USDA Natural Resources Conservation Service

Ecological site F022AC006CA
Moderately Deep Cryic Sandy Till

Accessed: 05/11/2025

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

MLRA 22A
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. Due to the extreme elevational range found within this MLRA, Land Resource Units (LRUs) were designated to group the MLRA into similar land units.

LRU "C" Northern Sierra Subalpine: Elevations are typically between 7,800 and 9,800 feet. The frost free period is between 30 and 90 days, MAAT is between 35 and 44 degrees, MAP is between 45 and 65 inches. Soils are typically cryic, but frigid soils may occur at lower elevations on southern aspects. Forests are dominated by whitebark pine (Pinus albicaulis), Sierra lodgepole pine (*Pinus contorta* spp. murrayana), mountain hemlock (Tsuga mertensiana) and/or California red fir (*Abies magnifica*).

Classification relationships

Forest Alliance = *Pinus contorta* ssp. murrayana – Lodgepole pine forest; Association = tentatively *Pinus contorta* ssp. murrayana. (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 site occurs on gently to steep subalpine, south-facing mountain slopes at elevations typically between 7,600 and 9,000 feet. Slopes are typically between 9 and 30 percent. Soils are derived from volcanic parent material, and are moderately deep over dense glacial till. This dense layer inhibits roots and water movement, which favors dominance by Sierra lodgepole pine (*Pinus contorta* var. murrayana), which is shallow-rooted and tolerant of saturated soils. The vegetation is relatively open, as the root-restrictive layer limits forest density. California red fir (*Abies magnifica*) and western white pine (*Pinus monticola*) are important secondary species. Moist soils support a productive understory, which is dominated by greenleaf fescue (*Festuca viridula*) and lupines (Lupinus sp.).

Associated sites

F022AC007CA	**North-Facing Cryic Loamy Mountain Slopes** This site occurs on adjacent north-facing slopes with moderately deep, andic soils. Vegetation is subalpine mixed conifer forest with mountain hemlock (Tsuga mertensiana), red fir (Abies magnifica), western white pine (Pinus monticola), and lodgepole pine (Pinus contorta var. murrayana). Understory density and composition is variable with site moisture, but purple mountainheath (Phyllodoce breweri) and rose meadowsweet (Spiraea splendens) are common.
F022AE007CA	**Frigid, Sandy, Moraines And Hill Slopes** Occurs at lower elevations on moraines and hillslopes with moderately deep to very deep soils derived from glacial outwash and till. Vegetation is a dense Jeffrey pine (Pinus jeffreyi) - white fir (Abies magnifica) forest.
F022AX101CA	**Moist Colluvial Headwater System** Occurs on adjacent headwater swales and first order streams. A complex of vegetation community types is present, and quaking aspen (Populus tremuloides) is a characteristic species.
R022AA200CA	**Alpine Scree** Occurs at higher elevations, above treeline, on windswept alpine slopes and ridges with very shallow to moderately deep, sandy skeletal granitic soils. The sparse vegetation consists of dwarf forbs and grasses.
R022AC202CA	**Shallow Andesite Ridge** Occurs on adjacent slopes with loamy shallow soils over andesitic bedrock. The vegetation is a low productivity shrubland dominated by low sagebrush (Artemisia arbuscula).
R022AE213CA	**Steep Rubbly Slope** Occurs on lower elevation slopes with at least 50 percent cover of rubbleland. Vegetation is a shrubland comprised of dense patches dominated by huckleberry oak (Quercus vaccinifolia) and greenleaf manzanita (Arctostaphylos patula).

Similar sites

F022AF003CA	**Frigid, Loamy, Fragipan, Outwash** This site occurs at lower elevations on gently sloping outwash. Soils are very deep with a shallow weak fragipan that causes a perched water table. Vegetation is a dense Sierra lodgepole pine (Pinus contorta var. murrayana) forest with a sparse grassy understory.
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.

