

Ecological site F022BI118CA

Frigid Landslide Undulating Slopes

Accessed: 10/06/2026

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.

MLRA notes

Major Land Resource Area (MLRA): 022B–Southern Cascade Mountains

Site concept: Landform: Landslide Elevation (feet): 5,830-8,100 Slope (percent): 10-50 Water Table Depth (inches): n/a Flooding-Frequency: None Ponding-Frequency: None Aspect: South, East, West Mean annual precipitation (inches): 99.0-113.0 Primary precipitation: Winter months in the form of snow Mean annual temperature: 39 degrees F (3.9 degrees C) Restrictive Layer: None Temperature Regime: Frigid Moisture Regime: Xeric Parent materials: Colluvium from hydrothermally altered rock Surface Texture: Ashy Fine sandy loam Surface Fragments =3" (% Cover): 8-20 Surface Fragments > 3" (% Cover): 12-55 Soil Depth (inches): 60 Vegetation: Dominated by a dense California red fir (*Abies magnifica*) forest with a very sparse understory. Notes: This ecological site is found on landslides from hydrothermally altered volcanic rocks; slopes are undulating with a moderate amount of rocks and boulders from the landslide.

Classification relationships

Forest Alliance = *Abies magnifica* – Red fir forest; Association = *Abies magnifica*. (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.)

Associated sites

R022BI209CA	Loamy Seeps This is a riparian site found in drainages.
R022BI203CA	Moderately Deep Fragmental Slopes This is a rangeland site dominated by woolly mule-ears.

Similar sites

F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces This site is not associated with the hydrothermally altered soils but has dense red fir.
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Table 1. Dominant plant species

Tree	(1) <i>Abies magnifica</i>
Shrub	Not specified

Herbaceous	(1) <i>Carex</i> (2) <i>Hieracium albiflorum</i>
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Physiographic features

This ecological site is found on landslides from hydrothermally altered volcanic rocks between 5830 and 8,100 feet in elevation. Slopes range from 10 to 50 percent.

Table 2. Representative physiographic features

Landforms	(1) Landslide
Flooding frequency	None
Ponding frequency	None
Elevation	1,780 – 2,470 m
Slope	10 – 50 %
Aspect	E, S, W

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 99 to 113 inches (2,515 to 2,870 mm) and the mean annual temperature is about 39 degrees F (3.9 degrees C). The frost free (>32 degrees F) season is 60 to 85 days. The freeze free (>28 degrees F) season is 75 to 190 days.

There are no representative climate stations for this site.

Table 3 Representative climatic features

Frost-free period (average)	90 days
Freeze-free period (average)	190 days
Precipitation total (average)	2,870 mm

Influencing water features

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

Soil features

The Typic Dystrochrepts, landslides soil component is associated with this site. These are very deep, well drained soils with moderate available water capacity (AWC) that developed in landslide deposits. The landslide occurred in a portion of the park that was hydrothermally altered. The original rock mineralogy was modified by acidic steam and water of various temperatures and pH to produce soils that have significantly higher amounts of clay and lower pH values than most soils in the rest of the park. The surface texture is an

ashy fine sandy loam, with very stony ashy sandy clay loam subsurface textures. Percent clay increases from 13 percent in the upper horizon to 28 percent in the lowest horizon. Rock fragments increase with depth, with about 25 percent cobbles and stones in the lowest horizon. The surface pH is 5.0, decreasing to 4.3 in the lower horizons. These soils are extremely acid to strongly acid and have high levels of aluminum and manganese. The soil lab report indicates levels of aluminum and manganese that could cause toxicity in plants. Aluminum +++ becomes soluble in acidic soils and impairs root growth, reducing the plant's ability to access water. Plants with aluminum toxicity may show symptoms of phosphorus (P), calcium (Ca), and magnesium (Mg) deficiencies due to the low pH. Manganese toxicity is also associated with acidic soils. The symptoms of manganese toxicity are reduced shoot growth, discoloring and chlorosis of leaves.

This ecological site is associated with the following soil components within the Lassen Volcanic National Park Soil Survey Area (CA789):

Map Unit Component/ Comp %
118 Typic Dystrochrepts, landslides/ 90

Table 4. Representative soil features

Surface texture	(1) Ashy fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Soil depth	150 cm
Surface fragment cover <=3"	10 – 20 %
Surface fragment cover >3"	10 – 60 %
Available water capacity (0-101.6cm)	0.48 – 19.89 cm
Soil reaction (1:1 water) (0-101.6cm)	4.5 – 6.5
Subsurface fragment volume <=3" (Depth not specified)	0 – 80 %
Subsurface fragment volume >3" (Depth not specified)	0 – 50 %

Ecological dynamics

This ecological site is dominated by a dense California red fir (*Abies magnifica*) forest with a very sparse understory. The canopy cover in this forest ranges from 40 to 55 percent. The slope is undulating with a moderate amount of rocks and boulders from the landslide.

The soils are unique to this area because of a high clay content, low pH, and potentially toxic levels of aluminum and manganese. In addition to the inherent properties of the soil, there may be ongoing chemical deposition from the active hydrothermal vents and bare areas. Deposition can sometimes be seen as a yellow coating on the snow, which can affect surface pH and mineralogy. Hydrogen sulfide (H₂S), carbon dioxide (CO₂), hydrogen gas (H₂), nitrogen (N), and helium (He) are some of the chemicals found in the thermal springs, which react with oxygen and other elements to form the variety of chemicals found in the steam deposits.

Despite the low pH values and possible toxicity levels, the fastest growing red firs within the park are found on this soil. The initial height growth for these trees is very rapid during the first 60 to 70 years and results in a relatively high site index. After this period however, height growth slows and the site index (based on limited data) computes to about 10 to 15 feet lower. The soils are very deep with fine textures that hold seasonal water longer than most of the other soils in the park, providing the trees with a longer growing season. The growing season may also be extended by the many springs nearby, which may add to the ground waterflow. It is possible that the landslide altered conditions that affected the ability of conifers to establish as on the nearby Diamondpeak soils (see ecological sites F022BI113CA and R022BI203CA).

California red fir (*Abies magnifica*) is generally dominant in this ecological site. California red fir is a tall, long lived conifer with short branches and a narrow crown. It produces single 0.8 to 1.4 in long needles that are distributed along the young branches. Firs produce upright cones that open and fall apart while still attached to the tree, so cones are not often seen on the forest floor unless cut by squirrels or chipmunks in fall. California red fir cones are about 9 inches long. California red fir prefers cold wet winters in areas with deep snow accumulation, followed by warm summers. The young trees have thin bark and are very susceptible to fire, but as trees mature the bark thickens and fire resistance increases.

Conifers have evolved with their environment, developing characteristics that enable them to survive specific climatic conditions. Temperature and precipitation are important environmental variables that determine which conifer species are most likely to be present in a given area. Temperature is critical in initiating conifer growth after snowmelt. Trees generally start stem growth about 2 weeks after snow melt, a delay that may be related to the warming of soils and roots. If the snow melt is unusually early, trees will not begin annual growth until specific air temperatures and/or a photoperiod (a ratio of light hours to dark hours during one 24 hour period) is met. The pines associated with this site begin leader growth at cooler temperatures than the firs. The pines have heavily insulated terminal buds, whereas the terminal buds of the fir trees are less insulated and more susceptible to frost damage (Royce and Barbour, 2001). Seedling establishment and survival are also dependent upon the frost resistance of the species. After temperatures and the photo period criteria have been met, precipitation and soil available water determine the length of the growing season. The length of the leader growth is predetermined by growth conditions of the prior year. If drought conditions set in before the leader has reached its determinate length, growth will be terminated prematurely. If precipitation comes after the snow has melted, it can prolong the growing season. Conifer growth ceases with the onset of drought conditions and the decline of water potentials (Royce and Barbour, 2001). In addition to drought conditions, the growing season is shorter at higher elevations due to late snow melt and early frost dates in fall. California red fir takes advantage of the short growing season with rapid initial growth that gradually declines through the summer (Royce and Barbour, 2001).

This forest type has evolved with fire over the centuries. It is dense but slow growing and accumulates fuels slower than lower elevation forests. Therefore fire spreads across this site less frequently. The point fire return interval for the red fir-western white pine forest on Prospect Peak between the years of 1685 and 1937 ranged from 26 to 109 years, with a mean of 70 (Taylor, 2000). In the Thousand Lakes Wilderness point fire return interval ranges from 4 to 55 years with a mean of 24 for red fir-white fir forests, and 9 to 91 years with a mean of 20 for red fir-mountain hemlock forests (Bekker and Taylor, 2001). In the Caribou Wilderness the mean fire return interval between the years of 1768 and 1874 was 66 years for red fir-western white pine forest (Taylor and Solem, 2001). This site is most like the red fir-mountain hemlock site, so it may have a similar fire history. In a separate study, Beaty and Taylor report that fire return intervals are longer on north facing slopes than on south facing slopes. Stand replacing fire is 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 fire to burn upslope, preheating the fuels as it goes. Large fires and multiple small fires in the same season are associated with dry and very dry years (Beaty and Taylor, 2001).

There is evidence everywhere in this forest type of fire suppression. Young seedlings and saplings are filling in the understory and shading out pinemat manzanita. Some of this area is further along in understory development, with several canopy layers dominated by California red fir. As the canopy cover increases, the shade intolerant western white pine declines in the understory.

This forest is susceptible to several pathogens that can break out to epidemic levels and cause extensive stand mortality. Native pathogens are a natural component of the ecosystem and, at times, have important functions within the forest cycle. Trees become more vulnerable to pests and disease when overstressed due to drought or competition for sunlight. Pathogens often infest weak trees and spread in overcrowded conditions. Surviving trees may benefit from the death of overstocked trees when canopy gaps open and provide opportunities for the regeneration of the same or different species.

The major pathogens that affect California red fir in this area are 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 et al., 2000). Other diseases that can affect red fir are the heart rots yellow cap fungus (*Pholiota limonella*) and Indian paint fungus (*Echinodontium tinctorium*). Insects that can affect red fir are cone maggots (*Earomyia* spp.), several chalcids (*Megastigmus* spp.) and cone moths (*Barbara* spp. and *Eucosma* spp.) (Burns, et al., 1990).

The reference state consists of the most successional 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 successional 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

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Tree					
0	Tree (understory only)			0-35	
	California red fir	ABMA	<i>Abies magnifica</i>	0-26	0-5
	mountain hemlock	TSME	<i>Tsuga mertensiana</i>	0-7	0-2
	western white pine	PIMO3	<i>Pinus monticola</i>	0-2	0-1
Shrub/Vine					
0	Shrub			0-18	
	gooseberry currant	RIMO2	<i>Ribes montigenum</i>	0-17	0-1
	whiteveined wintergreen	PYPI2	<i>Pyrola picta</i>	0-1	0-1
Grass/Grasslike					
0	Grass/Grasslike			0-13	
	Ross' sedge	CARO5	<i>Carex rossii</i>	0-7	0-2
	squirreltail	ELEL5	<i>Elymus elymoides</i>	0-3	0-1
	western needlegrass	ACOC3	<i>Achnatherum occidentale</i>	0-3	0-1
Forb					
0	Forb			0-7	
	slender penstemon	PEGR4	<i>Penstemon gracilentus</i>	0-3	0-1
	white hawkweed	HIAL2	<i>Hieracium albiflorum</i>	0-2	0-1
	Holboell's rockcress	ARHO2	<i>Arabis holboellii</i>	0-1	0-1

Table 6. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height M	Canopy Cover (%)	Diameter Cm	Basal Area (square M/hectare)
Tree							
California red fir	ABMA	<i>Abies magnifica</i>	Native	–	40-50	–	–
western white pine	PIMO3	<i>Pinus monticola</i>	Native	–	2-5	–	–
mountain hemlock	TSME	<i>Tsuga mertensiana</i>	Native	–	1-3	–	–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Ross' sedge	CARO5	<i>Carex rossii</i>	Native	–	0-2
squirreltail	ELEL5	<i>Elymus elymoides</i>	Native	–	0-1

western needlegrass	ACOC3	<i>Achnatherum occidentale</i>	Native	–	0-1
Forb/Herb					
Holboell's rockcress	ARHO2	<i>Arabis holboellii</i>	Native	–	0-1
white hawkweed	HIAL2	<i>Hieracium albiflorum</i>	Native	–	0-1
slender penstemon	PEGR4	<i>Penstemon gracilentus</i>	Native	–	0-1
Shrub/Subshrub					
whiteveined wintergreen	PYPI2	<i>Pyrola picta</i>	Native	–	0-1
gooseberry currant	RIMO2	<i>Ribes montigenum</i>	Native	–	0-1
Tree					
California red fir	ABMA	<i>Abies magnifica</i>	Native	–	0-5
mountain hemlock	TSME	<i>Tsuga mertensiana</i>	Native	–	0-2
western white pine	PIMO3	<i>Pinus monticola</i>	Native	–	0-1

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 10. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 11. Community 1.5 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 12. Community 1.5 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height M	Canopy Cover (%)	Diameter Cm	Basal Area (square M/hectare)
Tree							
California red fir	ABMA	<i>Abies magnifica</i>	Native	30.5-	45-65	–	–
California red fir	ABMA	<i>Abies magnifica</i>	Native	–	10-15	–	–

Animal community

Animals that use California red fir forests include martin, fisher, wolverine, black bear, squirrel, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, mountain beaver, and pocket gopher. Deer browse the leaves of these conifers in winter and the new growth in the spring. Birds forage for insects in the foliage of mature conifers. Spruce grouse feed on Sierra lodgepole pine needles during the winter (Cope, 1993). The California red fir cones are cut and cached by squirrels. Western white pine seeds are eaten by red squirrels and deer mice (Griffith, 1992). The seeds of Sierra lodgepole pine are eaten by squirrels, chipmunks, birds, and mice (Cope, 1993). The fruit of pinemat manzanita is eaten by black bear, deer, coyote, and various birds and rodents. Young foliage after fire is browsed by deer, but older foliage is not desirable. The grasses provide forage for deer and small rodents.

Recreational uses

This site is suitable for trails.

Wood products

The wood from California red fir is straight-grained and light. California red fir is soft but stronger than the wood of other firs and has a low specific gravity. The wood is used for fuel, coarse lumber, quality veneer, solid framing, plywood, printing paper, high-quality wrapping paper, and is preferred for pulping (Cope, 1993). Western white pine wood is straight-grained, light, and highly valued. The wood is used to make window and door sashes, doors, paneling, dimension stock, matches, wood carvings and toothpicks (Griffin, 1992).

Other products

California red fir is used for Christmas trees (Cope, 1993). Native Americans chewed the resin of western white pine, wove baskets from the bark, concocted a poultice for dressing wounds from the pitch, and collected the cambium in the spring for food (Griffith, 1992). Cones of western white pine are collected for novelty items. The wood is good for carving. The tree is also planted as an ornamental (Griffin, 1992).

Other information

Forest Pathogens: The parasitic red fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. *magnificae*) is common in the survey area, as evident by witches brooms, top kill, stem cancers and swellings. The vegetative shoots of the dwarf mistletoe are often present from spring to fall. Infestation of the red fir dwarf mistletoe can cause reduced growth and vigor. A fungus, (*Cytospora abietis*), kills the branches that are infected with dwarf mistletoe. Dwarf mistletoe 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 (Burns, et al., 1990). Fir broom rust (*Melampsorella caryophyllacearum*) is a disease that causes dense witches brooms with stunted yellow needles. 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). This disease can damage tree growth by reducing crown development. Mortality is less common in mature trees than in younger regeneration trees. Annosus root rot (*Heterobasidion annosum*) can affect large acres of fir forest. It spreads from infected roots to healthy roots. 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 also be spread aerially, infecting freshly cut stumps or other fresh tree wounds. Painting borax on freshly cut stumps restricts the entry of the fungus. In all management activities it is important to reduce damage to the bark. The rot itself does not often kill red fir directly, but it weakens the tree and makes it easier for bark beetles (*Scolytus* spp.) to infest the tree (Burns, et al., 1990). The fir engraver (*Scolytus ventralis*) can cause extensive damage to red fir forests and outbreaks can cause mortality to several acres of trees. It can reach epidemic levels when the trees are stressed due to drought, annosus root rot, dwarf mistletoe, or from fire damage. (Burns, et al., 1990). Site index documentation: Schumacher (1928) was used to determine forest site productivity for red fir. 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.

Table 13. 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	60	60	214	214	140	050	50TA	Schumacher, Francis X. 1928. Yield, stand and volume tables for red fir in California. University of California Agricultural Experiment Station Bulletin 456.
California red fir	ABMA	60	60	214	214	—	—	—	

Inventory data references

The following NRCS vegetation plots were used to describe this ecological site: 789177 789363 789364- type location

Type locality

Location 1: Tehama County, CA	
Township/Range/Section	T30 N R4 E S28
General legal description	The type location is about 3,250 feet northwest of the Southwest Entrance Station to Lassen Volcanic National Park, north of the trail that goes from the southwest entrance to Brokeoff Mountain.

Other references

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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:

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:
