Ecological site F022BI100CA
Low Precip Frigid Sandy Tephra Gentle Slopes

Accessed: 05/18/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

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): 022B–Southern Cascade Mountains

Site Concept:
Landform: (1) Moraine, (2) Outwash plain
Elevation (feet): 5,850-6,960
Slope (percent): 0-35
Water Table Depth (inches): n/a
Flooding - Frequency: None
Ponding - Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 23.0-43.0
Primary Precipitation: Winter months in the form of snow
Mean annual temperature: 42 to 44 degrees F (6 to 7 degrees C)
Restrictive Layer: Some soils have a root restrictive densic horizon or duripan between 40 to 60 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Thick tephra deposits
Surface Texture: (1)Ashy Sand, (2) Ashy Coarse sand
Surface Fragments <=3" (% Cover): 3-56
Surface Fragments > 3" (% Cover): 0-9

Soil Depth (inches): 40 to > 60
Vegetation: Montane coniferous forest dominated by Jeffrey pine (*Pinus jeffreyi*) with some white fir (*Abies concolor*). There is low cover of grasses and forbs in the understory, even in areas with open canopies. With an increase in precipitation and elevation the composition of white fir increases, generally to the west of the majority of the site.
Notes: This ecological site is found in the northeastern portion of Lassen Volcanic National Park. Fairly recent tephra deposits disturbed the vegetation in this area. Lower precipitation and droughty tephra layer favor the drought tolerant Jeffrey pine over white fir.

Classification relationships

Forest Alliance = *Pinus jeffreyi* – Jeffrey pine forest; Association = *Pinus jeffreyi-Abies concolor* (no matching understory species). (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.)

Similar sites

F022BI119CA	**Low Precip Frigid Sandy Moraine Slopes** This is also a Jeffrey pine- white fir forest, but has more white fir and is associated with cooler slopes.

Table 1. Dominant plant species

Tree	(1) *Pinus jeffreyi* (2) *Abies concolor*
Shrub	Not specified
Herbaceous	(1) *Achnatherum occidentale ssp. occidentale* (2) *Elymus elymoides*

Physiographic features

This ecological site is found in the vicinity of Butte Lake on moraines and glacial outwash plains, between 5,850 and 6,960 feet in elevation. Slopes range from 0 to 35 percent.

Table 2. Representative physiographic features

Landforms	(1) Ground moraine (2) Outwash plain
Flooding frequency	None
Ponding frequency	None
Elevation	1,783–2,121 m
Slope	0–35%
Aspect	Aspect is not a significant factor

Climatic features

This ecological site receives most of its annual precipitation in the winter months in the form of snow. The mean annual precipitation ranges from 23 to 43 inches (584 to 1,092 mm) and the mean annual temperature ranges from 42 to 44 degrees F (6 to 7 degrees C). The frost free (>32 degrees F) season is 60 to 90 days. The freeze free (>28 degrees F) season is 75 to 200 days.

There are no representative climate stations for this site. The nearest one is Manzanita Lake, which receives substantially more precipitation than this area.

Table 3. Representative climatic features

Frost-free period (average)	90 days
Freeze-free period (average)	200 days
Precipitation total (average)	1,092 mm

Influencing water features

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

Soil features

This site is correlated with the Buttelake, Buttewash, Typic Xerorthents, and Typic Xerorthents, tephra soil components. The soils are deep to very deep and well to excessively drained. The Buttelake and Buttewash components have about 12 inches of tephra over the buried soils but the Typic Xerorthents and Typic Xerorthents, tephra components have formed in thick tephra deposits. The tephra deposits are from the eruption of Cinder Cone, about 350 years ago. The surface textures are ashy sand, ashy coarse sand, very gravelly ashy sand, and ashy loamy sand, all with coarse subsurface textures. The Buttelake and Buttewash soils have a root restrictive densic horizon or duripan between 40 to 60 inches. Permeability is moderately rapid in the upper horizons and very slow through the densic and duripan horizons. This site is in the driest region of the park and has very droughty soils due to the coarse tephra deposits. The tephra may not have killed all the existing trees at the time of the eruption, but a sterile, black, coarse textured layer of tephra was left on the surface. The thickness, texture and chemistry of the ash deposits all affect the survival and regeneration of the pre-existing vegetation. An ash layer greater than 15 centimeters is considered a thick burial. A thick burial isolates the old soil from oxygen, effectively sterilizing it. Younger trees were probably killed by ash deposits, while older trees were most likely injured by the weight of the ash on the branches (http://volcanoes.usgs.gov/ash/agric/index.html#intro).