F022AC007CA	**North-Facing Cryic Loamy Mountain Slopes** This site occurs on north-facing slopes with moderately deep skeletal, andic soils. Mountain hemlock (Tsuga mertensiana), red fir (Abies magnfica), and western white pine (Pinus monticola) are co-dominant with Sierra lodgepole pine (Pinus contorta var. murrayana).
F022AF001CA	**Frigid Sandy Outwash Plain Gentle Slopes** This site occurs at lower elevations on gently sloping glacial outwash. Soils are deep over a silica cemented horizon. The vegetation is an open Sierra lodegepole pine forest (Pinus contorta var. murrayana) with scattered western juniper (Juniperus grandis) and a grassy understory.
F022AC005CA	**Cryic Sheltered, Moist Sandy Mountain Slopes** This site is found on north-facing slopes with deep, sandy skeletal soils, over decomposed granite. The vegetation is a mixed subalpine forest, with lodgepole pine (Pinus contorta var. murrayana), mountain hemlock (Tsuga mertensiana), red fir (Abies magnifica), and western white pine (Pinus monticola). Purple mountainheath (Phyllodoce breweri) and rose meadowsweet (Spiraea splendens) are common in the understory.

Table 1. Dominant plant species

Tree	(1) *Pinus contorta var. murrayana* (2) *Abies magnifica*
Shrub	Not specified
Herbaceous	(1) *Festuca viridula* (2) *Lupinus arbustus*

Physiographic features

This ecological site is found on mountain slopes that may range from 9 to 50 percent, but are typically below 30 percent. Aspects are variable, and elevations may range from 6,380 feet to 9,550 feet, but are typically between 7,600 and 9,000 feet. Runoff class is high.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	6,380–9,550 ft
Slope	9–50%

Climatic features

The average annual precipitation ranges from 37 to 61 inches, mostly in the form of snow in the winter months (November through April). The average annual air temperature ranges from 38 to 42 degrees Fahrenheit. The frost-free (>32F) season is 25 to 75 days, and the freeze-free (>28F) season is 60 to 100 days.

Maximum and minimum monthly climate data for this ESD were generated using PRISM data (PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created 4 Feb 2004.) and the ArcGIS ESD extract tool.

Table 3. Representative climatic features

Frost-free period (average)	49 days
Freeze-free period (average)	80 days
Precipitation total (average)	48 in

Influencing water features

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

Soil features

The soils associated with this ecological site are moderately deep and developed from colluvium over glacial till derived from volcanic rock. The glacial till typically presents a root-limiting horizon (Cd horizon) occurring from approximately 20 inches and extending to about 40 inches below the soil surface. These soils are well drained with very slow to moderately rapid permeability. The soil moisture regime is xeric and the soil temperature regime is cryic. Surface rock fragments smaller than 3 inches in diameter are typically not present and larger fragments range from 0 to 3 percent. Surface textures are very gravelly loamy coarse sand. Partially decomposed organic matter overlies the mineral horizons (Oi horizon). Subsurface textures are very stony and extremely stony coarse sandy loam. Subsurface rock fragments smaller than 3 inches in diameter range average 32 percent by volume, and larger fragments average 20 percent (for a depth of 0 to 39 inches). The soils that are correlated to this ecological site are the Callat soils (Loamy-skeletal, isotic Xeric Humicryepts).

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

Area_sym ; Musym ; MUname ; Compname ; Local_phase ; Comp_pct
9101 ; Callat very gravelly coarse sandy loam, 9 to 30 percent slopes, very stony ; Callat ; ; 82
9102 ; Callat very gravelly coarse sandy loam, 30 to 50 percent slopes, very stony ; Callat ; ; 82
7524 ; Tallac gravelly coarse sandy loam, moderately well drained, 0 to 5 percent slopes ; Callat ; ; 4
7525 ; Tallac gravelly coarse sandy loam, moderately well drained, 5 to 9 percent slopes ; Callat ; ; 4

