7–5.7 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	5.1–6.5
Subsurface fragment volume <=3" (Depth not specified)	0–53%
Subsurface fragment volume >3" (Depth not specified)	0–30%

Ecological dynamics

Abiotic Factors
This ecological site is found on gentle slopes formed from glacial outwash, primarily along the south to south-east shore of Lake Tahoe, which receives the lowest precipitation in the Lake Tahoe Basin. Soils very deep with coarse textures and low available water capacity. These dry environmental conditions tend to support Jeffrey pine (*Pinus jeffreyi*) over other conifer species (Vasek 1978, Burns and Honkala 1990, Gray et al. 2005, North et al. 2005). The droughty, nutrient poor soils of this site do not support an extensive herbaceous community, and grasses and forbs are of low importance on this site.

Ecological factors
Fire, fire suppression, logging, drought and insect pathogens are the primary disturbance factors affecting the dynamics of this ecological site. Pre-European settlement, the most successionally advanced community phase was composed of large, old growth Jeffrey pine with a multiple age class distribution, with an open canopy allowing for the growth of patchy shrubs in the understory (Beardsley et al. 1999, Murphy and Knopp 2000, Barbour et al. 2002, Taylor 2004, Stephens and Fry 2005). Historically, this community phase developed with patchy, frequent, low intensity surface fires that occurred primarily in the fall when fuel moisture was lowest and trees were dormant (Taylor 2004, North et al. 2005). Fire scar analysis indicates the average historic fire return interval was approximately 11 years for this community (Taylor, 2004), with a range from 5 to 39 years (Murphy, 2000; Skinner, 1996; Stephens, 2002}. These frequent patchily distributed fires kept the understory open and clear of shade-tolerant and fire-intolerant white fir (*Abies concolor*) and red fir (*Abies magnifica*), while providing bare mineral soil and canopy openings necessary for Jeffrey pine recruitment, and maintaining a multiple age-class forest structure. Frequent fire would have limited abundant shrub cover and the accumulation of litter, thus reducing the occurrence of high severity, stand-clearing fire, although such fires did infrequently occur.

This pre-settlement phase is rare due to either fire suppression or clear-cutting. This ecological site was almost entirely clear-cut during the 1870s to 1890s during the period known as the Comstock Era (Elliot-Fisk et al. 1996, Murphy and Knopp 2000, Barbour et al. 2002, Taylor 2004), and forests that have developed since have higher density and basal area, and are comprised of younger and smaller trees with a more even age-class distribution, with all canopy trees 80 to 120 years old (Taylor 2004, Stephens and Fry 2005). A long-term policy of fire suppression has impacted these second-growth forests, as well as the few contemporary stands of old-growth forest (Barbour et al. 2002, Stephens and Fry 2005). White and red fir are more important in the understory, and provide ladder fuels that increase the likelihood of large high severity fire.

Contemporary forests, with more crowded conditions and a higher frequency of drought (e.g. Jones et al. 2004) are more susceptible to pathogen induced mortality (Barbour et al. 2002). Jeffrey pine bark beetle (Dedroctonus jeffreyi), is the most significant disease agent for Jeffrey pine. Fire damage increases the likelihood of bark beetle infestation and mortality (Bradley and Tueller 2001, Fettig et al. 2010). Drought also increases the likelihood of mortality. Barbour et al. (2002) found that most of the mortality of old-growth Jeffrey pine in the Lake Tahoe Basin was due to severe drought from 1988-1992, and all dead trees were infected by bark beetle. Nitrogen deposition and ozone pollution have been shown to contribute to Jeffrey pine susceptibility to pathogens and mortality in Southern California (e.g. Peterson et al. 1987), but equivalent studies have not been done in the northern Sierra.

The reference state consists of the pre-settlement, most successionally advanced community phase (numbered 1.1), and the community phases that result from natural and human disturbances. Community phase 1.1 is deemed the phase representative of the most successionally advanced pre-European plant/animal community including periodic natural surface fires that influenced its composition and production. Because this phase is determined from reconstruction of stumps (Taylor 2004), comparison of modern day remnant forests to equivalent old-growth forest in Baja that has never been subject to fire suppression (Barbour et al. 2002, Stephens and Fry 2005), and/or historic literature, some speculation is necessarily involved in describing it.

All tabular data listed for a specific community phase within this ecological site description represent a summary of one or more field data collection plots taken in modal communities within the community phase. Although such data are valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase overstory and understory species, production and composition, and growth), they do not represent the absolute range of characteristics or an exhaustive listing of all species that may occur in that phase over the geographic range of the ecological site.

State and transition model

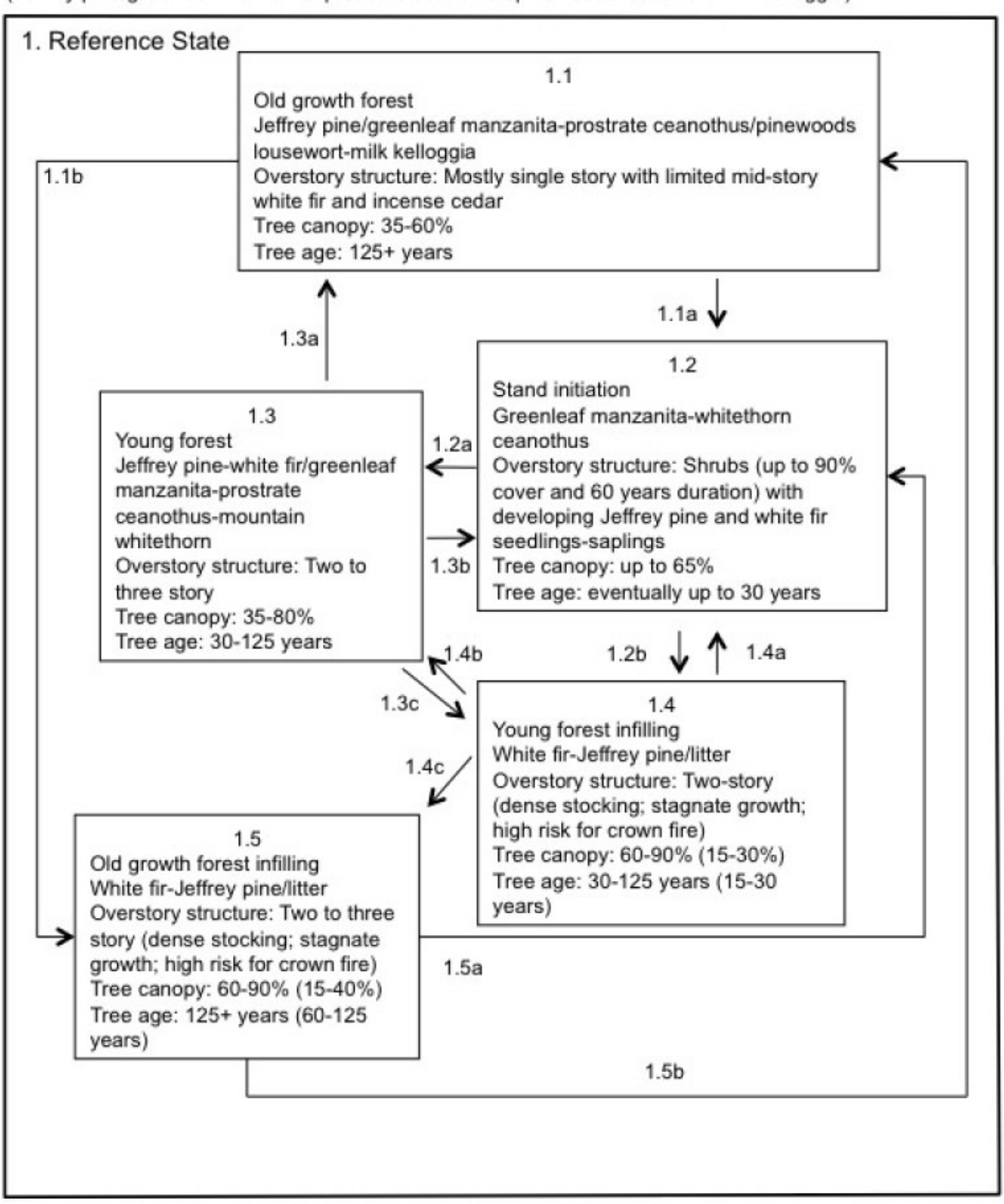

Figure 6. F022AF002CA

State 1
Reference

Community 1.1
Old-growth forest

This community phase represents the most successionally advanced community for this ecological site and is characterized by an open forest of Jeffrey pine. White fir and incense cedar are common associates, with a moderate cover of shrubs and forbs in the understory. The forest canopy cover is less than 60 percent and shrubs cover is approximately 30 percent. The most common shrubs are greenleaf manzanita, prostrate ceanothus, and antelope bitterbrush. Common grasses and forbs likely included lupine (Lupinus spp.), buckwheat (Eriogonum spp.) and phlox (Beardsley et al. 1999). This community phase is maintained by low and moderate intensity fires that remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires kill some of the overstory trees, leaving canopy openings that are favorable for Jeffrey pine regeneration. Moderate intensity fires break the uniformity of older forest stands with pockets of intermixed younger forests. Because the reference phase was largely either clear-cut during the Comstock era or impacted by fire suppression, plot data representing this phase are not available.

Community 1.2
Stand initiation

This shrubland community phase thrives in openings created by large high-severity fire that burns the forest canopy and kills the majority of overstory trees, or when canopy trees are removed by clear-cutting. Remnant overstory trees that escaped fire or logging may be present in limited numbers. Fire dependent shrubs such as greenleaf manzanita, huckleberry oak, mountain whitethorn, and prostrate ceanothus resprout and germinate from seed vigorously after a fire. Greenleaf manzanita vigorously resprouts from underground lignotubers, and regenerates from heat scarified seeds that may survive in the soil for more than 400 years (Nagal and Taylor 2005, Hauser 2007). Huckleberry oak is a fire-adapted species that is highly flammable and vigorously resprouts from the root crown after fire (Howard 1992, Nagal and Taylor 2005, Odion et al. 2009). Mountain whitethorn is an obligate resprouter after low to medium intensity fire, and seeds require heat for germination (Reeves 2006). Prostrate ceanothus recruits from long-lived seed that is stimulated by fire, and forms large mats that stabilize soils and fix nitrogen, enhancing soils for colonization by other species (Skau et al. 1970, Brown et al. 1971). With rapid regeneration of fire-adapted shrubs, shrubs may dominate in 7 to 9 years (Risser and Fry 1988). Scattered Jeffrey pine and white fir seedlings sprout but may take 50 to 60 years to dominate over the shrubland community phase (Smith 1994, Azuma et al. 2004). Perennial bunchgrasses and some forbs cover small portions of the area. The size and the intensity of a burn may influence the shrub expression. Shrubs have been associated with large burn size, whereas trees were not able to establish across the landscape (Royce and Barbour 2001). The intensity of burn may affect the scarification of seeds. Shrubs can prevail in areas prone to frequent fire, such as ridges and wind tunnels. Greenleaf manzanita is a strong competitor for water. It continues to deplete water after conifer species have gone dormant for the drought season. This competition for water and sunlight between the shrubs and conifer seedlings can delay the establishment of a forest (Royce and Barbour 2001). Surviving overstory trees are a valuable source of seed for tree regeneration. Seeds are dispersed downwind at approximately twice the height of the source tree, possibly farther under windy conditions. Jeffrey pine seed is also cached by squirrels and chipmunks, which aid in dispersing the seed. Studies have shown that Jeffrey pine seed germination and seedling survival is greater for cached seeds that have been buried in soil rather than for wind blown seeds deposited on the surface. Jeffrey pine seedlings prefer open sunlight and bare soil for germination and development. While white fir may be present at this time, however it is more likely to come in later under the shade of Jeffrey pine. Jeffery pine and white fir seedlings may take 50 to 60 years to dominate over the shrubland community (Azuma et al. 2004, Smith 1994). The shrub community can be perpetuated by frequent fire or other disturbances such as grazing, human intervention, or heavy foot traffic.

Forest overstory. Scattered remnants of overstory Jeffrey pine and white fir may be present.

Forest understory. Greenleaf manzanita (Arctostaphylos patula), mountain whitethorn (Ceanothus cordulatus) and huckleberry oak (Quercus vacciniifolia) have high cover after a fire or manual treatment projects.

Table 5. Ground cover

Tree foliar cover	1-20%
Shrub/vine/liana foliar cover	20-80%

Grass/grasslike foliar cover	0-5%
Forb foliar cover	0-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 6. Soil surface cover

Tree basal cover	0-2%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-1%
Non-vascular plants	0%
Biological crusts	0%
Litter	15-90%
Surface fragments >0.25" and <=3"	10-30%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	1-15%

Table 7. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-1%	0-10%	0-5%	0-5%
>0.5 <= 1	0-1%	0-10%	0-5%	0-10%
>1 <= 2	0-1%	5-50%	0-5%	0-10%
>2 <= 4.5	1-20%	20-80%	–	–
>4.5 <= 13	1-20%	–	–	–
>13 <= 40	1-10%	–	–	–
>40 <= 80	0-5%	–	–	–
>80 <= 120	0-5%	–	–	–
>120	0-5%	–	–	–

Community 1.3
Young forest

Figure 7. Community Phase 1.3

This community phase is currently the most common expression of this ecological site. It is a heavily managed forest with manual thinning and prescribed burns helping to remove the white fir component and maintain the dominance of Jeffrey pine. The removal of the understory creates a more open forest with less competition between trees. The manual thinning and prescribed burns can replace and emulate the natural fire regime.

Forest overstory. Jeffrey pine is dominant in the overstory with a range in cover from 35 to 80 percent, with an average of 65 percent. White fir is often found in small percentages in the understory and mid-canopy. White fir does not seem to prefer this zone; the soils may be too droughty. Lodgepole pine (Pinus contorta ssp. murrayana) is also found in positions of greater available soil moisture (duration, frequency or amount of soil moisture).

Forest understory. The understory cover and diversity increases as the overstory canopy decreases. Mountain whitethorn, prostrate ceanothus, and greenleaf manzanita are common shrubs that average 10 percent combined cover. Herbaceous cover is low, averaging 3 percent. Pinewoods lousewort (Pedicularis semibarbata), milk kelloggia (Kelloggia galioides), and lettuce wirelettuce (Stephanomeria lactucina) are often present. Squirreltail (Elymus elymoides) and western needlegrass (Achnatherum occidentale) are common graminoids but of limited extent.

Table 8. Ground cover

Tree foliar cover	25-85%
Shrub/vine/liana foliar cover	3-20%
Grass/grasslike foliar cover	1-10%
Forb foliar cover	1-25%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 9. Soil surface cover

Tree basal cover	3-5%
Shrub/vine/liana basal cover	1-2%
Grass/grasslike basal cover	0-1%

Forb basal cover	0-1%
Non-vascular plants	0%
Biological crusts	0%
Litter	60-90%
Surface fragments >0.25" and <=3"	1-15%
Surface fragments >3"	0-2%
Bedrock	0%
Water	0%
Bare ground	1-15%

Table 10. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-3%	1-10%	1-5%	1-5%
>0.5 <= 1	0-3%	1-10%	1-10%	1-5%
>1 <= 2	0-3%	1-20%	1-5%	1-5%
>2 <= 4.5	1-5%	1-20%	–	–
>4.5 <= 13	1-10%	–	–	–
>13 <= 40	15-50%	–	–	–
>40 <= 80	25-80%	–	–	–
>80 <= 120	25-80%	–	–	–
>120	–	–	–	–

Community 1.4
Young forest infilling

This community phase is defined by a dense multiple-layer canopy and high basal area of predominantly white fir. Canopy cover ranges from 60 to 90 percent. The trees are often overcrowded and stressed due to the competition for water and nutrients, which makes them more susceptible to death from pests and drought. Fire hazard is high in this community due to the deep accumulation of litter, the standing dead and down trees, and dense multi-layered structure of the forest (which creates ladder-fuels).

Forest overstory. White fir dominates this forest with a dense canopy and multiple tree layers. Jeffrey pine is a common associate, while Sierra lodgepole pine and incense cedar are occasionally present with low cover.

Forest understory. The understory is barren under the dense canopy of white fir. However, shade-tolerant white fir and incense cedar are present as regeneration.

Community 1.5
Old-growth forest infilling

Figure 8. Community Phase 1.5

This community phase is defined by a dense multiple-layer canopy and high basal area of older white fir. Canopy cover ranges from 60 to 90 percent. The trees are overcrowded and often diseased and stressed due to the competition for water and nutrients. Fire hazard is high in this community due to the deep accumulation of litter, the standing dead and down trees, and dense multi-layered structure of the forest.

Forest overstory. White fir dominates this forest with a dense canopy and multiple tree layers. Jeffrey pine is a common associate, while lodgepole pine and incense cedar are occasionally present with low cover.

Forest understory. The understory is sparse under the dense canopy of white fir. However, shade-tolerant white fir and incense cedar seedlings and saplings are present.

Table 11. Ground cover

Tree foliar cover	25-95%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0-10%
Forb foliar cover	0-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 12. Soil surface cover

Tree basal cover	3-8%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-2%
Non-vascular plants	0%
Biological crusts	0%
Litter	60-95%
Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	0-5%

Table 13. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	0-5%	0-5%	0-10%	0-10%
>0.5 <= 1	0-5%	0-10%	0-10%	0-10%
>1 <= 2	0-5%	0-10%	0-2%	0-5%
>2 <= 4.5	0-10%	0-5%	–	–
>4.5 <= 13	1-15%	–	–	–
>13 <= 40	25-60%	–	–	–
>40 <= 80	25-60%	–	–	–
>80 <= 120	25-60%	–	–	–
>120	0-25%	–	–	–

Pathway 1.1a
Community 1.1 to 1.2

In the event of a severe canopy fire, or a clear-cut and a prescribed burn this community phase would move to the stand initiation phase,1.2.

Pathway 1.1b
Community 1.1 to 1.5

If fire is excluded from the old growth community phase, tree density will continue to increase, shifting this community towards the closed white fir-mixed conifer community phase 1.5.

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to community phase 1.3. This pathway is maintained with a natural fire regime. Reports vary on the natural fire return interval, but this pathway assumes that surface fires were relatively frequent from 5 to 18 years. Manual thinning with prescribed burns can emulate the natural cycle and lead to the same open community phase.

Pathway 1.2b
Community 1.2 to 1.4

An alternate pathway is created when fire is excluded from the system, and leads to forest infilling, community phase 1.4.

Pathway 1.3a
Community 1.3 to 1.1

This is the natural pathway for this community phase, which evolved with a historic fire regime of relatively frequent surface and moderate severity fires, and partial tree mortality from pest outbreaks. Manual thinning or prescribed burning can be implemented to replace the natural disturbances that keep this forest open. This pathway leads to community phase 1.1.

Pathway 1.3b
Community 1.3 to 1.2

In the event of a canopy fire this community would move quickly to community phase 1.2.

Pathway 1.3c
Community 1.3 to 1.4

If fire does not occur, the density of the forest increases, favoring infill of white fir and incense cedar. The increased density shifts this community phase to the young forest infilling community phase, 1.4.

Pathway 1.4a
Community 1.4 to 1.2

Fire hazard is high and a severe crown fire would quickly shift the community phase to community phase 1.2.

Pathway 1.4b
Community 1.4 to 1.3

The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest if it had developed with fire over time. Manual treatment to thin out the understory trees and fuels or prescribed burns could be implemented to shift this forest to community phase 1.3. A partial mortality pest infestation could also create a shift towards phase 1.3.

Pathway 1.4c
Community 1.4 to 1.5

Continued absence of fire would progress the community phase to older and older ages (community phase 1.5) with some additional infill of white fir and some incense cedar.

Pathway 1.5b
Community 1.5 to 1.1

The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels. Considerable and repeated management efforts would be needed to create the open forest conditions that should exist in this forest if it had developed with fire over time. Manual treatment to thin out the understory trees and fuels and/or prescribed burns could be implemented to shift this forest toward community phase 1.1 provided enough Jeffrey pine was present in the overstory. A partial mortality disease or pest infestation could also create a shift towards community phase 1.1 provided enough overstory Jeffrey pine was present.

Pathway 1.5a

Community 1.5 to 1.2

Fire hazard is high and a severe crown fire would quickly shift this community phase to community phase 1.2.

Additional community tables

Table 14. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–7	–	–
white fir	ABCO	*Abies concolor*	Native	–	0–2	–	–

Table 15. Community 1.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Shrub/Subshrub					
greenleaf manzanita	ARPA6	*Arctostaphylos patula*	Native	–	10–40
whitethorn ceanothus	CECO	*Ceanothus cordulatus*	Native	–	10–40
huckleberry oak	QUVA	*Quercus vacciniifolia*	Native	–	5–25
Tree					
white fir	ABCO	*Abies concolor*	Native	–	3–7
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	3–7

Table 16. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	35–80	–	–
white fir	ABCO	*Abies concolor*	Native	–	2–5	–	–
lodgepole pine	PICO	*Pinus contorta*	Native	–	0–2	–	–

Table 17. Community 1.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
sedge	CAREX	*Carex*	Native	–	1–3
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–2
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–1
Forb/Herb					
milk kelloggia	KEGA	*Kelloggia galioides*	Native	–	0–1
pinewoods lousewort	PESE2	*Pedicularis semibarbata*	Native	–	0–1
lambstongue ragwort	SEIN2	*Senecio integerrimus*	Native	–	0–1
Lemmon's catchfly	SILE2	*Silene lemmonii*	Native	–	0–1
lettuce wirelettuce	STLA	*Stephanomeria lactucina*	Native	–	0–1
Holboell's rockcress	ARHO2	*Arabis holboellii*	Native	–	0–0.5
Shrub/Subshrub					
greenleaf manzanita	ARPA6	*Arctostaphylos patula*	Native	–	4–8
whitethorn ceanothus	CECO	*Ceanothus cordulatus*	Native	–	2–6
prostrate ceanothus	CEPR	*Ceanothus prostratus*	Native	–	2–6
creeping snowberry	SYMO	*Symphoricarpos mollis*	Native	–	0–1
currant	RIBES	*Ribes*	Native	–	0–1
Tree					
white fir	ABCO	*Abies concolor*	Native	–	2–4

Table 18. Community 1.5 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
white fir	ABCO	*Abies concolor*	Native	–	50–80	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	20–35	–	–
incense cedar	CADE27	*Calocedrus decurrens*	Native	–	0–2	–	–
lodgepole pine	PICO	*Pinus contorta*	Native	–	0–2	–	–

Table 19. Community 1.5 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–1
needlegrass	ACHNA	*Achnatherum*	Native	–	0–1
Forb/Herb					
milk kelloggia	KEGA	*Kelloggia galioides*	Native	–	0–1
lambstongue ragwort	SEIN2	*Senecio integerrimus*	Native	–	0–0.5
spreading dogbane	APAN2	*Apocynum androsaemifolium*	Native	–	0–0.5
Shrub/Subshrub					
creeping snowberry	SYMO	*Symphoricarpos mollis*	Native	–	0–0.5
Tree					
incense cedar	CADE27	*Calocedrus decurrens*	Native	–	1–2
white fir	ABCO	*Abies concolor*	Native	–	1–2

Animal community

This forest provides food and shelter for squirrel, deer, bear, and many species of bird. The Jeffrey pine seeds are eaten by birds, and the roots and young stems are eaten by small mammals. The standing dead and downed trees provide habitat for nesting birds and shelter for cavity dwellers (Habeck, 1992).

Hydrological functions

The hydrology of this site is characterized by heavy snowmelt in the spring, with very little precipitation in the summer months.

Recreational uses

This ecological site is found in gently sloping areas near Lake Tahoe. It is often developed, but also provides suitable camping and picnicking areas. Trails for walking, biking and cross-country skiing trails are found along the lake and throughout the developed areas.

Wood products

Jeffrey pine and white fir provide many different timber products. Thinning projects would increase the health of the forest, reduce extreme fire hazards, and maintain the natural dominance of Jeffrey pine.

Other products

The Jeffrey pine cones are suitable for arts and craft stores, and the thin layer of pine needles could be a source of litter and duff for environmental restoration projects.

Other information

Forest Site Productivity:

Schumacher (1926) and Meyer (1961) were used to determine forest site productivity for white fir and Jeffrey pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will

greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phases 1.3 and 1.4. They are selected according to guidance listed in the site index publications. Please refer to the Tahoe Basin Soil Survey for detailed site index information by soil component.

Forest pathogen information:
Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. The most threatening of these are the dwarf mistletoe (Arceuthobium abietinum f. sp. Concoloris) and the Jeffrey pine bark beetle (Dedroctonus jeffreyi) (Murphy and Knopp, 2000; USDA, 2003). Other pathogens that affect Jeffrey pine in this area include: root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), red turpentine beetle (D. valens) and pine engraver beetles (Ips species).

Pathogens and insects infestations can also affect the white fir in the Lake Tahoe Basin. The most threatening of these is the combination of the fir engraver beetle (Scotylus ventralis) and annosus root disease (Heterobasidium annosum), which can kill large areas of white fir. (Murphy and Knopp, 2000, USDA, 2003). Other pathogens that affect white fir include: dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), broom rust (Melamsporlla caryophyllacearum) and trunk rot (Echinodontium tinctorium).

Table 20. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
Jeffrey pine	*PIJE*	80	90	69	85	40	600	–	
white fir	*ABCO*	30	35	51	57	70	030	–	

Inventory data references

The following NRCS plots were used to describe this ecological site:

MxF04214
MxF04217
Ra04222
UmF04057
UmF04205
UmF04215
UmF04216
UmF04221
WaE04102
Wae041022013

Type locality

Location 1: El Dorado County, CA	
UTM zone	N
UTM northing	4306934
UTM easting	0240368
General legal description	Plot is on USFS property near Elks Club Drive, South Lake Tahoe.

Other references

Azuma, D.L., J. Donnegan,D. Gedney. 2004. Southwest Oregon Biscuit Fire: An alalysis of Forest Resources and Fire Severity. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Research Paper PNW-RP-560.

Barbour, M., E. Kelly, P. Maloney, D. Rizzo, E. Royce, and J. Fites-Kaufmann. 2002. Present and past old-growth

forests of the Lake Tahoe Basin, Sierra Nevada, US. Journal of Vegetation Science 13:461-472.

Beardsley, D., C. Bolsinger, and R. Warbington. 1999. Old-growth forest in the Sierra Nevada: By type in 1945 and 1993 and ownership in 1999. PNW-RP-516, USDA Forest Service, Pacific Northwest Research Station.

Bradley, T. and P. Tueller. 2001. Effects of fire on bark beetle presence on Jeffrey pine in the Lake Tahoe Basin. Forest Ecology and Management 142:205-214.

Brown, R. W., R. H. R. Jr., and E. E. Farmer. 1971. Suitability of Ceanothus prostratus Benth. for the revegetation of harsh sites. U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Burns, R. M. and B. H. Honkala. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. U.S Department of Agriculture, Forest Service, Washington, DC.

Elliot-Fisk, D. L., R. Harris, R. A. Rowntree, T. C. Cahill, R. Kattelmann, P. Rucks, O. K. Davis, R. Lacey, D. A. Sharkey, L. Duan, D. Leisz, S. L. Stephens, C. R. Goldman, S. Lindstrom, D. S. Ziegler, G. E. Gruell, and D. Machida. 1996. Lake Tahoe Case Study. Pages 217-276 Sierra Nevada Ecosystem Project. University of California, Centers for Water adn Wildland Resources, Davis, CA.

Fettig, C. J., S. R. McKelvey, D. R. Cluck, S. L. Smith, and W. J. Otrosina. 2010. Effects of prescribed fire and season of burn on direct and indirect levels of tree mortality in Ponderosa and Jeffrey Pine forests in California, USA. Forest Ecology and Management 260:207-218.

Gray, A. N., H. S. Zald, R. A. Kern, and M. North. 2005. Stand conditions associated with tree regeneration in Sierran mixed-conifer forests. Forest Science 51:198-210.

Hauser, A. S. 2007. Arctostaphylos patula. Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.

Howard, J. L. 1992. Quercus vaccinifolia. Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.

Jones, M. E., T. D. Paine, M. E. Fenn, and M. A. Poth. 2004. Influence of ozone and nitrogen deposition on bark beetle activity under drought conditions. Forest Ecology and Management 200:67-76.

Murphy, D. D. and C. M. Knopp. 2000. Lake Tahoe Basin Watershed Assessment. PSW-GTR-175, USDA Forest Service, Pacific Southwest Research Station.

Nagal, T. A. and A. H. Taylor. 2005. Fire and persistence of montane chaparral in mixed conifer forest landscapes in the northern Sierra Nevada, Lake Tahoe Basin, California, USA. Journal of the Torrey Botanical Society 132:442-457.

North, M., M. Hurteau, R. Fiegener, and M. Barbour. 2005. Influence of fire and El Nino on tree recruitment varies by species in Sierran Mixed Conifer. Forest Science 51:187-197.

Odion, D. C., M. A. Moritz, and D. A. DellSala. 2009. Alternative community states maintained by fire in the Klamath Mountains, USA. Journal of Ecology 98:96-105.

Peterson, D. L., M. J. Arbaugh, V. A. Wakefield, and P. R. Miller. 1987. Evidence of growth reduction in Ozone-injured Jeffrey pine (*Pinus jeffreyi* Grev. and Balf.) in Sequioa and Kings Canyon National Parks. JAPCA 37:906-912.

Reeves, S. L. 2006. Ceanothus cordulatus. Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.

Risser, R. J. and M. E. Fry. 1988. Montane chaparral. California wildlife habitat relationships system., California Department of Fish and Game. California Interagency Wildlife Task Group.

Royce, E. B. and Barbour, M.G. 2001. Mediterranean Climate Effects. II. Conifer Growth Phenology Across a Sierra Nevada Ecotone. American Journal of Botany 88: 919–932.

Skau, C. M., R. O. Meeuwig, and T. W. Townsend. 1970. Ecology of eastside Sierra chaparral, a literature review. Max C. Fleischmann College of Agriculture, University of Nevada Reno, Reno, NV.

Skinner, C. N. and C.-R. Chang. 1996. Fire regimes, past and present. Pages 1041-1069 Status of the Sierra Nevada. Sierra Nevada Ecosystems Project: Final report to Congress. . University of California, Centers for Water and Wildland Resources, Davis, CA.

Smith, S. 1994. Ecological guide to eastside pine associations. USDA Forest Service, Pacific Southwest Region, R5-ECOL-TP-004.

Stephens, S. L. and D. L. Fry. 2005. Spatial distribution of regeneration patches in an old-growth Pinus jeffrey-mixed conifer forest in northwestern Mexico. Journal of Vegetation Science 16:693-702.

Taylor, E. H. 2004. Identifying forest reference conditions on early cut-over lands, Lake Tahoe Basin, USA. Ecological Applications 14:1903-1920.

Vasek, F. C. 1978. Jeffrey pine [*Pinus jeffreyi*] and vegetation of the southern Modoc National Forest [California]. Madroño 25:9-30.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

---

6. **Extent of wind scoured, blowouts and/or depositional areas:**

---

7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

---

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

---

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**