This ecological site has been correlated with the following map units and major soil components within the CA789 Soil Survey Area:

Mapunit, Component, Percent
100 Buttelake, 85
101 Buttewash, 85
108 Typic Xerorthents, 80
203 Typic Xerorthents, tephra, 90

This site is also associated with minor components in several mapunits.

Table 4. Representative soil features

Surface texture	(1) Ashy sand (2) Ashy coarse sand
Family particle size	(1) Sandy
Drainage class	Well drained
Permeability class	Moderately rapid to very slow
Soil depth	102 cm
Surface fragment cover <=3"	3–56%
Surface fragment cover >3"	0–9%
Available water capacity (0-101.6cm)	6.35–10.67 cm
Soil reaction (1:1 water) (0-101.6cm)	5.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	3–55%

Subsurface fragment volume >3" (Depth not specified)	0–20%

Ecological dynamics

This ecological site is found in the northeastern portion of Lassen Volcanic National Park. The interpretive plant community associated with this site is a montane coniferous forest dominated by Jeffrey pine (*Pinus jeffreyi*) with some white fir (*Abies concolor*). There is low cover of grasses and forbs in the understory, even in areas with open canopies. With an increase in precipitation and elevation the composition of white fir increases, generally to the west of the majority of the site.

Jeffrey pine is healthier and more productive than white fir in this area, because it is adapted to the drier conditions of this site. In areas of higher precipitation a white fir dominated ecological site (white fir-Jeffrey pine forest, F022BI103CA) is found. The white fir dominated ecological site has soil moisture for a longer duration during the growing season, allowing the cover and growth rates of white fir to nearly double compared production on this ecological site. Annual precipitation almost doubles from the eastern to the western side of the park. The difference in soil moisture may be the primary factor affecting the rate of tree growth on these sites.

Jeffrey pine is a relatively large and long-lived tree. It can attain heights of 200 feet and live for 400 to 500 years or more. It produces 3 to 8 inch needles in bundles of three. The female seed cones range in size from 4.7 to 12 inches long. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007). Jeffrey pine roots are intolerant of wet conditions. Jeffrey pine looks similar to ponderosa pine but has a vanilla-like odor in the bark, which is not as yellow as the ponderosa pine. Jeffrey pine is shade intolerant and can be replaced over time by white fir if fire is excluded from the system. Jeffrey pines are somewhat adapted to fire because the thicker bark of older trees offers protection from moderate intensity flames. Additionally, the branches of Jeffrey pine tend to thin out along the lower portion of the tree trunk, leaving the crown 65 to 100 feet above the forest floor.

White fir is also a large and long-lived tree. In this area it can commonly attain heights of 120 to 140 feet and live for 300 to 400 years. It produces single needles from 1.2 to 2.8 inches long that are distributed along the young branches. The female cones open and fall apart while still attached to the tree, so cones are not often seen on the forest floor. White fir tends to develop a shallow root system, which can graft to other white fir roots and spread root rots (Zouhar, 2001).

It is difficult to find detailed maps or information about the logging and fire history throughout this area, though there is evidence of small fires and controlled burns. There are old growth trees across this landscape, but they do not create a uniform forest. Most of the trees found in this area are less than 100 feet tall and usually less than 30 inch DBH.

This ecological site is has been affected by tephra deposits from the eruption of Cinder Cone. The tephra may have killed many trees and injured others. Understory species may have been killed as well, and their seed source buried, which could be a factor leading to the barren understory that is present today.

Historically, this community developed with frequent low to moderate intensity fires. Fire regime studies of tree rings and fire scars report historic median fire return intervals in the Jeffrey pine-white fir forest of 14.0, 18.8, and 70.0 years (Bekker and Taylor; Skinner and Chang; Taylor and Solem respectively). Beaty and Taylor report that fire frequency and intensity is also associated with slope position, aspect, and climatic fluctuations. Fire return intervals are longer on north facing slopes than on south facing slopes, and fire intensity increases from the lower slopes to the upper slope positions. Their study also indicates a slightly later burn season in the Southern Cascades than in the Sierra Nevada. Fire scars are primarily found at the annual tree ring boundary, indicating that the trees were dormant at the time of the fire, whereas in the Sierra Nevada fires scars are often in the late-season wood. This timing shift may be due to summer drought conditions, which begin earlier in the south. In July and August, thunderstorms are common in Lassen Volcanic National Park and summer drought conditions begin, initiating the fire season. Large fires and multiple small fires in the same season are associated with dry and very dry years (Beaty and Taylor, 2001). The moderate and low intensity fires seem to have kept the forest open by removing the less fire tolerant white fir seedlings and sapling from the understory. Beaty and Taylor report that stand replacing fires are more common on the upper slopes while low to moderate intensity fires occur only along the lower slopes. This is probably due to the tendency of fires to burn upslope, preheating the fuels as they go (Beaty and Taylor, 2001). After a stand replacing fire, a more evenly aged forest is formed. With the current management practices of

fire suppression, there has been a shift in forest density and composition. Fire suppression has created a change in species composition by allowing the fire intolerant and shade tolerant firs to increase in cover and density, eventually out-competing the fire tolerant-shade intolerant pines (Tayler and Solem, 2001).

Tree pathogens and insect infestations can have significant impacts on the composition and structure of mid and upper montane coniferous forests. Small infestations may affect just a few trees but large outbreaks can kill the dominant trees over large areas of forest, creating large canopy openings and stand regeneration. Most of these pathogens are a natural cycle of regulation and can push the closed forest types to a more open forest. Fuel loads are often high after outbreaks creating ideal conditions for high intensity fires.

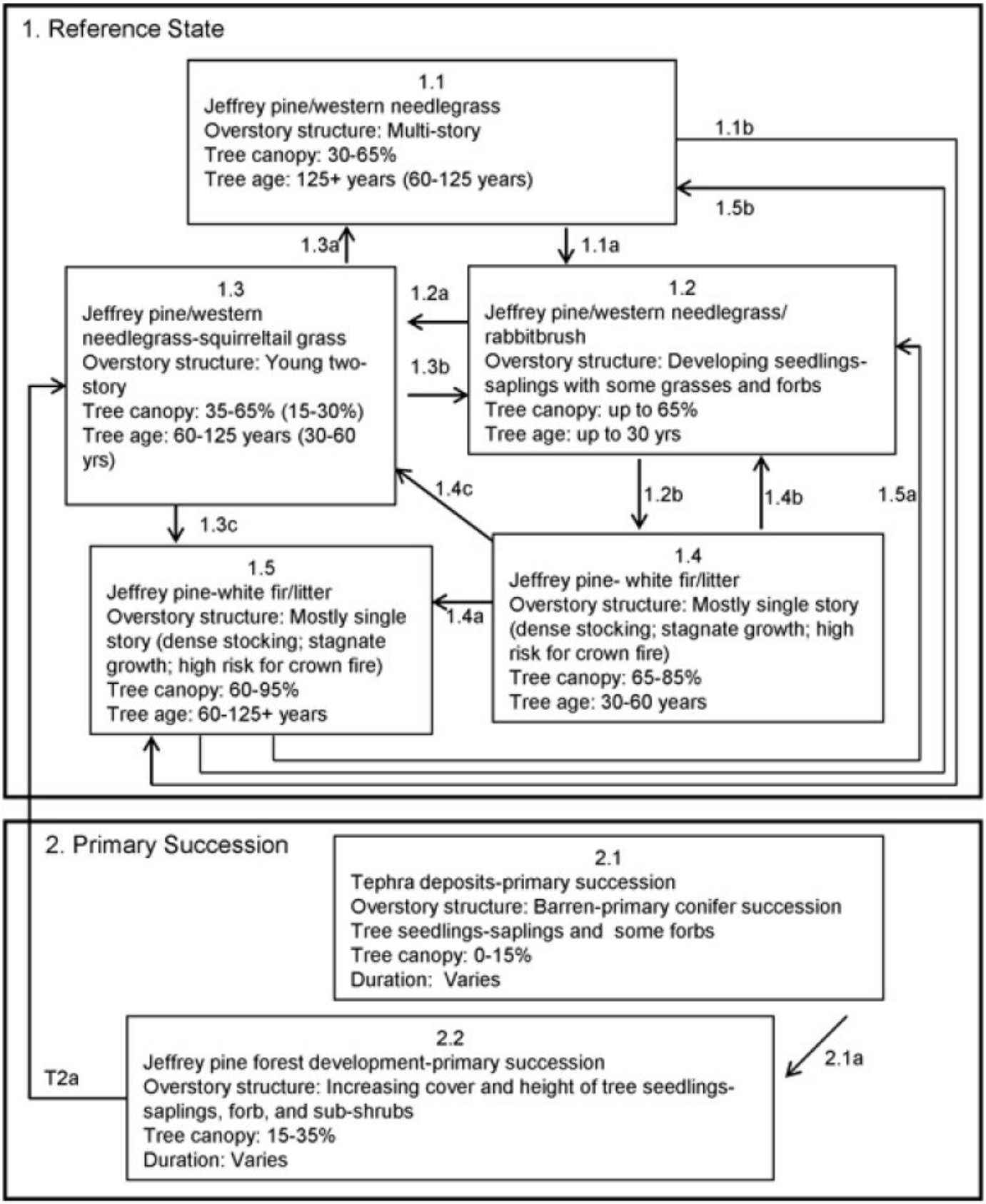
Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. Pathogens that affect Jeffrey pine in this area are: dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle, (Dedroctonus jeffreyi), Red turpentine beetle (D. valens), and pine engravers (Ips species). The most threatening of these are the dwarf mistletoe and the Jeffrey pine bark beetle (Bohne, 2006; Jenkinson, 1990).

Pathogens that affect white fir are: dwarf mistletoe (*Arceuthobium abietinum* f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporlla caryophyllacearum), annosus root disease (Heterobasidium annosum), trunk rot (Echinodontium tinctorium) and the fir engraver (Scotylus ventralis). The most threatening of these is the combination of the fir engraver and annosus root disease. These pathogens can kill large areas of white fir (Bohne, 2006; Laacke, 1990).

All tabular data listed for a specific community phase within the ecological site description represents a summary of one or more field data collection plots taken in communities within the community phase. Although such data is valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase 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

State-Transition Model - Ecological Site No. F022BI100CA
Pinus jeffreyi-Abies concolor/Achnatherum occidentale
(Jeffrey pine-white fir/western needlegrass)



State 1
Reference

Community 1.1
Jeffrey pine/western needlegrass

This community phase represents the reference community phase and may be similar to the plant community phase that was present before the ash-fallout was deposited from Cinder Cone, about 300 years ago. This forest is dominated by mature Jeffrey pine with a small component of white fir. Washoe pine has also been documented in this area. Although montane shrubs such as greenleaf manzanita (*Arctostaphylos patula*) and snowbrush ceanothus (*Ceanothus velutinus*) are often associated with Jeffrey pine and white fir forests, these shrubs were mostly absent from this area. Western needlegrass (*Achnatherum occidentale*), squirreltail grass (Elymus elymiodes), shinleaf (*Pyrola picta*), and slender penstemon (*Penstemon gracilentus*) were common but had low cover. This community phase is maintained by low and moderate intensity fires that effectively remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires kill some of the overstory trees, leaving canopy openings which are favorable for Jeffrey pine regeneration. Moderate intensity fires break the uniformity of older forest stands with pockets of intermixed younger forests.

Forest overstory. Tree canopy ranges from 30 to 65 percent, most of which is from Jeffrey pine. The understory is open with some regeneration on Jeffrey pine and white fir. The canopy trees have 20 to 30 inch DBH and range from 85 to 110 feet tall. Larger Jeffrey pines are intermixed. Basal area ranges from 110 to 240 Ft2/acre, with an average of 180 Ft2/acre.

Forest understory. The understory cover ranges from 1 to 48 percent but averages about 18 percent. This average is high for the overall area due to a couple of plots with relatively lush understories. Common plants include: western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides), pioneer rockcress (Arabis platysperma, carex (Carex sp.), rabbitbrush (Chrysothamnus sp.), Torrey's blue eyed Mary (Collinsia torreyi), quill cryptantha (Cryptantha affinis), naked buckwheat (Eriogonum nudum), spreading groundsmoke (Gayophytum diffusum), mountain monardella (Monardella odoratissima), slender penstemon (Penstemon gracilentus), silverleaf phacelia (Phacelia hastata), whitevein shinleaf (Pyrola picta), and wax currant (Ribes cereum).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	6	36	105
Tree	–	9	21
Forb	–	1	13
Shrub/Vine	–	1	2
Total	**6**	**47**	**141**

Table 6. Ground cover

Tree foliar cover	30-65%
Shrub/vine/liana foliar cover	0-3%
Grass/grasslike foliar cover	1-26%
Forb foliar cover	0-19%
Non-vascular plants	0%
Biological crusts	0%
Litter	65-80%
Surface fragments >0.25" and <=3"	0-10%
Surface fragments >3"	0-2%
Bedrock	0%
Water	0%
Bare ground	1-25%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-1%	0-5%
>0.15 <= 0.3	–	0-1%	1-25%	0-4%
>0.3 <= 0.6	0-1%	0-2%	–	0-10%
>0.6 <= 1.4	0-1%	–	–	–
>1.4 <= 4	0-1%	–	–	–
>4 <= 12	0-3%	–	–	–
>12 <= 24	2-5%	–	–	–
>24 <= 37	25-55%	–	–	–
>37	0-2%	–	–	–

Community 1.2
Jeffrey pine/western needlegrass/rabbitbrush

The eruption of Cinder Cone left tephra deposits of various thickness. The depth of tephra that was deposited varies in thickness from 10 centimeters to over 2 meters. The deeper deposits killed many of the trees, buried the understory, and created complete isolation from the old soil horizon. This initiated primary succession, the slow re-establishment of conifer species. Cinder Cone is reportedly dormant and should not repeat this cycle in the future. In areas of thick tephra deposits, the forest and understory species were killed and/or completely buried. This initiated primary succession, requiring the physical break down of the ash and the slow process of tree seedling recruitment. The dissemination of conifer seed and seedling establishment most likely began from the periphery of the buried zone and is slowly moving inward. The intact forests adjacent to thick ash deposits provided the seeds for early colonization. As the forest on the periphery developed, more seeds were produced and disseminated further into the ash deposits. Heath, 1967, reports that strong winter winds come from the southwest, which would bring seed from the forests upwind, affecting the distribution of seeds on the bare ash surface. With normal wind conditions Jeffrey pine, white fir, and Sierra lodgepole pine disperse seed within 200 feet of the source. In addition to the wind, animals often cache the pine seeds. The age of some of the larger trees in the areas of thick ash deposit were around 220 years old (NRCS data 2007). This suggests a period of 30 to 70 years before the trees were able to re-establish. However, more tree data is needed to verify this assumption. Primary succession is still occurring in this area, as Jeffrey pine cones roll down the mountain or are cached by small mammals and rodents into the barren black ash.

Forest overstory. Jeffrey pine seedlings/saplings are the main vegetation with some white fir particularly later under the shade of Jeffrey pine.

Forest understory. Western needlegrass (Achnatherum occidentale), squirreltail grass (Elymus elymoides), rabbitbrush (Chrysothamnu sp.), and a few other understory species are present after fire. Composition can vary widely.

Community 1.3
Jeffrey pine/western needlegrass-squirreltail grass

This young community phase is a Jeffrey pine forest that begins as a stand of pole sized trees and matures to large trees with 20 to 30 inch DBH. White fir is a small component in the overstory and understory. This community phase naturally develops over time, but needs low to moderate intensity fire to maintain Jeffrey pine dominance and remove understory fuels. If the historic fire regime data is accurate, this community would experience low to moderate intensity fires in 14 to 20 (or 70) year intervals. The structure, composition and age of this forest at the time of fire would determine the fire intensity and extent of damage to the young trees. Slope position, season of burn, and aspect also affect fire intensity and frequency. Jeffrey pine saplings have thicker bark and higher branches than white fir saplings and have a higher rate of survival after a fire at this stage. The removal of the understory trees creates a more open forest structure, which reduces the competition between trees and lowers the potential for severe canopy fires.

Forest overstory. Jeffrey pine predominates the overstory with some white fir. A secondary canopy may be present with 15-30% cover and younger ages.

Forest understory. Understory species and biomass are in equilibrium with overstory canopy cover.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	–	13	92
Shrub/Vine	–	6	41
Forb	–	6	18
Tree	–	6	11
Total	**–**	**31**	**162**

Community 1.4
Jeffrey pine-white fir/litter

This community phase is defined by a dense canopy and high basal area of white fir and Jeffrey pine. Canopy cover ranges from 65 to 85 percent. 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. 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. A mix of Jeffrey pine and white fir with dense stocking, stagnate growth and high risk of crown fire.

Forest understory. Understory is sparse to absent with litter predominating.

Community 1.5
Jeffrey pine-white fir/litter

This community phase is defined by a dense canopy and high basal area of white fir. Canopy cover ranges from 60 to 95 percent. The trees are overcrowded and often diseased and stressed due to the competition for water and nutrients. The understory is almost absent due to the lack of sunlight on the forest floor. Fire hazard is high in this community phase due to the deep accumulation of litter, the standing dead and down trees, and dense multi-layered structure of the forest.

Forest overstory. Dense Jeffry pine and white fir, stagnate growth and high risk for crown fire.

Forest understory. Little to no understory with litter predominating.

Pathway 1.1a
Community 1.1 to 1.2

If this mature Jeffrey pine forest has a severe canopy fire, tree mortality could be significant, leaving a barren landscape with many standing dead trees, initiating Jeffrey pine regeneration (Community 1.2).

Pathway 1.1b
Community 1.1 to 1.5

This pathway is created when fire is excluded from this old growth community. White fir continues to regenerate in the understory, increasing tree density and shifting the community toward a closed white fir-mixed conifer community (Community 1.5).

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to community 1.3, the young open Jeffrey pine forest. This pathway is followed with natural fire regime. Reports vary on the natural fire return interval; this pathway assumes that surface fires were relatively frequent from 14 to 19 years. Manual thinning with prescribed burns can imitate the natural cycle and lead to the same open community.

Pathway 1.2b
Community 1.2 to 1.4

An alternate pathway is created when fire is excluded from the system and leads to the young closed white fir-Jeffrey pine forest (Community 1.4).

Pathway 1.3a
Community 1.3 to 1.1

This is the natural pathway for this community, which evolved with a historic fire regime of relatively frequent surface or moderately severe fires, and/or partial tree mortality from a pest outbreak. Manual thinning or prescribed burning can be implemented to replace the natural disturbances that keep this forest open. This pathway leads to the mature Jeffrey pine forest (Community 1.1).

Pathway 1.3b
Community 1.3 to 1.2

In the event of a canopy fire this community would return to Community 1.2, Jeffrey pine regeneration.

Pathway 1.3c
Community 1.3 to 1.5

If fire does not occur, then the density of the forest increases. This may favor white fir over Jeffrey pine. The increased density shifts this community towards the closed white fir- Jeffrey pine community (Community 1.5).

Pathway 1.4b
Community 1.4 to 1.2

At this point, the density of ground fuels and the ladder fuels formed in the mid canopy create conditions for a high intensity canopy fire. A severe fire would initiate Jeffrey pine regeneration (Community 1.2).

Pathway 1.4c
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 white fir and fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to its natural state of a young open Jeffrey pine forest (Community 1.3). A partial mortality disease or pest infestation could also create a shift towards Community 1.3.

Pathway 1.4a
Community 1.4 to 1.5

If fire continues to be excluded from this system the mature closed Jeffrey pine-white fir forest community develops (Community 1.5).

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 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 back to its natural state of an open Jeffrey pine forest community (Community 1.1). A partial mortality disease or pest infestation could also create a shift towards Community 1.1.

Pathway 1.5a
Community 1.5 to 1.2

At this point a severe fire is likely and would initiate Jeffrey pine regeneration (Community 1.2).

State 2
Primary succession (preceding the Reference State)

Community 2.1
Tephra deposits-primary succession

The eruption of Cinder cone left various thickness of tephra deposits. The depth of tephra that was deposited varies in thickness from 10 centimeters to over 2 meters. The deeper deposits killed many of the trees, buried the understory, and created complete isolation from the old soil horizon. This initiated primary succession, the slow re-establishment of conifer species. Cinder Cone is reportedly dormant and should not repeat this cycle in the future. In areas of thick tephra deposit, the forest and understory species were killed and/or completely buried. This initiated primary succession, requiring the physical break down of the ash and the slow process of tree seedling recruitment. The dissemination of conifer seed and seedling establishment most likely began from the periphery of the buried zone and is slowly moving inward. The intact forests adjacent to thick ash deposits provided the seeds for early colonization. As the forest on the periphery developed, more seeds were produced and disseminated further into the ash deposits. Heath, 1967, reports that strong winter winds come from the southwest, which would bring seed from the forests upwind, affecting the distribution of seeds on the bare ash surface. With normal wind conditions Jeffrey pine, white fir, and Sierra lodgepole pine disperse seed within 200 feet of the source. In addition to the wind, animals often cache the pine seeds. The age of some of the larger trees in the areas of thick ash deposit were around 220 years old (NRCS data 2007). This suggests a period of 30 to 70 years before the trees were able to re-establish. However, more tree data is needed to verify this assumption. Primary succession is still occurring in this area, as Jeffrey pine cones roll down the mountain or are cached by small mammals and rodents into the barren black ash.

Forest overstory. Slow establishment of primarily Jeffrey pine and lodgepole pine with some white fir.

Forest understory. Slow establishment and sparse representation of grasses, shrubs and forbs similar to community phase 1.3.

Community 2.2
Jeffrey pine forest development-primary succession

This community phase slowly develops as conditions become more hospitable for tree growth. The trees that are established on the barren ash have produced some litter accumulation, provided some shade, and have reached reproductive maturity. Jeffrey pine is the dominant tree, with some Sierra lodgepole pine. Total canopy cover may reach up to 35 percent. There is a range in tree age, possibly due to the continued establishment of seedlings in the open areas, however older trees are beginning to form a forest canopy and may be 100 feet tall. Sierra lodgepole pine is eventually shaded out by Jeffrey pine. There is very little understory vegetation.

Forest overstory. Jeffrey pine is the dominant tree with some Sierra lodgepole pine. Lodgepole pine is eventually shaded out by Jeffrey pine.

Forest understory. Slow establishment and sparse representation of grasses, shrubs and forbs similar to community phase 1.3.

Pathway 2.1a
Community 2.1 to 2.2

With time and growth primary succession continues, and a Jeffrey pine forests slowly develops.

Transition T2a
State 2 to 1

As forest structure develops, this forest resembles the young Jeffrey pine forest (Community 1.3 in the state and transition model) and follows the same community pathways.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0–21	
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–11	0–3
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–6	0–1
	white fir	ABCO	*Abies concolor*	0–4	0–1
Shrub/Vine					
0	**Shrub**			0–2	
	whiteveined wintergreen	PYPI2	*Pyrola picta*	0–2	0–1
Grass/Grasslike					
0	**Grass**			6–105	
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–56	0–5
	squirreltail	ELEL5	*Elymus elymoides*	6–45	1–8
	naked buckwheat	ERNU3	*Eriogonum nudum*	0–4	0–2
Forb					
0	**Forb**			0–13	
	silverleaf phacelia	PHHA	*Phacelia hastata*	0–9	0–1
	spreading groundsmoke	GADI2	*Gayophytum diffusum*	0–2	0–1
	pioneer rockcress	ARPL	*Arabis platysperma*	0–1	0–1
	Torrey's blue eyed Mary	COTO	*Collinsia torreyi*	0–1	0–1

Table 10. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	30–61	–	–
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–2	–	–
white fir	ABCO	*Abies concolor*	Native	–	0–2	–	–

Table 11. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
squirreltail	ELEL5	*Elymus elymoides*	Native	–	1–8
naked buckwheat	ERNU3	*Eriogonum nudum*	Native	–	0–2
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–1
Forb/Herb					
pioneer rockcress	ARPL	*Arabis platysperma*	Native	–	0–1
Torrey's blue eyed Mary	COTO	*Collinsia torreyi*	Native	–	0–1
spreading groundsmoke	GADI2	*Gayophytum diffusum*	Native	–	0–1
silverleaf phacelia	PHHA	*Phacelia hastata*	Native	–	0–1
Shrub/Subshrub					
whiteveined wintergreen	PYPI2	*Pyrola picta*	Native	–	0–1
Tree					
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–3
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–1
white fir	ABCO	*Abies concolor*	Native	–	0–1

Table 12. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0–11	
	white fir	ABCO	*Abies concolor*	0–6	0–2
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–6	0–2
Shrub/Vine					
0	**Shrub**			0–41	
	rubber rabbitbrush	ERNAN4	*Ericameria nauseosa ssp. nauseosa var. nana*	0–22	0–4
	snowbrush ceanothus	CEVE	*Ceanothus velutinus*	0–17	0–1
	whiteveined wintergreen	PYPI2	*Pyrola picta*	0–2	0–1
Grass/Grasslike					
0	**Grass**			0–92	
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–56	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–34	0–6
	naked buckwheat	ERNU3	*Eriogonum nudum*	0–2	0–1
Forb					
0	**Forb**			0–18	
	silverleaf phacelia	PHHA	*Phacelia hastata*	0–13	0–2
	spreading groundsmoke	GADI2	*Gayophytum diffusum*	0–2	0–1
	Torrey's blue eyed Mary	COTO	*Collinsia torreyi*	0–1	0–1
	quill cryptantha	CRAF	*Cryptantha affinis*	0–1	0–1

Table 13. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	34–55	–	–
white fir	ABCO	*Abies concolor*	Native	–	1–10	–	–

Table 14. Community 1.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–6
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–5
naked buckwheat	ERNU3	*Eriogonum nudum*	Native	–	0–1
Forb/Herb					
silverleaf phacelia	PHHA	*Phacelia hastata*	Native	–	0–2
spreading groundsmoke	GADI2	*Gayophytum diffusum*	Native	–	0–1
Torrey's blue eyed Mary	COTO	*Collinsia torreyi*	Native	–	0–1
quill cryptantha	CRAF	*Cryptantha affinis*	Native	–	0–1
Shrub/Subshrub					
rubber rabbitbrush	ERNAN4	*Ericameria nauseosa ssp. nauseosa var. nana*	Native	–	0–4
snowbrush ceanothus	CEVE	*Ceanothus velutinus*	Native	–	0–1
Tree					
white fir	ABCO	*Abies concolor*	Native	–	0–2
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–1

Animal community

American black bears, a diversity of small mammals and bird species, as well as insects, amphibians, and reptiles utilize Jeffrey pine for habitat or use the seeds and needles for food. Animals that eat the seeds include: California quail, northern flickers, American crows, Clark's nutcrackers, western gray squirrels, Douglas's squirrels, California ground squirrels, Heermann's kangaroo rats, deer mice, yellow-pine chipmunks, least chipmunks, Colorado chipmunks, lodgepole chipmunks, and Townsend's chipmunks (Gucker, 2007).

Hydrological functions

This site is in hydrologic soil group a, which is defined by very high or high saturated hydraulic conductivity, with very deep free water.

Recreational uses

This site is suitable for trails and campgrounds.

Wood products

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber.

Other products

Jeffrey pine seeds are edible. Native Americans used Jeffrey pine sap as a remedy for pulmonary disorders. Later, heptane was distilled from the sap and sold as a treatment for pulmonary problems and tuberculosis. Jeffrey pine heptane was also utilized in developing the octane scale used to rate petroleum for automobiles (Gucker, 2007).

Other information

Meyer (1961) and Schumacher (1926) were used to determine forest site productivity for Jeffrey pine and white fir, 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.

Trees appropriate for site index measurement typically occur in stands of community phases 1.3, 1.4 and 1.5. Jeffrey pine and white fir are selected according to guidance in Meyer (1961) and Schumacher (1926), respectively.

Table 15. 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
white fir	*ABCO*	53	61	102	131	70	030	–	
Jeffrey pine	*PIJE*	77	84	65	75	40	600	–	

Inventory data references

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

789104
789122- good reference site
789178
789179- site location
789194
789238
789342

Type locality

Location 1: Lassen County, CA	
Township/Range/Section	T31 N R6 E S3
UTM zone	N
UTM northing	4493705
UTM easting	644004
General legal description	This site is to the east of the road to Butte Lake, appox. .75 miles north of Bathtub Lake.

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Contributors

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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:

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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:**