Table 4. Representative soil features

Parent material	(1) Colluvium–volcanic breccia
Surface texture	(1) Very gravelly coarse sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to moderately rapid
Soil depth	20–39 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0–3%
Available water capacity (0-40in)	1.6–2 in
Soil reaction (1:1 water) (0-40in)	5.1–6.5
Subsurface fragment volume <=3" (Depth not specified)	32%
Subsurface fragment volume >3" (Depth not specified)	20%

Ecological dynamics

Abiotic factors
This site occurs on gentle to steep subalpine, south-facing mountain slopes at elevations of 6,380 to 9,550 feet. Soils are derived from volcanic parent material, and are moderately deep over dense till. This dense layer inhibits roots and water movement, which favors dominance by Sierra lodgepole pine (*Pinus contorta* var. murrayana), which is shallow-rooted and tolerant of saturated soils. The vegetation is relatively open, as the root-restrictive layer limits forest density. California red fir (*Abies magnifica*) and western white pine (*Pinus monticola*) are important secondary species. Moist soils support a productive understory, which is dominated by greenleaf fescue (*Festuca viridula*) and lupines (Lupinus sp.).

Disturbance factors
Fire, insect infestations and fire suppression are the primary natural disturbances affecting this ecological site. Subalpine forests in the Sierra Nevada have relatively long fire return intervals compared to low and mid-elevation forests due to lower productivity which leads to lower rates of fuel accumulation, and due to a shorter fire season (Skinner and Chang 1996, Bekker and Taylor 2010, Mallek et al. 2013). Fire return intervals are estimated to be 100 to several hundred years or more (Cope 1993, Safford and Water 2014). Fires are generally large and stand-replacing, creating conditions ideal for re-colonization by Sierra lodgepole pine, which is killed by fire. The forests in this ecological site are situated in areas broken by large portions of bedrock outcrops, barren ridges and mountain peaks, which are natural firebreaks that can inhibit the spread of large fires.

Along with fire, tree pathogens and insect infestations can kill large areas of this subalpine forest, and insect outbreaks can create conditions that increase the susceptibility of this forest to severe fire (Cope 1993). These forests are susceptible to several forest pathogens; with Sierra lodgepole pine and California red fir each having a suite of native and non-native threats. Sierra lodgepole pine can experience large-scale mortality from mountain pine beetle (Dendroctonus ponderosae), but beetle infestations in this higher elevation Sierra lodgepole pine-California red fir forest are less severe. Under future global climate change warming scenarios, higher elevation forests may become more susceptible to beetle kill as beetles are able to move upslope (e.g.Williams and Liebhold 2002).

The effects of fire suppression in these subalpine forests have not been as severe as at lower elevations since these forests are generally located inaccessible wilderness where fires suppression is logistically not feasible and/or not critical (Mallek et al. 2013). Further, since the natural fire return intervals for these forests is long, the effects of a century of fire suppression are only just being realized (Mallek et al. 2013, Safford and Water 2014). Nevertheless, fire suppression over the last century has impacted contemporary subalpine forests (Skinner and Chang 1996, Bekker and Taylor 2010, Mallek et al. 2013). The dominant effect has been an increase in forest density, without major changes in forest composition as are seen in other forest types (Bekker and Taylor 2010, Mallek et al. 2013, Safford and Water 2014).

Whether observed changes in forest density in the subalpine is due to fire suppression or due to climate warming are difficult to disentangle. Several studies attribute observed patterns of increased forest density in the subalpine more to climate warming over fire suppression (Dolanc et al. 2012, Mallek et al. 2013, Safford and Water 2014). Between 1929 and 2009, stem density of subalpine forests in the Sierra Nevada increased over 30 percent, 63 percent of which comes from small understory trees (Dolanc et al. 2012). Over the same time period, daily minimum temperatures increased by 1.2 degrees Celsius, and precipitation increased (Dolanc et al. 2012). Areas mapped by the U.S. Forest Service as subalpine forest in the 1930s are currently mapped as red fir (Safford and Water 2014), indicating a potential compositional shift in these forests. Lodgepole pine recruitment is positively impacted by warm wet periods with low snowpack (Pierce and Taylor 2011). Increases in subalpine forest density, likely due to a warmer climate, are already occurring. Recent California based climate models predict a 9 degree F increase in temperature by 2100, and more conservative models predict a 2 to 4 degree F increase in winter and 4 to 8 degree increase in summer (Mallek et al. 2013). Models are more variable for precipitation, but recent models for the Sierra Nevada, predict similar to slightly less precipitation. Most models agree that summers will become drier, since more of the precipitation is predicted to come as rain, and snow melt-off will occur earlier in spring (Hayhoe et al. 2004, Safford et al. 2012). These scenarios will bring more extreme changes to subalpine forests. Species requiring cool, moist conditions to dominate, such as mountain hemlock, will likely be pushed upslope, while species with wider ecological amplitude, such as red fir and lodgepole pine, may remain dominant in this site. With extreme warming, lower montane species like Jeffrey pine (*Pinus jeffreyi*) and white fir (*Abies magnifica*) will likely move into the elevation zone occupied by this site. How pathogens, both existing and novel, increased fire frequencies with increased tree densities, introduced species, mycorrhizal relationships, and new species interactions will impact dynamics under these warming scenarios is unknown.

The reference state consists of the most successionally advanced community phase (numbered 1.1) as well as other community phases, which 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 the oldest modern day remnant forests 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 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), it typically does not represent the absolute range of characteristics nor an exhaustive listing of species for all the dynamic communities within each specific community phase.

State and transition model

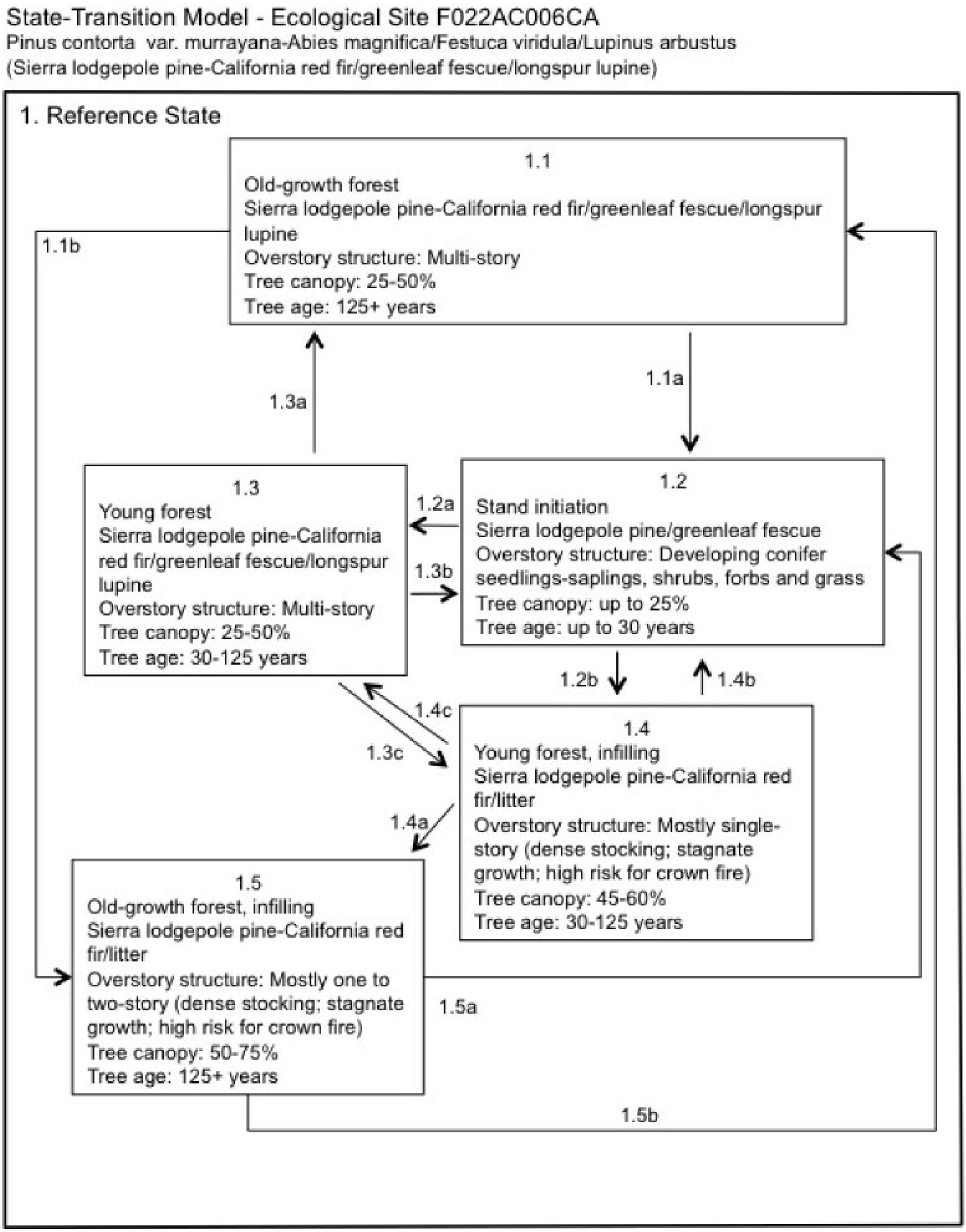

Figure 6. F022AC006CA

State 1
Reference

Community 1.1
Old-growth forest

Figure 7. Community Phase 1.1

This community phase represent the most successionally advanced community for this ecological site. It is fairly undisturbed by human influences because of its inaccessibility. Sierra lodgepole pine has an open canopy, with several age classes. California red fir and western white pine are present in small amounts, but will not successionally replace Sierra lodgepole pine on this site due to the root restrictive till layer and possibly frost issues. The trees in this forest are commonly over 200 years old, but are slow growing due to harsh environmental variables such as a short growing season and low soil fertility. An estimate on life span for this community phase ranges from 125 to more than 500 years.

Forest overstory. Sierra lodgepole pine, California red fir, and western white pine provide between 25 and 50 percent cover. The upper canopy height averages 60 feet, and scattered mid-canopy cover is also present. White fir may be present at low cover.

Forest understory. There is a high cover of grasses and forbs, dominated by greenleaf fescue and lupines. Shrub cover is sparse, with mountain big sagebrush (Artemisia tridentata ssp. vaseyana) the most abundant shrub.

Community 1.2
Stand initiation

This community phase develops after severe canopy fire. Remnant overstory trees may be present in limited numbers. Sierra lodgepole pine, California red fir, and western white pine readily germinate from seed in the mineral soil exposed by fire. However, Sierra lodgepole pine is generally an early pioneer species that becomes abundant post-fire (Dickman and Cook 1989, Cope 1993, Pierce and Taylor 2011). Western white pine is a fire-dependent species that also requires open conditions for regeneration (Griffith 1992), and will establish early post-burn. California red fir seeds germinate best in bare mineral soil, but seedlings develop best under shade (Cope 1993), so the growth of red fir in this community phase occurs more slowly, after other vegetative cover is established. Due to the patchy distribution of fuels, high intensity fires may be restricted to smaller pockets where tree growth was denser, while open areas may not have fuel loads sufficient to carry fire. Greenleaf fescue will re-sprout after a low intensity fire, while lupines will quickly colonize bare mineral soil from seed. Other annuals and perennials will re-sprout or germinate from seed. In areas of hotter burns, fire dependent shrubs such as greenleaf manzanita (*Arctostaphylos patula*) and whitethorn ceanothus (*Ceanothus cordulatus*) may establish on this site even if they were not present before the fire.

Forest understory. Sierra lodgepole pine, western white pine and Californa red fir seedlings are also present. Forb species that may be present include: lupines (Lupinus spp.), mountain monardella (Monardella odoratissima), pinewoods lousewort (Pedicularis semibarbata), spreading phlox (Phlox diffusa), and lambstongue ragwort (Senecio integerrimus), dusky onion (Allium campanulatum), buckwheat (Eriogonum spp.), and Asters (aster spp.). Grasses and grasslike species include greenleaf fescue (Festuca viridula), needlegrasses (Achnatherum spp.), Ross' sedge (Carex rossii), and squirreltail grass (Elymus elymoides).

Community 1.3
Young forest

In this community phase, young Sierra lodgepole pine provides an open canopy over mixed grasses and forbs. This phase naturally develops over time with small scale canopy disturbances that break up the uniformity of the forest canopy. Within this phase low to moderate intensity fires may be initiated by lighting that creates canopy gaps for Sierra lodgepole pine regeneration. Pest outbreaks and tree fall may also create canopy gaps. California red fir is uncommon in this forest, but can establish in the understory during this phase.

Community 1.4
Young forest infilling

This community phase is defined by a dense canopy and high basal area of Sierra lodgepole pine with a lesser amount of California red fir. Canopy cover ranges from 45 to 65 percent. In the absence of canopy disturbance, the Sierra lodgepole pine canopy is relatively even aged and has higher cover than areas with canopy gaps. California red fir may continue to establish in the understory. The trees are overcrowded and often diseased and stressed due to the competition for water and nutrients. This stress makes the trees more susceptible to death from disease and drought.

Community 1.5
Old-growth forest infilling

This phase develops with the continued exclusion of fire and other natural disturbances, which allows the tree density to increase. The even aged overstory of Sierra lodgepole pine may begin to deteriorate due to old age, drought stress, and disease infestations. California red fir remains a minor component of this forest, and is taller than the shorter statured Sierra lodgepole pine canopy. An estimated age for this community phase ranges from approximately 125 to more than 500 years.

Pathway 1.1a
Community 1.1 to 1.2

In the event of a severe canopy fire, or a clear-cut and prescribed burn, the old growth forest would return to the stand initiation phase (community phase 1.2).

Pathway 1.1b
Community 1.1 to 1.5

If fire or other canopy disturbances are absent from this system for several centuries, tree density may increase, and tree health and vigor may decline. This would shift this community phase towards the old-growth, infilling forest (community phase 1.5).

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to community phase 1.3, a young, open Sierra lodgepole pine-California red fir forest. This pathway is followed with a natural fire regime, small pest outbreaks, or other natural disturbances that create forest openings.

Pathway 1.2b
Community 1.2 to 1.4

An alternate pathway is created when fire or other natural disturbances do not create openings in the forest structure or canopy. In this case a young, denser Sierra lodgepole pine-red fir forest develops (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 sporadic lighting-ignited surface fires, partial tree mortality from a pest outbreaks, or from other disturbances. 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 phase would return to community phase 1.2, stand initiation.

Pathway 1.3c
Community 1.3 to 1.4

If natural disturbances do not occur, then the density of the forest increases shifting this community to community phase 1.4.

Pathway 1.4b
Community 1.4 to 1.2

A severe canopy fire would initiate stand initiation (community phase 1.2).

Pathway 1.4c
Community 1.4 to 1.3

Manual treatments to thin out the understory trees and fuels or prescribed burns could be implemented to shift this forest back to the young open forest (community phase 1.3). A partial mortality disease or pest infestation could also create a shift towards community phase 1.3.

Pathway 1.4a
Community 1.4 to 1.5

If fire continues to be excluded from this system the old-growth infilling forest develops (community phase 1.5).

Pathway 1.5b
Community 1.5 to 1.1

Manual treatments to thin out the understory trees and fuels or prescribed burns could be implemented to shift this forest back to the open Sierra lodgepole pine-California red fir forest (Community phase 1.1). A partial mortality disease or pest infestation could also create a shift towards Community phase 1.1.

Pathway 1.5a
Community 1.5 to 1.2

A severe canopy fire would initiate stand initiation (community phase 1.2).

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	20–35	–	–
California red fir	ABMA	*Abies magnifica*	Native	–	3–7	–	–
western white pine	PIMO3	*Pinus monticola*	Native	–	2–6	–	–
white fir	ABCO	*Abies concolor*	Native	–	0–2	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
greenleaf fescue	FEVI	*Festuca viridula*	Native	–	7–12
squirreltail	ELEL5	*Elymus elymoides*	Native	–	2–4
Ross' sedge	CARO5	*Carex rossii*	Native	–	1–3
needlegrass	ACHNA	*Achnatherum*	Native	–	1–3
sedge	CAREX	*Carex*	Native	–	0–2
Forb/Herb					
silvery lupine	LUAR3	*Lupinus argenteus*	Native	–	2–4
longspur lupine	LUAR6	*Lupinus arbustus*	Native	–	1–3
lupine	LUPIN	*Lupinus*	Native	–	0–2
dusky onion	ALCA2	*Allium campanulatum*	Native	–	0–2
aster	ASTER	*Aster*	Native	–	0–2
Torrey's blue eyed Mary	COTO	*Collinsia torreyi*	Native	–	0–0.5
pioneer rockcress	ARPL	*Arabis platysperma*	Native	–	0–0.5
pinewoods lousewort	PESE2	*Pedicularis semibarbata*	Native	–	0–0.5
lambstongue ragwort	SEIN2	*Senecio integerrimus*	Native	–	0–0.5
Shrub/Subshrub					
mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	Native	–	1–3
spreading phlox	PHDI3	*Phlox diffusa*	Native	–	0–0.5
marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	Native	–	0–0.5
mountain monardella	MOOD	*Monardella odoratissima*	Native	–	0–0.5
frosted buckwheat	ERIN9	*Eriogonum incanum*	Native	–	0–0.5
Tree					
California red fir	ABMA	*Abies magnifica*	Native	–	0–1
white fir	ABCO	*Abies concolor*	Native	–	0–0.5
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–0.5
western white pine	PIMO3	*Pinus monticola*	Native	–	0–0.5

Animal community

Almost 50 bird species and many mammals use this forest for food, cover, or habitat. Common animals include bears, deer, chipmunks, and squirrels. Dead or dying trees provide nesting sites for cavity-nesting birds, and the fallen branches from these trees provide sites for ground-nesting birds and mammals. The seeds are a food source for squirrels, chipmunks, birds, and mice (Cope 1993, Tesky 1992).

Recreational uses

This area provides beautiful scenery and is used for backpacking, hiking, bike riding, photography, and other activities.

Wood products

The remoteness of this area and the slow growth of trees at this elevation make commercial forestry production impractical. However, the wood of Sierra lodgepole pine, California red fir and Western white pine is of good quality. Sierra lodgepole pine is suited for common lumber grades, and used for light framing materials, interior paneling, exterior trim, posts, railroad ties, pulp and paper, and has potential for structural particle board. The uniform size of Sierra lodgepole pine makes harvesting efficient (Cope 1993).

The wood of California red fir is of high quality and is stronger than other firs. It is used for fuel, coarse lumber, quality veneers, solid framing, plywood, printing paper, and high-quality wrapping paper, and is preferred for pulping (Cope 1993).

Western white pine can produce valuable timber and is often used for finish work. It is used to build doors, paneling, dimension stock, matches, and toothpicks. The wood is also excellent for carving (Griffith 1992).

Other information

Site index documentation:
Schumacher (1928), Dunning (1942) and Alexander (1966) were used to determine forest site productivity for red fir, western white pine and lodgepole 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. (CMAI values are not available for western white pine, so zeros were used to indicate the lack of data.) 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.

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

Forest pathogen information:
The major pathogens that affect California red fir in this area include: red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae), fir broom rust (Melampsorella caryophyllacearum), annosus root rot (Heterobasidion annosum), and the fir engraver (Scolytus ventralis) (Murphy and Knopp 2000). Other diseases also affecting red fir are known as heart rots, which cause the centers of limbs and trunks to decay. Commonly seen heart rots include: yellow cap fungus (Pholiota limonella) and Indian paint fungus (Echinodontium tinctorium). Common pests affecting red fir are: cone maggots (Earomyia spp.), several chalcids (Megastigmus spp.) and cone moths (Barbara spp. and Eucosma spp.) (Burns and Honkala 1990).

Red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) is a parasitic plant common in the survey area. Visible symptoms include witches brooms, top kill, stem cancers, and swellings. The vegetative shoots of the dwarf mistletoe are also often present from spring to fall. Infestation of the red fir dwarf mistletoe can cause reduced growth and vigor, which weakens the tree and allows other pathogens to infest the tree. The mistletoe cankers create an entry point for other diseases such as heart rots and the cytospora canker (Cytospora abietis) (Burns and Honkala 1990).

Fir broom rust (Melampsorella caryophyllacearum) causes dense witches brooms with stunted yellow needles, and can damage tree growth by reducing crown development. Mortality is less common in mature trees than in the younger regeneration trees. The infected branch sheds its needles in fall leaving a barren dead looking branch. The alternate host for this rust is the chickweeds (Stellaria spp. and Cerastium spp.) (Hagle et al. 2003).

Annosus root rot (Heterobasidion annosum) can affect large acres of fir forest. It slowly decays the roots, the root collar and the stem butt for many years causing structural weaknesses and making the tree vulnerable to wind throw. Annosus root rot can spread from infected roots to healthy roots as well as aerially by infecting freshly cut stumps or other fresh tree wounds. Painting Borax on the freshly cut stumps restricts the entry of the fungus. In all management activities, it is important to reduce damage to the bark because the rot itself does not often kill red fir directly, but it weakens the tree and makes it easier for bark beetles (Scolytus spp), annosus root rot, or dwarf mistletoe to infect the tree (Burns and Honkala 1990).

The fir engraver (Scolytus ventralis) can cause extensive damage to a red fir forest and outbreaks can cause several acres of trees to die. It can reach epidemic levels when the trees are stressed due to annosus root rot, dwarf mistletoe, drought, or fire damage (Burns and Honkala 1990).

The major pathogen affecting western white pine is white pine blister rust (Cronartium ribicola). It is a non-native disease that was introduced from Europe and Asia in the 1920s. The fungus causes cankers on five needle pines that eventually kill most of the infected trees. Visible symptoms are swollen cankers with an abundance of pitch flowing down the branch or stem. The cankers can eventually girdle the tree, killing the portions above. The leaves on the upper portion eventually turn red and fall (Hagle et al. 2003). Pruning cankers off of infected stems has been shown to be beneficial. Some strains of western white pine have shown resistance to the disease.

Other pathogens that can affect western white pine are: white pine needle cast (Lophodermella arcuata), pine needle cast (Lophodermium nitens), Bifusella lineari, butt-rot fungi, red ring rot (Phellinus pini), root disease (Phaeolus schweinitzii), annosus root rot (Heterobasidion annosum), and Armillaria root disease (Armillaria spp). Insects affecting western white pine include: Mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Taylor et al. 1991).

Table 7. 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
California red fir	*ABMA*	30	30	104	104	140	050	–	
Sierra lodgepole pine	*PICOM*	55	55	43	43	90	520	–	
western white pine	*PIMO3*	87	87	0	0	0	605	–	

Inventory data references

The following NRCS plots represent this ecological site:

Tme02607- site location
Tme02608
Tme02609
Tme04045

Type locality

Location 1: El Dorado County, CA	
Township/Range/Section	T12N R17E S16
UTM zone	N
UTM northing	4308594
UTM easting	750744
General legal description	Take HW 89 to Fallen Leaf Lake Road. Take road to end to the Fallen Leaf Lake Trailhead. Plot is south east of gilmore lake, 50 feet south of small trail.

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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:**

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

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):**

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):**

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:**