

Ecological site F022AX100CA

Frigid, Sandy, Moist, Outwash Fan

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General information

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

MLRA notes

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

Major Land Resource Area 22A, Sierra Nevada Mountains, is located predominantly in California and a small section of western Nevada. The area lies completely within the Sierra Nevada Section of the Cascade-Sierra Mountains Province. The Sierra Nevada range has a gentle western slope, and a very abrupt eastern slope. The Sierra Nevada consists of hilly to steep mountains and occasional flatter mountain valleys. Elevation ranges between 1,500 and 9,000 ft throughout most of the range, but peaks often exceed 12,000 ft. The highest point in the continental US occurs in this MLRA (Mount Whitney, 14,494 ft). Most of the Sierra Nevada is dominated by granitic rock of the Mesozoic age, known as the Sierra Nevada Batholith. The northern half is flanked on the west by a metamorphic belt, which consists of highly metamorphosed sedimentary and volcanic rocks. Additionally, glacial activity of the Pleistocene has played a major role in shaping Sierra Nevada features, including cirques, arêtes, and glacial deposits and moraines. Average annual precipitation ranges from 20 to 80 inches in most of the area, with increases along elevational and south-north gradients. Soil temperature regime ranges from mesic, frigid, and cryic. LRU “X” represents ecological sites driven by abiotic features that override the typical soils or climatic features that drive most of the other LRU zones. In the Sierra Nevada these sites are typically driven by water features associated with lotic or lentic riparian systems. Other features maybe shallow bedrock, or unique chemical development which affects the growth of typical vegetation.

Classification relationships

Forest Alliance = *Pinus contorta* ssp. *murrayana* – Lodgepole pine forest; Association = *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 sloping meadows and forest edges on alluvial flats at elevations of approximately 6200 to 6500 feet. It often occurs in depressions between moraine features. Soils are very deep, with a weak fragipan at 12 to 65 inches and redox features at 10 to 20 inches. The fragipan creates a perched water table, so soils are saturated at shallow depths during the wet season, and droughty during the dry season. This limits the forest canopy to dominance by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*), which is tolerant of both saturated and droughty soil conditions. The understory is moist meadow vegetation with willows, grasses and sedges. Lemmon's willow (*Salix lemmonii*) is the most common shrub on this site.

Associated sites

F022AF002CA	Frigid, Sandy, Or Loamy Outwash Occurs on adjacent gently sloping outwash, moraines and outwash fans with moderatley deep to very deep soils of mixed origin. Vegetation is an open Jeffrey pine (<i>Pinus jeffreyi</i>) forest.
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F022AF003CA	Frigid, Loamy, Fragipan, Outwash Occurs on adjacent gently sloping glacial outwash with very deep soils with a weak fragipan that causes a seasonally perched water table. Vegetation is a dense Sierra lodgepole pine (<i>Pinus contorta</i> var. <i>murrayana</i>) forest with a sparse grass understory.
R022AX102CA	Frigid E-C Meadow System Occurs on nearby low gradient Rosgen C to E type channels with broad gently sloped floodplains. Vegetation is a wet to dry meadow complex, with Lemmon's (<i>Salix lemmonii</i>) and Geyer willow (<i>Salix geyeriana</i>), sedges, grasses and forbs.

Similar sites

F022AF001CA	Frigid Sandy Outwash Plain Gentle Slopes Occurs on undulating outwash soils that are deep to a duripan. The depth to the duripan is variable due to undulating topography, which creates a mosaic of saturated and very droughty soils. The vegetation is a patchy Sierra lodgepole pine (<i>Pinus contorta</i> var. <i>murrayana</i>) forest, with western juniper (<i>Juniperus grandis</i>) scattered in shallower dry areas. Willows are absent, and only patches of grasses occur in the understory.
F022AF003CA	Frigid, Loamy, Fragipan, Outwash Occurs on very deep soils from outwash and alluvium from mixed sources. Soils have a weak fragipan that causes a perched water table during wet seasons and droughty conditions during dry seasons. The vegetation is dense Sierra lodgepole pine (<i>Pinus contorta</i> var. <i>murrayana</i>) forest with sparse grasses in the understory.

Table 1. Dominant plant species

Tree	(1) <i>Pinus contorta</i> var. <i>murrayana</i>
Shrub	(1) <i>Salix lemmonii</i>
Herbaceous	Not specified

Physiographic features

This ecological site is found on level to gently sloping meadows and forest edges on outwash and lake terraces and valley flats. It is primarily located along the southern shore of Lake Tahoe, near lake level, with elevations ranging from 6,220 to 6,500 feet.

Table 2. Representative physiographic features

Landforms	(1) Outwash terrace (2) Lake terrace (3) Valley flat
Flooding duration	Brief (2 to 7 days)

Flooding frequency	None to rare
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to frequent
Elevation	1,900 – 1,980 m
Slope	0 – 10 %
Water table depth	30 – 180 cm
Aspect	Aspect is not a significant factor

Climatic features

The average annual precipitation is 23 to 49 inches, mostly in the form of snow in the winter months (November to April). The average annual air temperature ranges from 41 to 46 degrees Fahrenheit. The frost-free (>32F) season is 20 to 90 days and the freeze-free (>28F) season is 55 to 120 days, with a median of 80 days.

Table 3 Representative climatic features

Frost-free period (average)	60 days
Freeze-free period (average)	90 days
Precipitation total (average)	910 mm

Influencing water features

This site borders wetland areas, including wet meadows and marshes. The soil meets the hydric soil criteria for 2b3(<http://soils.usda.gov/use/hydric/criteria.html>). During the growing season, the water table can range from 12 to 24 inches. The area can be briefly flooded and ponded during times of rapid spring snowmelt.

Soil features

The soils associated with this ecological site are very deep and developed from granitic alluvium. These soils are poorly to moderately well drained with slow to moderately rapid permeability. The soil moisture regime is xeric and the soil temperature regime is frigid. Surface textures are loamy coarse sand and sandy loam. Partially decomposed organic matter overlies the mineral horizons (Oi horizon). Subsurface textures are loamy coarse sand, clay loam, fine sandy loam, sandy loam, sandy clay loam, and clay. Lower horizons have fine textures that may be buried lake sediments. Mottles from the seasonally high water table are present below 14 inches. The soils that are correlated to this ecological site are the Marla soils (Sandy, mixed, frigid Aquic Dystrocherepts) and the Ubaj soils (Fine-loamy, mixed, superactive, frigid Ultic Haploxeralfs).

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

7471 ; Marla loamy coarse sand, 0 to 5 percent slopes ; Marla ; ; 80; Ubaj ; 4
7541 ; Ubaj sandy loam, 0 to 9 percent slopes ; Ubaj ; ; 80; Marla ; 2

7011 ; Beaches ; Marla ; ; 5
7444 ; Christopher-Gefo complex, 0 to 5 percent slopes ; Marla ; ; 5; Ubaj ; ; 5
9011 ; Oxyaquic Cryorthents-Aquic Xerorthents-Tahoe complex, 0 to 15 percent slopes ; Marla ; ; 5
7431 ; Celio loamy coarse sand, 0 to 5 percent slopes ; Marla ; ; 4
7441 ; Christopher loamy coarse sand, 0 to 9 percent slopes ; Marla ; ; 2
7442 ; Christopher loamy coarse sand, 9 to 30 percent slopes ; Marla ; ; 2
7443 ; Christopher gravelly loamy coarse sand, 9 to 30 percent slopes ; Marla ; ; 2
7451 ; Gefo gravelly loamy coarse sand, 2 to 9 percent slopes ; Marla ; ; 2
7452 ; Gefo gravelly loamy coarse sand, 9 to 30 percent slopes ; Marla ; ; 2
7461 ; Jabu coarse sandy loam, 0 to 9 percent slopes ; Marla ; ; 2
7462 ; Jabu coarse sandy loam, 9 to 30 percent slopes ; Marla ; ; 2
7491 ; Oneidas coarse sandy loam, 0 to 5 percent slopes ; Marla ; ; 2
7492 ; Oneidas coarse sandy loam, 5 to 15 percent slopes ; Marla ; ; 2
7051 ; Oxyaquic Xerorthents-Water association, 0 to 5 percent slopes ; Marla ; ; 1
7411 ; Cagwin-Rock outcrop complex, 5 to 15 percent slopes, extremely stony ; Marla ; ; 1
7412 ; Cagwin-Rock outcrop complex, 15 to 30 percent slopes, extremely stony ; Marla ; ; 1
7413 ; Cagwin Rock outcrop complex, 30 to 50 percent slopes, extremely stony ; Marla ; ; 1
7414 ; Cagwin-Rock outcrop complex, 50 to 70 percent slopes, extremely stony ; Marla ; ; 1
7421 ; Cassenai gravelly loamy coarse sand, 5 to 15 percent slopes, very stony ; Marla ; ; 1
7425 ; Cassenai cobbly loamy coarse sand, moist, 5 to 15 percent slopes, very bouldery ; Marla ; ; 1
7426 ; Cassenai cobbly loamy coarse sand, moist, 15 to 30 percent slopes, very bouldery ; Marla ; ; 1

Table 4. Representative soil features

Parent material	(1) Alluvium – granite
Surface texture	(1) Loamy coarse sand
Family particle size	(1) Sandy
Drainage class	Poorly drained
Permeability class	Slow to moderately rapid
Soil depth	200 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	10.16 – 17.53 cm
Soil reaction (1:1 water) (0-101.6cm)	5.1 – 7.3

Subsurface fragment volume <=3" (Depth not specified)	Not specified
Subsurface fragment volume >3" (Depth not specified)	Not specified

Ecological dynamics

This ecological site consists primarily of a forest of Sierra lodgepole pine. It is more common in the southern portion of the Lake Tahoe Basin, especially within the Upper Truckee River and Trout Creek drainages. It is currently found in narrow strips between wet meadow areas, and in drier white fir-Jeffery pine forest. The moist meadow vegetation can be found in the understory. Some wetland plants are also found in this area due to the seasonally high water table of 12 inches.

The presumed historic most successional advanced community phase is identified as Sierra lodgepole pine/Lemmon's willow (*Salix lemmonii*). This phase likely consisted of multi-aged stands with areas of large older open Sierra lodgepole pines with intermixed small areas of dense young seedlings. White fir (*Abies concolor*), Jeffrey pine (*Pinus jeffreyi*) and incense cedar (*Calocedrus decurrens*) were occasionally present.

Sierra lodgepole pine can tolerate harsher conditions than many other conifers—especially cold, light, heat, drought, saturation, and hardpan soils (Kocher, 2005; Lotan and Critchfield, 1990). On these montane sites, lodgepole pine grows in the cold air drainages (Agee, 1994). They are moderately tolerant to shade and competition. The thin bark and shallow root systems of lodgepole pine makes it susceptible to fire and windfall (Lotan and Critchfield, 1990). Prolonged drought and flooding can kill the trees or make them vulnerable to disease and pest outbreaks.

Fire can play an important role in thinning and renewing Sierra lodgepole forests. Studies on fire frequency in Sierra lodgepole pine forests vary from 20 to 200 years, depending on location, elevation, and precipitation (Cope, 1993; Murphy and Knopp, 2000). This area has moderate precipitation, is at mid-elevations, and has seasonal wetness. The fire interval for moderate or severe fires was likely between 70 to 100 years, and was heavily correlated with mountain pine beetle infestations and the decline of the overstory trees. Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. In addition to a natural fire regime, it is believed the Washoe Tribe used fire to preserve meadow environments and to keep the forests open (Murphy and Knopp, 2000).

Human disturbance regimes have altered the historic community phase and its natural cycles. Much of the lodgepole pine forest terrain was clear-cut during the Comstock era from the mid-1870s to the mid-1890s although small scale logging occurred in sections from 1911 to the 1970s (Murphy and Knopp, 2000). Intense sheep and cattle grazing began as early as 1850, especially in the meadows. In 1924, fire exclusion became national policy (Murphy and Knopp, 2000), which led to an increase in forest density as well as the buildup of fuel in both the overstory and the understory. These disturbances and fire exclusion created lodgepole pine forests which are generally young, overcrowded, and do not necessarily resemble the historic forest.

The reference state consists of the most successional advanced community phase (numbered 1.1) as well as other community phases that 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

Figure 5. F022AX100CA

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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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							
Sierra lodgepole pine	PICOM	<i>Pinus contorta var. murrayana</i>	Native	–	27-50	–	–
white fir	ABCO	<i>Abies concolor</i>	Native	–	5-10	–	–
Jeffrey pine	PIJE	<i>Pinus jeffreyi</i>	Native	–	3-5	–	–
incense cedar	CADE27	<i>Calocedrus decurrens</i>	Native	–	0-2	–	–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
bentgrass	AGROS2	<i>Agrostis</i>	Native	–	3-7
California brome	BRCA5	<i>Bromus carinatus</i>	Native	–	1-3
sedge	CAREX	<i>Carex</i>	Native	–	0-2
Forb/Herb					
Torrey's blue eyed Mary	COTO	<i>Collinsia torreyi</i>	Native	–	–
cryptantha	CRYPT	<i>Cryptantha</i>	Native	–	–
ragwort	SENEC	<i>Senecio</i>	Native	–	–
checkerbloom	SIDAL	<i>Sidalcea</i>	Native	–	–
mayflower	MAIAN	<i>Maianthemum</i>	Native	–	–
yampah	PERID	<i>Perideridia</i>	Native	–	–
Shrub/Subshrub					
Lemmon's willow	SALE	<i>Salix lemmonii</i>	Native	–	3-7
currant	RIBES	<i>Ribes</i>	Native	–	0-2
Virginia rose	ROVIV2	<i>Rosa virginiana var. virginiana</i>	Native	–	–
Tree					
Sierra lodgepole pine	PICOM	<i>Pinus contorta var. murrayana</i>	Native	–	3-7
white fir	ABCO	<i>Abies concolor</i>	Native	–	3-7
incense cedar	CADE27	<i>Calocedrus decurrens</i>	Native	–	–

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 1.6 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Animal community

These forests provide cover at the edges of meadows and riparian corridors. There are many mammals including bear, deer, and squirrels, as well as almost 50 bird species that use Sierra lodgepole pine forests for food, cover, and habitat. Dead or dying trees provide nesting sites for cavity-nesting birds. The fallen branches from these trees also provide sites for ground-nesting birds and mammals. The seeds are a food source for squirrel, chipmunk, birds, and mice (Cope, 1993).

Recreational uses

This site is primarily used for hiking trails along streams and meadows.

Wood products

The wood is suited for common lumber grades and has potential for structural particle board. It can also be used for light framing materials, interior paneling, exterior trim, posts, railroad ties, pulp, and paper. The uniform size of Sierra lodgepole pine makes harvesting efficient (Cope, 1993). In this area, the pole-sized trees may be useful as fence material, but this open lodgepole community would not be very productive for commercial harvest.

Other products

All willows produce salacin, which is closely related chemically to aspirin. Native Americans used various preparations from willows to treat toothache, stomachache, diarrhea, dysentery, and dandruff. Native Americans also used flexible willow stems for making baskets, bows, arrows, scoops, fish traps, and other items (Uchytíl, 1989).

Other information

Site index documentation: Alexander (1966), Schumacher (1926), and Meyer (1961) were used to determine forest site productivity for lodgepole pine, white fir and Jeffrey pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI. Trees appropriate for site index measurement typically occur in stands of community phases 1.4 and 1.6. Site trees are selected according to guidance in the cited publications. Please refer to the Tahoe Basin Area Soil Survey for detailed site index information by soil component.

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
white fir	ABCO	55	55	109	109	70	030	50TA	Schumacher, Francis X. 1926.Yield, stand, and volume tables for white fir in the California pine region. University of California Agricultural Experiment Station Bulletin 407.
Sierra lodgepole pine	PICOM	80	80	88	88	100	520	100TA	Alexander, Robert R. 1966. Site indexes for Lodgepole pine, with corrections for stand density: instructions for field use. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station Research Paper RM-24.
Jeffrey pine	PIJE	80	80	69	69	40	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Inventory data references

The following NRCS plots were used to describe this ecological site. Co03013 Ev0201 lo03310 101 106 107 108

Other references

Agee, James K.1994. The Lodgepole Pine Series in Fire and Weather Disturbances in Terrestrial Ecosystems of the Eastern Cascades. From volume III:Assessment. USDA, Forest Service, Pacific Northwest Research Station. Gen. Tech. Report.

Amman, Gene D., McGregor, Mark D., Dolph Robert E. 1990. Mountain Pine Beetle: Forest Insect and Disease Leaflet 2. USDA, Forest Service, Pacific Northwest Region, Portland OR.

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Kocher, Susan D. 2005. Why does Lodgepole Pine Grow Here? In: Working in the Woods: A guide for California's Landowners. University of California, Berkeley; Division of Agriculture and Natural Resources Cooperative Extension –Forestry. <http://www.cnr.berkeley.edu/departments/espm/extension/LODGEPOL.HTM>

Lotan, James, E.; Critchfield, William B. 1990. Pinus contorta: Lodgepole Pine In: Burns, Russel M., Honkala, Barbara H. eds. Silvics of North America, Vol 1. Conifers.

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Parker, Albert J. 1986. Persistence of lodgepole pine forests in the central Sierra Nevada. Ecology, 67(6):1560-1567.

Peattie, Donald C. 1953. A Natural History of Western Trees. Houghton Mifflin; Boston

United States Department of Agriculture, Natural Resources Conservation Service. 2007. Soil survey of the Tahoe Basin Area, California and Nevada. Accessible online at: http://soils.usda.gov/survey/printed_surveys/. Accessed on November 5, 2009.

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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:
