United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with United States Department of the Interior, National Park Service, and Regents of the University of California

Ecological Site Descriptions of Lassen Volcanic National Park, California

Nondiscrimination Statement

Citation

The correct citation for this report is as follows:
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Cover Caption

Site photo of ecological site R022BI1204CA – Glaciated Mountain Slopes and the corresponding soil profile of Terracelake soil series. Root limiting bedrock is at a depth of 37 inches (94 cm.). Pinemat Manzanita (*Arctostaphylos nevadensis*) is common on soils less than 40 inches (102 cm.) deep.

Contents

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Ecological Sites Data Collection Methods for Lassen Volcanic National Park

This section was prepared by Kendra Moseley, Marchel Munneche, and Lyn Townsend.

This section discusses the methods used to develop the ecological site concepts and descriptions for the Lassen Volcanic National Park.

Introduction

The methods used to develop the ecological site concepts and descriptions for Lassen Volcanic National Park (LAVO), followed the current guidelines for ecological sites provided in the “National Range and Pasture Handbook” (2003 & 2006), chapters 3 and 4 specifically, the “National Forestry Manual” (September 2010), and the “National Forestry Handbook” (2004). The publication “Monitoring Methods for Shrubland, Grassland, and Savanna Ecosystems” (2009) was also used for some specific data collection methods that are described in further detail below. See References for links to these documents online.

General Site Development Concepts

Ecological site concept and description development is a complex process that requires several steps and multiple iterations of data collection and peer review. For an in-depth description of the general ecological site concept development process, refer to “Ecological Site Development: A Gentle Introduction” by K. Moseley, P. Shaver, H. Sanchez, and B. Bestelmeyer in the December 2010 “Rangelands” journal.

Draft ecological site concepts were developed for LAVO after an exhaustive literature review of the ecosystems within the Park, and several reconnaissance field visits to begin to understand the general plant-soil relationships. This information served as the foundation of the ecological relationships, including draft state-and-transition models that highlighted the generally understood dynamics of the ecological sites as they were originally drafted.

The next step required a vegetation specialist to spend time in the field with soil scientists mapping the soils in the Park, collecting vegetation data at as many soil description locations as possible, focusing on representative soil description locations as top priority. These data consisted of ocular estimates of foliar cover, species composition by weight estimates, line-point intercept data for foliar cover, ground cover measurements, site index data collection, Culmination of Mean Annual Increment (CMAI) data collection, and double sampling for annual production of understory vegetation and rangeland vegetation. Field notes, photographs and Global Positioning System (GPS) locations were taken at all data collection locations. The vegetation sites are labeled with the same ID as the soils descriptions to ensure that vegetation data and soils data were linked.

Data were collected and entered into a database for organization and analysis in order to test the original site concepts and determine what site characteristics truly represented the ecological site concepts being developed. As these concepts were refined using the vegetation and soil and site characteristics, representative locations were determined for additional data collection to properly define the ecological site concepts and their range in variation.

All information and data compiled during the process of the project were entered into the Ecological Site Information System, including all data representative of the ecological site, photos, inventory locations, references, ecological dynamics, and a reviewed and refined State and Transition Models (STM).

Due to the difficulties of getting around the Park, or the unique, small extent of ecological sites, some sites did not receive the same data collection intensity as others that were more accessible or of larger extent. This is evident in the amount of inventory listed at the end of the of the ecological site descriptions. All ecological sites are considered dynamic documents that are continually being improved and should be improved as the information becomes available.

Specific Data Collection Methods

Vegetation data were collected at the soil (pedon) description locations or in close proximity. Ecological site type locations were selected at places that best represented the reference community phase for the ecological site, as well as the best representation of the soils for that ecological site, ensuring tight soil-site correlation.

Full Data Characterization Data Plots

Each reference type location for the ecological site had a minimum of one to three full data characterization data plots, depending on size and extent of the ecological site throughout the Park. Small or unique sites may not have any data collection at this level of detail due to complexity and variation within the site and may only include ocular estimates and line-point intercept. When possible, annual production data were collected using double sampling. For example, the Thermal Seeps site was limited in extent for repeatability and high variety in composition and therefore, full data characterization was difficult. For a few plots, annual production was not collected.

All reference type locations included:

1) Ocular estimates
2) Line-point intercept
3) Annual production (one year's data only) using either double sampling or comparative yield
4) Photos
5) GPS locations
6) Full soil data characterization correlated

In addition to the protocols listed above for rangeland sites, site index and basal area data were collected for forested ecological sites.

7. Site Index
8. Basal Area

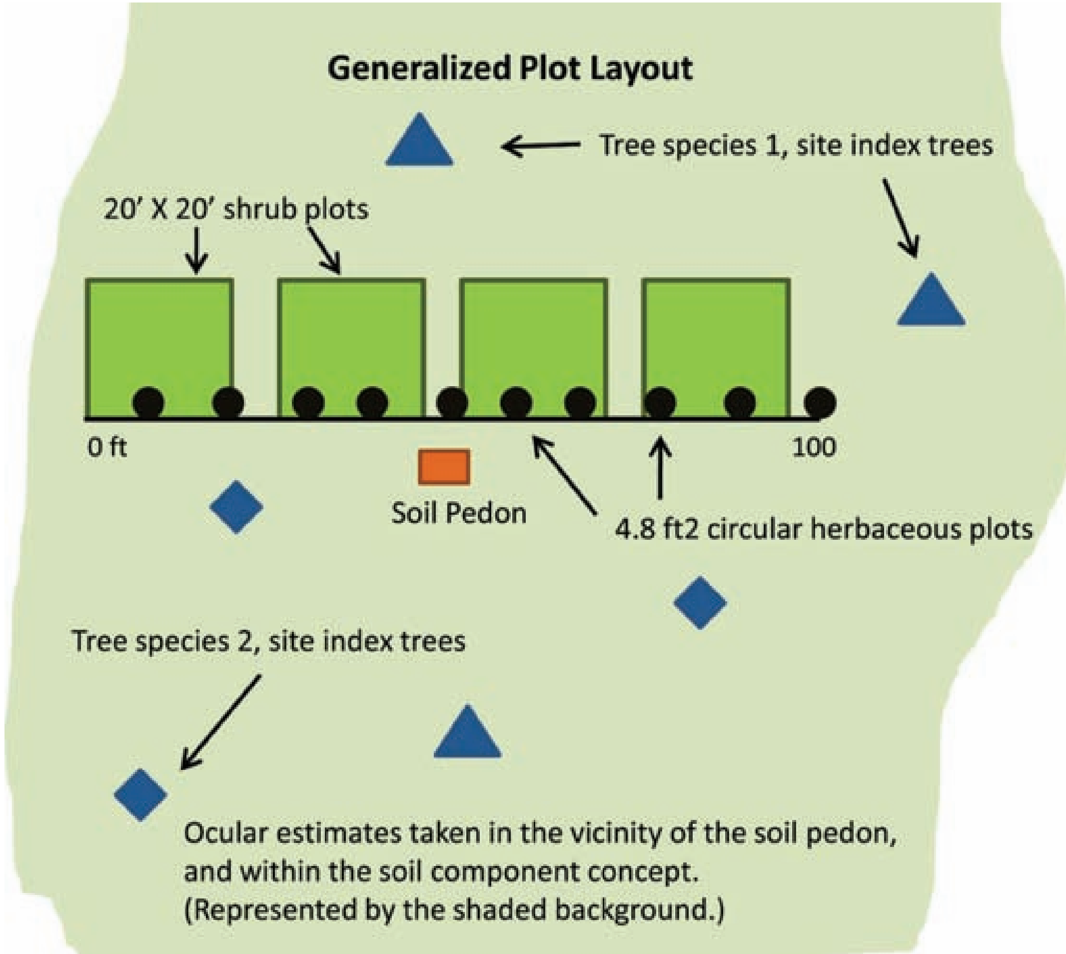

Figure 1 –This diagram illustrates a typical plot layout.

Ocular Estimation

Visual plant cover estimates are very subjective but are often used because they are more rapid than other cover methods. Species and their covers are estimated visually as a percent of the area. This method also allows information to be collected on the presence and coverage of trace species that may not be discovered when collecting transect data.

For LAVO, species composition by weight and foliar cover estimates were made in the area around the soil pedon, (approximately 0.1 acre). There was no set area to be covered. The main focus was to stay on the soil component concept, which was determined by discussions with the soil scientist (for, example shallow soil, with bedrock outcrop).

Line-Point Intercept

Line-point intercept is a rapid, accurate method for quantifying soil cover including vegetation, litter, rocks and biotic crusts. These measurements are related to wind and water erosion, water infiltration and the ability of the site to resist and recover from degradation. For detailed methods, refer to “Monitoring Methods for Shrubland, Grassland, and Savanna Ecosystems”, ARS Jornada Experimental Range (2009).

This method was used in LAVO for all rangeland ecological sites, as well as for description of the understory and overstory vegetation in all forestland ecological sites. Data points were collected at one foot intervals along the transect, getting 100 points of coverage.

Double Sampling

Weight is the most meaningful expression of the productivity potential of a soil and its related plant communities or an individual species. The total production of all plant species of a plant community during a single year is designated as total annual production. For specific purposes, production of certain plants or groups of plants can be identified as herbage production for herbaceous species, woody-plant production for woody plants, and production of forage species for plants grazed by wildlife. Total annual production includes the above-ground parts of all plants produced during a single growth year regardless of accessibility to grazing animals. An increase in the stem diameter of trees and shrubs, production from previous years, and underground growth are excluded. The detailed methods for double sampling can be obtained in the National Resources Conservation Service (NRCS) “National Range and Pasture Handbook”, Chapter 4 (2006).

For LAVO, this method was used for all herbaceous and woody understories in forested and rangeland ecological sites. Woody annual production, including both shrubs and trees under 4.5 meters (13 feet), was collected along a 100-foot transect laid out within proximity of the soil pit location and representing the soil component being correlated, the same transect as the ocular estimates. Shrub, sub-shrub and tree production was sampled and estimated in four, 20 by 20 foot plots, which were placed at 25 foot intervals along the transect. Herbaceous annual production was collected along the same transect in ten, 4.8 square foot plots, at 10 foot intervals.

Site Index and Culmination of Mean Annual Increment (CMAI) for Height Growth and Wood-fiber Production and Ocular Estimates of Associated Cover, Basal Area, Crown Cover, and Diameters.

Typically, three trees of each common tree species in close proximity to the soil pedon location were measured for height and age to compute the site index for that species (e.g., three common species would have nine trees measured for site index). The CMAI for the site index for each individual species was interpolated from tables in the applicable site index/CMAI reference publication for that species. At least one basal area measurement was taken near the soil pedon (using a basal area prism or angle gauge).

References

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Major Land Resource Area 22B (Southern Cascade Mountains)

Lassen Volcanic National Park is located in Major Land Resource Area 22B (Southern Cascade Mountains). This MLRA covers the southernmost area of the north-to-south-trending Cascade Mountains. The Southern Cascade Mountains are made up primarily of Tertiary and Quaternary volcanics (basalt, andesite, dacite, and rhyolite) exposed as prominent peaks and volcanic uplands that are surrounded by lower, moderately steep and steep shield and composite volcanoes and cinder cones.

Well-known peaks and recently active volcanoes in this area include Medicine Lake Volcano, Mount Lassen, and Mount Shasta. Alluvial and lacustrine deposits have collected in the depressions on lava flows, between lava flows, and in stream valleys and basins. Glacial drift occurs at the higher elevations.

Elevation generally ranges from about 1,500 feet (455 meters), in the foothills, to 8,200 feet (2,500 meters). It is as high as 14,162 feet (4,318 meters) on Mount Shasta.

The average annual precipitation is 15 to 80 inches (380 to 2,030 millimeters). The annual precipitation can be as high as 125 inches (3,175 millimeters). The precipitation falls mainly from fall to spring, mostly as snow. Winter precipitation is from Pacific storms that are frontal in nature. The amount of precipitation decreases from west to east. Summers are typically warm and dry, but there are occasional thunderstorms. The average annual temperature is 33 to 62 degrees F (1 to 17 degrees C).

The rainfall and snowfields that are abundant on the higher mountain slopes supply the water needed to support forests and rangelands as well as help in meeting water needs of the lower areas by contributing to perennial streams.

This MLRA has three main vegetation types-—low-elevation mixed conifer (ponderosa pine) forest, mixed conifer forest, and upper montane red fir forest.

Meadows occur throughout the forested areas. Federally owned land, mainly as national forests, makes up more than half of this MLRA. The remaining land is privately owned ranches, farms, and forestland. About 72 percent of the total MLRA consists of forests which are used for wildlife habitat, recreation, timber, and watershed, and about 17 percent is rangeland. Only about 2 percent of the MLRA is used as cropland.

Ecological Sites in Lassen Volcanic National Park

This section was prepared by Marchel Munnecke.

This section discusses the characterization and management of forestland and rangeland in Lassen Volcanic National Park and provides a general description of the vegetation.

Characterization and Management of Forestlands and Rangelands

Forestlands and rangelands are currently subject to an abundance of uses. It is important to characterize and quantify these areas based upon their ability to produce various kinds, proportions, and amounts of plants. These abilities and their resultant plant communities are largely dependent on the soil, climate, topography, aspect, and slope of the landscape as well as on other abiotic features. To better understand these soil-plant interactions and the effects of selected management practices, the Natural Resources Conservation Service classifies forestlands and rangelands into ecological sites.

Landscapes of native vegetation are divided into ecological sites for the purposes of inventory, evaluation, and management. An ecological site is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation.

An ecological site is the product of all the environmental factors responsible for its development, including parent material, landscape, climate, soils, living organisms, hydrology, fire, and time in place. Ecological site descriptions contain information on each of these environmental factors. Included are brief descriptions of: a) physiographic and climatic features; b) major identifiable plant community types that may occupy the site, including the reference plant community; c) total annual production; d) ecological dynamics of the plant communities; e) soils and their main properties; and f) site interpretations and general management considerations for wildlife, hydrology, recreation, fire, aesthetics, and restoration/revegetation. The reference plant community for a site is the plant community that has evolved under natural ecological processes and disturbances and is considered to be at its highest natural site potential under the current climate. It is a plant community that has developed on the site as a result of all site-forming factors and is best adapted to the unique combination of environmental factors associated with the site. Natural disturbances, such as fire, drought, herbivory, and flooding, were inherent in the development and maintenance of these reference plant communities. Plant communities that are or have been subjected to anthropogenic disturbances or physical site deterioration or have been protected from their natural disturbance regimes do not typify the reference state and may exist in a stable or steady state that is different from the reference plant community.

The reference plant community of an ecological site is not a precise assemblage of species for which the proportions are the same from place to place or from year to year. In all plant communities, variability is apparent in productivity and occurrence of individual species. Special boundaries of the communities can be recognized by characteristic patterns of species composition, association, and community structure.

Generally one species or group of species dominates the site, and their stability within the natural dynamics or disturbances to the site allow them to be used as the distinguishing factor to differentiate one site from another. At times, less frequently occurring plants may increase on a site or plants not formerly occurring in the reference community may invade the site. The presence or abundance of these plants may fluctuate greatly due to the plant's ability to adapt to the differences in the microenvironment, weather conditions, soil alterations, or human actions. Using these species for site identification can be misleading; thus they should not be used to differentiate sites.

The following ecological site inventory methods are used in determining the characteristic plant communities of an ecological site:

1. Identification and evaluation of reference and/or relict sites with similar plant communities and associated soils.
2. Interpolation and extrapolation of plant, soil, and climatic data from existing historic reference areas along a continuum to other points on that continuum for which no suitable reference community is available.
3. Evaluation and comparison of the same ecological site in different areas that have experienced different levels of disturbance and management. Further comparison is made with areas that are not disturbed.
4. Evaluation and interpretation of research data dealing with the ecology, management, and soils of plant communities.
5. Review of historical accounts, survey and military records, and botanical literature of the area.

The initial description of the reference state should be considered as an approximation subject to modification as additional knowledge is gained or discovered.

Plant communities change along environmental gradients. When changes in soils, aspect, topography, or moisture conditions are abrupt, the plant community boundaries are reasonably distinct. Boundaries are less distinct or visible where the plant communities change gradually over wide environmental gradients of relatively uniform soils and topography. Thus, the need for site differentiation may not be readily apparent until the cumulative impact of soil, topography, hydrology, or climate is examined over a broad area. Frequently, such differences are reflected first in production and second in the kinds and proportions of a plant species making up the core of the plant community. In some cases, the boundaries that are drawn between ecological sites along a continuum of closely related soils and a gradually changing climate are somewhat arbitrary.

The following criteria are used to differentiate one ecological site from another:

1. Significant differences in the species or species groups that are in the characteristic plant community.
2. Significant differences in the relative proportion of species or species groups in the characteristic plant community.
3. Significant differences in the total annual production/site index of the characteristic plant community.
4. Soil factors that determine the plant production and composition, the hydrology of the site, and the functioning of the ecological process of the water cycle, mineral cycles, and energy flow.

Differences in kind, proportion, and production of plants are the result of differences in soil, topography, climate, and other environmental factors. Slight variations in these factors are not criteria for site differentiation. Individual environmental factors are frequently associated with significant differences in reference plant communities. The differences in the environmental factors must be great enough to affect the kinds, amounts, and proportions of the plant community to be differentiated into a distinct site (See the “National Range and Pasture Handbook,” available online at http://www.glti.nrcs.usda.gov/technical/publications/nrph.html.)

The ecological site descriptions for Lassen Volcanic National Park were reviewed and the approval process completed. These descriptions are dynamic documents that may be updated as new research and data is gained; thus, the online version, even after approval, will be the most recent version of the descriptions. They can be found at http://esis.sc.egov.usda.gov/.

The names of the forest ecological site descriptions were changed after the Soil Survey of Lassen National Park was released. See Table 3 to view the new name as compared to the old name appearing in the soil survey report.

Ecological sites are divided into forestland and rangeland, both of which carry specific descriptions.

Forestland is a spatially defined site where the reference community is dominantly a minimum 25 percent tree species that are overstory canopy cover, as determined by a crown perimeter-vertical projection. The reference community is the climax community that is present today that most resembles the forest conditions prior to European contact. It developed with natural disturbances, such as drought, fire, and insects. Several other plant communities may be present during the seral stages of development. Vegetation on forestland provides many habitat components, assists in controlling soil erosion, is suitable for grazing or browsing by wildlife, and offers scenic and recreational opportunities. Forestland is environmentally and economically important. For more information about national forestry policies of the Natural Resources Conservation Service, see the “National Forestry Manual,” which is available online at http://soils.usda.gov/technical/nfmanual/.

The reference community for a rangeland ecological site does not have the potential to produce a minimum 25 percent tree species that are overstory canopy cover. Several other plant communities may be present during phases of development or altered conditions. Vegetation on rangeland provides many habitat components, assists in controlling soil erosion, is suitable for grazing or browsing by wildlife and domestic animals, and offers scenic and recreational opportunities. Rangeland is environmentally and economically important.

There are 44 correlated ecological sites in this park: 25 are forestland ecological sites and 19 are rangeland ecological sites.

General Description of Vegetation

The vegetation in Lassen Volcanic National Park is dominated by coniferous forests. The park also has areas characterized by several types of rangelands. Conifer tree species occur in bands determined by species’ tolerance ranges for elevation, droughtiness, and annual precipitation. As elevation increases, precipitation and duration of snow pack tend to increase while soil temperature and length of growing season decrease. Park elevations vary from approximately 5,200 feet in Warner Valley to 10,457 feet on Lassen Peak. White fir mixed conifer forests and Jeffrey pine forests occupy the lower elevations.

California red fir and white fir codominate in some forests; however, California red fir eventually replaces white fir as elevation increases. California red fir can develop into pure stands or co-mingle with western white pine. Sub-alpine mixed conifer forests exist above or in cooler pockets than the California red fir forests. The sub-alpine mixed conifer forest is dominated by California red fir in addition to mountain hemlock, western white pine, and Sierra lodgepole pine. Above the sub-alpine mixed conifer forest is a band of mountain hemlock forests. The mountain hemlock zone grades into the tree-line forest that is often composed of multi-stemmed, dwarfed, and twisted mountain hemlock and whitebark pine. Sierra lodgepole pine grows in cold air drainages and wet areas bordering meadows and streams. Sierra lodgepole pine is a pioneer species. It is dominant during primary succession on volcanic debris or during secondary succession after fire in red fir mixed conifer forests. The general forest types described above are subdivided into several ecological sites based on productivity and species composition.

The rangeland sites identified for Lassen Volcanic National Park can be divided easily into wet or dry sites. The wet rangeland sites include riparian corridors, springs, hydrothermal seeps, and small stream channels with their associated meadows. The wet rangeland sites are differentiated by temperature regimes, stream channel types, and hydrology. The Rosgen Stream Type Classification is used to identify and classify stream types (Rosgen, 1996). For example, Rosgen type E channels occur in Upper Kings Meadow and Dersch Meadow while Hot Springs Creek has sections with characteristics of types B and C channels. There is an ecological site for springs that emerge from various locations within the park. Flows often emerge at contacts with bedrock, and vegetation is generally dominated by thinleaf alder with a variety of forbs and mosses. Another ecological site encompasses hydrothermal seeps and springs; however, the order of the soil survey did not allow time to collect soil, vegetation, and water chemistry data to fully describe the complexity of the hydrothermal areas. The ecological sites mentioned above are all associated with a unique hydrology. The sites are designed as a complex and are linked to a unique hydrologic regime. Thus the entire meadow, seep area, or flood plain and its associated plant communities are described as a unit. This way the relationship between the hydrology of the site and the presence (or absence) of the dominant plant communities can be described as a whole. Kings Creek, for example, has several associated plant community types, including cottonwood forests, alder shrubs, and pioneer forbs. Should flood wash out the cottonwood forest, the pioneer forbs community would establish itself for a few years in its place. Because the stream is constantly shifting and moving, the plant community types may always be present but in different places and compositions due to the dynamics of the stream channel.

Several dry upland rangeland sites are identified. They include slopes of woolly mule-ears near Sulfur Works, sagebrush shrub land on Loomis Peak, distributions of pinemat manzanita shrub land on southern slopes, and sparse alpine vegetation on exposed ridges and mountain peaks. The upland rangeland sites commonly have a high content of rock fragments at all soil depths and either bedrock or dense till that creates a layer of root restriction. The shallow soils have a limited water-holding capacity. Trees have a low survival rate due to the inability to tap into a deeper water source. Perennial forbs, annuals, or shrubs commonly occur because they are more adapted to a shorter growing season. Soils may be deep enough in other areas but exposure to sun and strong winds inhibit tree establishment and growth, leaving only the most compact, hardy perennials to endure the elements.

Mean annual precipitation reaches a maximum of 125 inches on Lassen Peak and diminishes quickly as elevation decreases. The Butte Lake area receives 23 to 27 inches of annual precipitation, which is the lowest precipitation within the park. Most precipitation is received as snow during the winter months. The combination of elevation, aspect, soil characteristics, and precipitation creates a complex pattern for the distribution of vegetation. The influence of aspect is more subtle in the soil survey area than in the foothills at the lower elevations, but some patterns can be seen. Due to heat intensities, high evapotranspiration rates, and resultant droughtiness, southern and western aspects commonly support pine forest communities or shrub-dominated rangeland sites. Northern and eastern aspects, which are exposed to less solar radiation, generally support fir or hemlock forests. The upper elevation range for tree species tends to be higher on southern aspects than on northern aspects. Alpine sites are affected by the duration of the snow pack and exposure to desiccating winds.

Areas with snow pockets that remain throughout most of the summer experience a shortened growing season, which inhibits the establishment of conifer seedlings. In wind-exposed areas, such as ridges and peaks, snow is blown away and redeposited on the leeward slopes. The exposed areas are desiccated by wind, resulting in a low amount of available water. In addition to elevation, aspect, and precipitation, soil properties such as texture, depth, temperature, and parent material affect the waterholding capacity and available nutrients.

Temperature is critical in initiating conifer growth after snowmelt. Many of the conifer species occurring in this soil survey area generally start stem growth about 2 weeks after snowmelt, a delay that may be related to the warming of soils, roots, and microbial activity. If snowmelt is unusually early, the trees may not begin annual growth until specific air temperatures are reached. Heavy shrub cover may delay the start of annual growth because the shade keeps the soil from warming. The pines begin leader growth at cooler temperatures when compared to firs. Pines have heavily insulated terminal buds, whereas the terminal buds of fir trees are less insulated and more susceptible to frost damage. It appears that some conifers do not start leader growth until a specific photoperiod (a ratio of light hours to dark hours during one 24-hour period) is met, even if the snow has melted and the temperatures are warm enough. If drought conditions set in before the leader has reached its determinate length, growth is 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). All of these factors can have a significant influence on the productivity, composition, and distribution of forest and rangeland plant communities.

Tables 8 through 12 of the Soil Survey of Lassen Volcanic National Park display the correlation between the map units and the soil component to the ecological sites. A description of the tables appears in the section titled “Ecological Site Tables”, pages 201-203. The citation for the soil survey report is:

United States Department of Agriculture, Natural Resources Conservation Service. 2010. Soil survey of Lassen Volcanic National Park, California. (Accessible online at: http://soils.usda.gov/survey/printed_surveys/).

Ecological Site Descriptions

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Low Precip Frigid Sandy Tephra Gentle Slopes

Pinus jeffreyi - Abies concolor / / Achnatherum occidentale ssp. occidentale - Elymus elymoides
(Jeffrey pine - white fir / / western needlegrass - squirreltail)

Site ID: F022BI100CA

Major Land Resource Area: 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.

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.

Landform:	(1) Ground moraine on glacial valley floor
	(2) Outwash plain

	Minimum	Maximum
Elevation (feet):	5850	6960
Slope (percent):	0	35
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Negligible	Low
Aspect:	No Influence on this site	

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.

	Minimum	Maximum
Frost-free period (days):	60	90
Freeze-free period (days):	75	200
Mean annual precipitation (inches):	23.0	43.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative 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.

Parent Materials:
Kind: Tephra
Origin: Volcanic rock
Surface Texture: (1)Ashy Sand
(2)Ashy Coarse sand
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	3	56
Surface Fragments > 3" (% Cover):	0	9
Subsurface Fragments <=3" (% Volume):	3	55
Subsurface Fragments > 3" (% Volume):	0	20

Drainage Class: Well drained To Well drained
Permeability Class: Moderately rapid To Very slow

	Minimum	Maximum
Depth (inches):	40	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	7.8
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	2.5	4.2

Plant Communities

Ecological Dynamics of the Site

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).

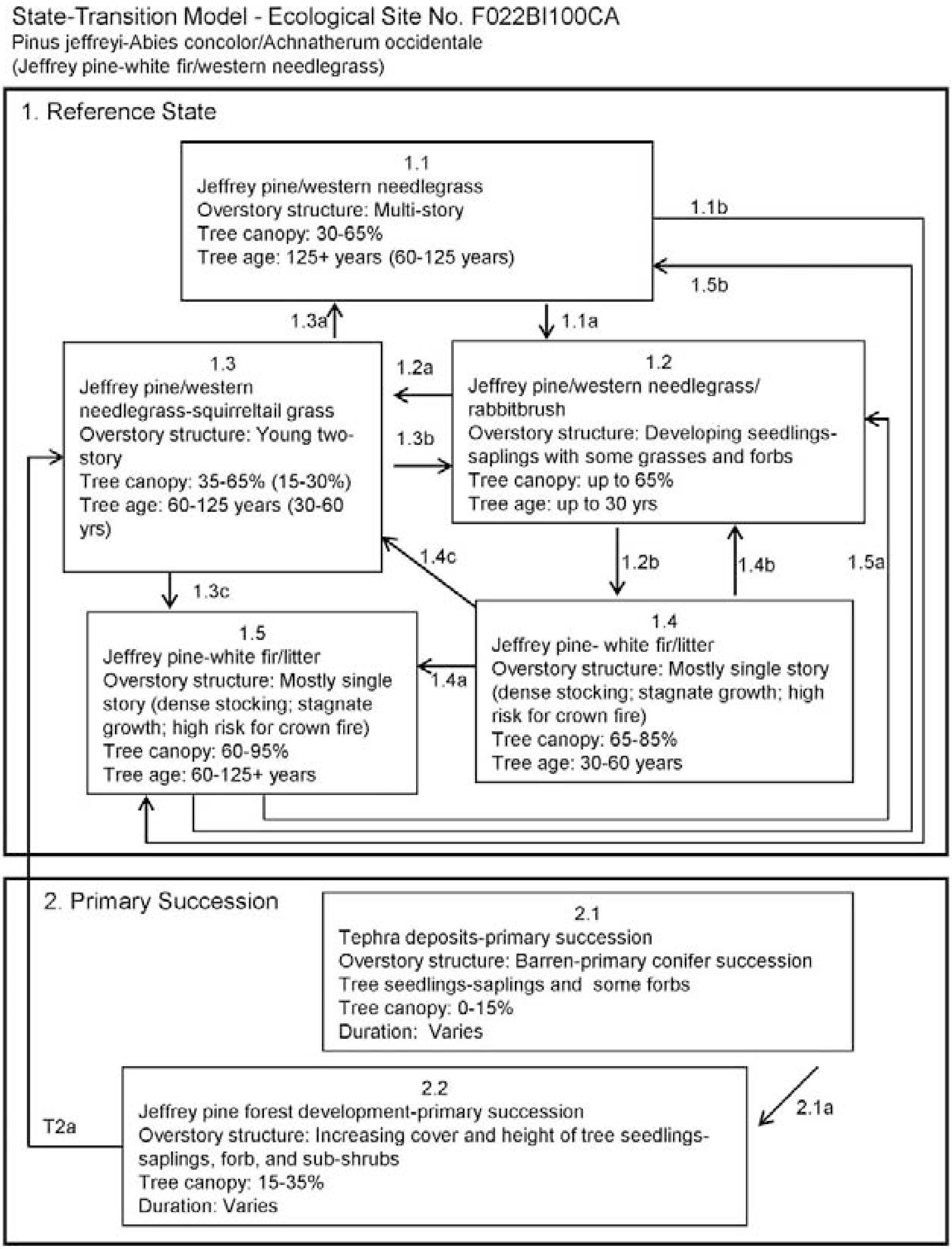
Tree pathogens and insect infestations can have significant impacts on the composition and structure of mid and upper montane coniferous forests. Small infestations may affect just a few trees but large outbreaks can kill the dominant trees over large areas of forest, creating large canopy openings and 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 Diagram



Reference - State 1

Jeffrey pine/western needlegrass - Community Phase 1.1

Jeffrey Pine- White Fir Forest

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.

Community Phase Pathway 1.1a
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).

Community Phase Pathway 1.1b
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).

Jeffrey pine/western needlegrass Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**12**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	1	0	1
		Torrey's blue eyed Mary	COTO	*Collinsia torreyi*	0	1	0	1
		spreading groundsmoke	GADI2	*Gayophytum diffusum*	0	2	0	1
		silverleaf phacelia	PHHA	*Phacelia hastata*	0	8	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass					**5**	**94**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	50	0	5
		squirreltail	ELEL5	*Elymus elymoides*	5	40	1	8
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	4	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**2**		

	whiteveined wintergreen	PYPI2	*Pyrola picta*	0	2	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**19**		
		white fir	ABCO	*Abies concolor*	0	4	0	1
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	5	0	1
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	10	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	5	32	94
Forb	0	1	12
Shrub/Vine	0	1	2
Tree	0	8	19
Total:	5	42	127

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	1%	26%
Forb	0%	19%
Shrub/ Vine	0%	3%
Tree	30%	65%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	65%	80%
Surface Fragments > 0.25" and <= 3"	0%	10%
Surface Fragments > 3"	0%	2%
Bedrock		
Water		
Bare Ground	1%	25%

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	1%	0%	5%	%	%		
> 0.5 - < 1 feet	1%	25%	0%	4%	0%	1%		
> 1 - <= 2 feet			0%	10%	0%	2%	0%	1%
> 2 - < 4.5 feet							0%	1%
> 4.5 - <= 13 feet							0%	1%
> 13 - < 40 feet							0%	3%
< 40 - >= 80 feet							2%	5%
> 80 - < 120 feet							25%	55%
>= 120 feet							0%	2%

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 Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	30	50	65

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	0	2.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	30.0	61.0						

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).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	1.0		
squirreltail *Elymus elymoides*	ELEL5	N	1.0	8.0		
naked buckwheat *Eriogonum nudum*	ERNU3	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	1.0		
Torrey's blue eyed Mary *Collinsia torreyi*	COTO	N	0	1.0		
spreading groundsmoke *Gayophytum diffusum*	GADI2	N	0	1.0		
silverleaf phacelia *Phacelia hastata*	PHHA	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	1.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	1.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	3.0		

Jeffrey pine/western needlegrass/rabbitbrush - Community Phase 1.2

This regeneration community phase is present after a severe crown fire. Tree seedlings and scattered grasses and forbs are present, with perhaps a few surviving canopy trees. The surviving trees are a valuable source of seed for tree regeneration. Seeds are dispersed downwind at approximately twice the height of the source tree, possibly farther under windy conditions. Jeffrey pine seed is also cached by squirrels and chipmunks, which aid in dispersing the seed. Some studies have shown that Jeffrey pine seed germination and seedling survival is greater for cached seeds that have been buried in soil rather than for wind blown seeds deposited on the surface. Jeffrey pine seedlings prefer open sunlight and bare soil for germination and development. While white fir may be present at this time, it is more likely to come in later under the shade of Jeffrey pine. Western needlegrass (Achnatherum occidentale), squirreltail grass

(Elymus elymoides), rabbitbrush (Chrysothamnu sp.), and a few other understory species are present after fire.

Community Phase Pathway 1.2a

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.

Community Phase Pathway 1.2b

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).

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.

Jeffrey pine/western needlegrass-squirreltail grass - Community Phase 1.3

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.

Community Phase Pathway 1.3a

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).

Community Phase Pathway 1.3b

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

Community Phase Pathway 1.3c

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).

Jeffrey pine/western needlegrass-squirreltail grass Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**16**		
		Torrey's blue eyed Mary	COTO	*Collinsia torreyi*	0	1	0	1
		quill cryptantha	CRAF	*Cryptantha affinis*	0	1	0	1
		spreading groundsmoke	GADI2	*Gayophytum diffusum*	0	2	0	1
		silverleaf phacelia	PHHA	*Phacelia hastata*	0	12	0	2

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass					**0**	**82**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	50	0	5
		squirreltail	ELEL5	*Elymus elymoides*	0	30	0	6
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	2	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**37**		
		snowbrush ceanothus	CEVE	*Ceanothus velutinus*	0	15	0	1
		rubber rabbitbrush	ERNAN4	*Ericameria nauseosa ssp. nauseosa var. nana*	0	20	0	4
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	2	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**10**		
		white fir	ABCO	*Abies concolor*	0	5	0	2

Jeffrey pine	PIJE	*Pinus jeffreyi*	0	5	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	12	82
Forb	0	5	16
Shrub/Vine	0	5	37
Tree	0	5	10
Total:	0	27	145

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 Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	50	65

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	1.0	10.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	34.0	55.0						

Forest Understory:

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

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	5.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	6.0		
naked buckwheat *Eriogonum nudum*	ERNU3	N	0	1.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Torrey's blue eyed Mary *Collinsia torreyi*	COTO	N	0	1.0		
quill cryptantha *Cryptantha affinis*	CRAF	N	0	1.0		
spreading groundsmoke *Gayophytum diffusum*	GADI2	N	0	1.0		
silverleaf phacelia *Phacelia hastata*	PHHA	N	0	2.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
snowbrush ceanothus *Ceanothus velutinus*	CEVE	N	0	1.0		
rubber rabbitbrush *Ericameria nauseosa ssp. nauseosa var. nana*	ERNAN4	N	0	4.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	2.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	1.0		

Jeffrey pine-white fir/litter - Community Phase 1.4

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.

Community Phase Pathway 1.4a

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

Community Phase Pathway 1.4b

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).

Community Phase Pathway 1.4c
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.

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.

Jeffrey pine-white fir/litter - Community Phase 1.5

Jeffrey pine- White fir forest

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.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate Jeffrey pine regeneration (Community 1.2).

Community Phase Pathway 1.5b
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.

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.

Primary succession (preceding the Reference State) - State 2

Tephra deposits-primary succession - Community Phase 2.1
The eruption of Cinder Cone left tephra deposits of various thicknesses. 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.

Community Phase Pathway 2.1a
With time and growth primary succession continues, and a Jeffrey pine forests slowly develops.

<u>Forest Overstory:</u>
Slow establishment of primarily Jeffrey pine and lodgepole pine with some white fir.

<u>Forest Understory:</u>
Slow establishment and sparse representation of grasses, shrubs and forbs similar to community phase 1.3.

<u>Jeffrey pine forest development-primary succession - Community Phase 2.2</u>

Jeffrey pine forest development

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.

Transition - T2a
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.

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.

Ecological Site Interpretations

Forest 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	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.
Jeffrey pine	*PIJE*	77	84	65	75	40	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

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).

Plant Preference by Animal Kind:

Hydrology 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.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative

Similar Sites:

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

State Correlation:
This site has been correlated with the following states:

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:

State:	CA
County:	Lassen
Township:	31 N
Range:	6 E
Section:	3
Datum:	NAD83
Zone:	10
Northing:	4493705
Easting:	644004
General Legal Description:	This site is to the east of the road to Butte Lake, appox. 0.75 miles north of Bathtub Lake.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104493705644004

Relationship to Other Established Classifications:

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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	6/26/2007	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	7/26/2010	Kendra Moseley	1/14/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Bouldery Glacially Scoured Ridges Or Headlands

Abies magnifica / *Arctostaphylos nevadensis* / *Carex rossii* - *Penstemon gracilentus*
(California red fir / pinemat manzanita / Ross' sedge - slender penstemon)

Site ID: F022BI102CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Headland, (2) Ridge, (3) Mountain slope
Elevation (feet): 5,500-8,190 but generally 6,300-8,400
Slope (percent): 2-80, but generally 8-40
Water Table Depth (inches): N/A
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 33-109, but generally 33-53
Primary Precipitation: Snow from November to May
Mean annual temperature: 38 to 43 degrees F (4 to 6 degrees C)
Restrictive Layer: Indurated bedrock is encountered between 20 to 40 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra over colluvium and/or residuum from volcanic rocks
Surface Texture: Very bouldery medial loamy sand
Surface Fragments <=3" (% Cover): 3-46
Surface Fragments > 3" (% Cover): 6-85
Soil Depth (inches): 20-40
Vegetation: Open forest dominated by large mature California red fir (Abies magnifica), western white pine (Pinus monticola), and Sierra lodgepole pine (Pinus contorta spp. murrayana) with pinemat manzanita (Arctostaphylos nevadensis) and forbs in the canopy openings.
Notes: This area is undulating with rocky bedrock ridges, open slopes, small swales, and small tarns. The forest is open and discontinuous due to the bedrock outcrops and rocky soils.

Physiographic Features

This ecological site is found between 5,500 and 8,190 feet in elevation, but the best representation is between 6,300 and 8,000 feet. This site is situated on glacially scoured ridges and glacial headlands. Slopes range from 2 to 80 percent, but are generally between 8 to 40 percent. This site is often found on east to south aspects, but can be found on all aspects.

Landform:
(1) Headland
(2) Ridge
(3) Mountain slope

	Minimum	Maximum
Elevation (feet):	5500	8190
Slope (percent):	2	40
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very low	Medium
Aspect:	South East West	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to May. The mean annual precipitation is between 33 and 109 inches (838 and 2768 mm) and the mean annual temperature ranges from 38 to 43 degrees F (4 to 6 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 available for this site. The nearest site is near Chester, which has lower precipitation and warmer temperatures

	Minimum	Maximum
Frost-free period (days):	60	85

Freeze-free period (days):	75	190
Mean annual precipitation (inches):	33	109

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is not influenced by water features.

Wetland Description: System	Subsystem	Class

Representative Soil Features

The Scoured soil series is associated with this site, which consists of moderately deep, well drained soils that formed in tephra over colluvium and/or residuum from volcanic rocks. The surface texture is very bouldery medial loamy sand. The combined A, AB, and C horizons have 2 percent clay, 17 to 24 percent gravel, 10 percent cobbles, 10 percent stones, and 10 to 15 percent boulders. The C horizon begins at 17 inches and has a bouldery texture, with 20 percent gravel and 75 percent cobbles, stones, and boulders. Indurated bedrock is encountered between 20 to 40 inches. Permeability is very rapid in the upper horizons and very slow through the bedrock. These moderately deep soils have very low AWC.

The scoured soils are classified as Medial-skeletal over fragmental, amorphic over isotic, frigid Humic Haploxerands.

This ecological site has been correlated with the following map units and major soil components within the Lassen Volcanic National Park Soil Survey (CA789):

Map Unit / Component / Component percent
103 Scoured 75%
104 Scoured 55%

This site is associated with Scoured as a minor component in several additional mapunits.

Parent Materials:

Kind: Tephra, Colluvium, Residuum
Origin: Volcanic rock

Surface Texture: (1)Very bouldery medial loamy sand
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	3	46
Surface Fragments > 3" (% Cover):	6	85
Subsurface Fragments <=3" (% Volume):	15	55
Subsurface Fragments > 3" (% Volume):	15	75

Drainage Class: Well drained To Well drained
Permeability Class: Very rapid To Impermeable

	Minimum	Maximum
Depth (inches):	20	40
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.0	2.44

Plant Communities

Ecological Dynamics of the Site

This ecological site is characterized by an open forest dominated by large mature California red fir (Abies magnifica), western white pine (Pinus monticola), and Sierra lodgepole pine (Pinus contorta spp. murrayana) with pinemat manzanita (Arctostaphylos nevadensis) and forbs in the canopy openings. This area is undulating with rocky bedrock ridges, open slopes, small swales, and small tarns. The forest is open and discontinuous due to the bedrock outcrops and rocky soils. Tree growth is relatively slow on this site. The inherently open forest provides an opportunity for the shrubs, forbs and grasses to grow in the open sunlight.

California red fir, western white pine and Sierra lodgepole pine are tall, long- lived conifers with short branches and narrow crowns. California red fir prefers cold wet winters in areas with deep snow accumulation, followed by warm summers.

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, which gradually declines through the summer (Royce and Barbour, 2001).

This ecological site has evolved with natural disturbances such as fire, wind throw and disease that create canopy gaps which allow for tree regeneration. Since this forest is open, the fuel loads are lower than a fully stocked red fir forest. Fires are likely to remain at low to moderate intensities, killing some of the young saplings yet leaving the mature red fir and western white pine with minor damage. Western white pine bark, when damaged by fire, can allow infestation of pathogens that can eventually kill the tree. Overstory trees would likely be killed in a high severity fire (Cope, 1993). Sierra lodgepole pine has thin bark and a shallow root system which make it vulnerable to low and moderate intensity fires. However, it often regenerates well from windblown seed after fire and may dominate the regenerating forest for several decades.

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). The stand densities and fuel characteristics of the forests in these studies are not specific enough to directly compare to fire return intervals for this site, but it seems likely that this ecological site is more open than the red fir-white fir forests on Prospect Peak or in Thousand Lakes Wilderness, so the fire return interval may lean toward the longer interval of 70 years or more. 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).

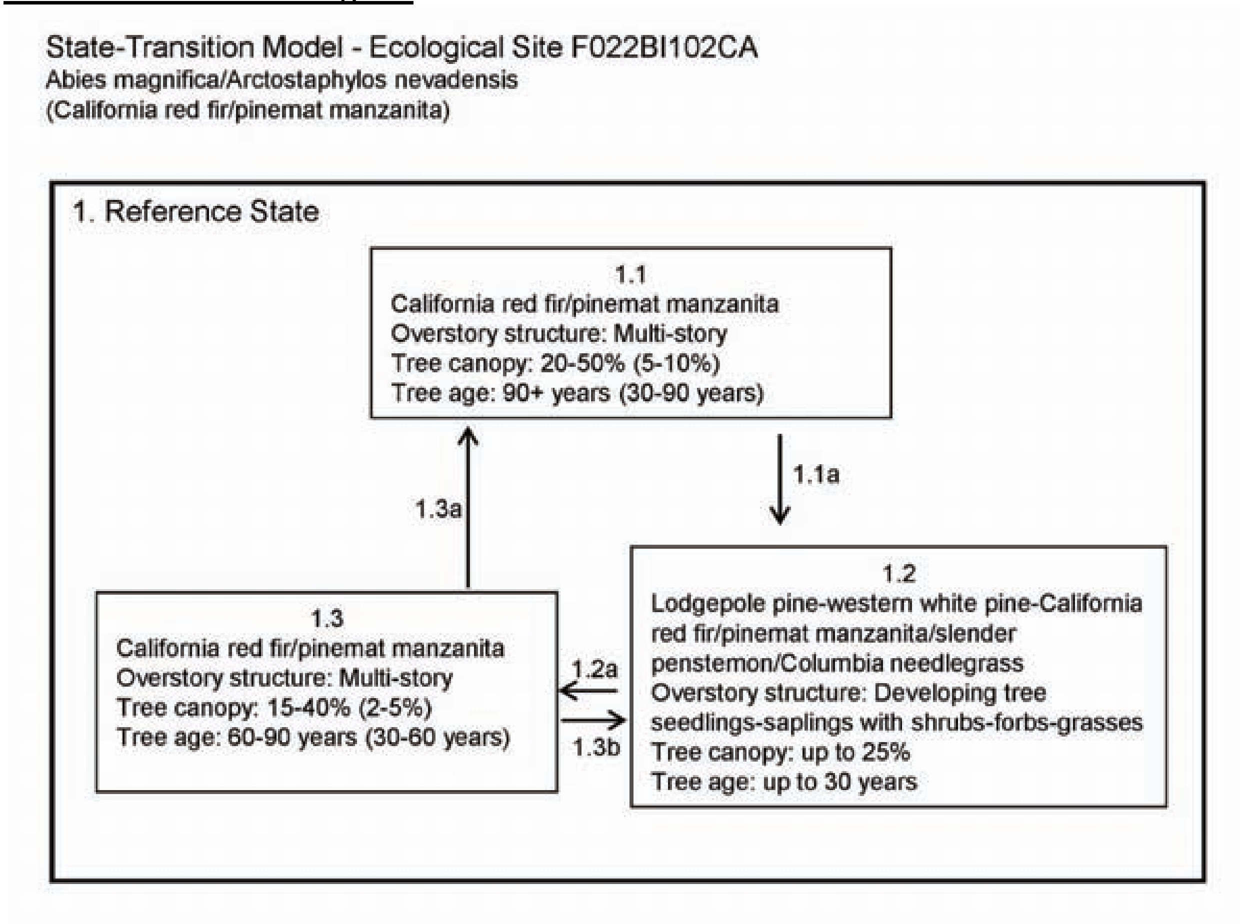
This forest is susceptible to several pathogens that can break out to epidemic levels and cause extensive stand mortality. The major pathogens that affect California red fir in this area are red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae), fir broom rust (Melampsorella caryophyllacearum), 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). Inspects 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 major pathogen affecting western white pine is the white pine blister rust (Cronartium ribicola). It is a non-native disease that was introduced from Europe and Asia in the 1920's. 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 turn red and fall (Hagle et al., 2003). Pruning cankers from infected stems has shown to be beneficial. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are the needle cast fungi: Lophodermella arcuata, Lophodermium nitens, and Bifusella lineari; the butt-rot fungi, Phellinus pini, Phaeolus schweinitzii, and Heterobasidion annosum, and Armillaria spp. Insects that can cause damage include the mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Graham, 1990).

The major pathogens of Sierra lodgepole pine are Annosus root disease (Heterobasidion annosum), Lodgepole pine dwarf mistletoe (Arceuthobium americanum), and the mountain pine beetle (Dendroctonus ponderosae).

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 Diagram



Reference - State 1

California red fir/pinemat manzanita - Community Phase 1.1

Red fir- Western white pine forest

The mature open California red fir, western white pine, and Sierra lodgepole pine forest is the reference community phase for this ecological site. It is relatively unchanged from its natural condition since most of this area has never been logged and the fire regime has not been markedly altered. The fire frequency for red fir forest is estimated from 10 to 65 years (Bancroft, 1979; Taylor et al., 1991). However this forest is so open, it would burn less frequently than a pure red fir forest. Large severe crown fires are uncommon due to lower ground fuels and the open canopy structure of the forest. Lightning strikes are a common source of ignition, but seldom do the fires reach farther than an acre (Kilgore, 1981). Large fires do occur but the fire hazard is lower than the white fir mixed conifer types at lower elevations. (Cope, 1993). At lower elevations this forest's fuel load, type and stand density tends to increase, and stand replacing fires may be more common.

Community Phase Pathway 1.1a

Wind-throw, fire, or tree die off from disease creates openings in the forest that present suitable conditions for California red fir, western white pine, and Sierra lodgepole pine regeneration (to Community Phase 1.2).

California red fir/pinemat manzanita Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**5**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	1	0	1
		pinewoods lousewort	PESE2	*Pedicularis semibarbata*	0	4	0	2

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**6**	**245**		
		Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0	100	0	20
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	10	0	2
		sedge	CAREX	*Carex*	6	60	1	10
		Whitney's sedge	CAWH	*Carex whitneyi*	0	50	0	5
		squirreltail	ELEL5	*Elymus elymoides*	0	25	0	5

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**350**	**935**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	350	650	30	70
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	0	120	0	15
		oceanspray	HOMI3	*Holodiscus microphyllus(syn)*	0	10	0	3
		mountain monardella	MOOD	*Monardella odoratissima*	0	40	0	5
		slender penstemon	PEGR4	*Penstemon gracilentus*	0	75	0	5
		mountain pride	PENE3	*Penstemon newberryi*	0	40	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**4**	**41**		
		California red fir	ABMA	*Abies magnifica*	2	25	1	5

Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	2	8	1	3
Jeffrey pine	PIJE	*Pinus jeffreyi*	0	3	0	1
western white pine	PIMO3	*Pinus monticola*	0	5	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	6	83	245
Forb	0	3	5
Shrub/Vine	350	610	935
Tree	4	31	41
Total:	360	727	1226

Structure and Cover:

Soil Surface Cover

Cover Type	**Minimum**	**Maximum**		**Wood Type**	**Minimum**	**Maximum**	**Predominant Decomposition Class***
Basal Cover - Grass/ Grasslike	1%	42%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	1%	15%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	30%	88%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	20%	50%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	10%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust				Tree Snags** (Hard***)			
Litter	30%	80%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	3%	46%		**Tree Snags** per Acre**			
Surface Fragments > 3"	6%	85%		Hard Snags***			
Bedrock	0%	5%		Soft Snags***			
Water	0%	0%					
Bare Ground	5%	50%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	2%	0%	1%	%	%		
> 0.5 - < 1 feet	1%	22%	0%	2%	30%	70%		
> 1 - <= 2 feet	0%	20%	0%	12%	0%	3%		
> 2 - < 4.5 feet					0%	15%	0%	2%
> 4.5 - <= 13 feet							2%	7%
> 13 - < 40 feet							0%	5%
< 40 - >= 80 feet							5%	10%
> 80 - < 120 feet							15%	35%
>= 120 feet								

Forest Overstory:

The canopy cover ranges from 20 to 50 percent with large openly spaced trees. The canopy cover of California red fir averages 25 percent, with 8 percent cover of western white pine and 5 percent cover of Sierra lodgepole pine. There is an occasional large Jeffrey pine with about 1 percent cover across the site. The overstory trees are 90 to 100 feet tall with diameters of 25 to 35 inches. The dominant trees are usually over 200 years old and a minimum of 90 years.

This forest does not have many canopy layers. A secondary layer may be present making up about 5-10% cover with ages of 30-90 years.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	20	35	50

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	13.0	32.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	3.0	6.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	2.0						
western white pine *Pinus monticola*	PIMO3	N	4.0	10.0						

Forest Understory:

The cover of pinemat manzanita (Arctostaphylos nevadensis) averages about 50 percent but may be as high as 70 percent. There is about 30 percent cover from other species, of which Columbia needlegrass (Achnatherum nelsonii), carex (Carex sp.), Sierra chinkapin (Chrysolepis sempervirens), and squirreltail (Elymus elymoides) dominate. Less abundant species include western needlegrass (Achnatherum occidentale), pioneer rockcress (Arabis platysperma), Whitney's sedge (Carex whitneyi), oceanspray (Holodiscus microphyllus (Syn)), mountain monardella (Monardella odoratissima), slender penstemon (Penstemon gracilentus), mountain pride, (Penstemon newberryi), and pinewoods lousewort (Pedicularis semibarbata).

Total annual production is about 726 lbs per acre, with about 500 lbs of this from pinemat manzanita. The remaining 226 lbs is moderate to low quality forage.

The unvegetated areas have minimal litter cover and exposed soils with 3 to 46 percent gravels and 6 to 85 percent cobbles, stones, and boulders. There is approximately 8 percent cover from trees less than 13 feet tall, which are generally in the open areas.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Columbia needlegrass *Achnatherum nelsonii*	ACNE9	N	0	20.0		
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	2.0		
sedge *Carex*	CAREX	N	1.0	10.0		
Whitney's sedge *Carex whitneyi*	CAWH	N	0	5.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	5.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	1.0		
pinewoods lousewort *Pedicularis semibarbata*	PESE2	N	0	2.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	30.0	70.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	0	15.0		
oceanspray *Holodiscus microphyllus(syn)*	HOMI3	N	0	3.0		
mountain monardella *Monardella odoratissima*	MOOD	N	0	5.0		
slender penstemon *Penstemon gracilentus*	PEGR4	N	0	5.0		
mountain pride *Penstemon newberryi*	PENE3	N	0	2.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	1.0	5.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	3.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	1.0		
western white pine *Pinus monticola*	PIMO3	N	0	3.0		

Lodgepole pine-western white pine-California red fir/pinemat manzanita/slender penstemon - Community Phase 1.2

This community phase develops after a stand replacing fire or in small gaps (1/2 acre to 3 acres) created by a canopy disturbance. While several large California red fir and western white pine trees may survive, the thin barked Sierra lodgepole pine is very susceptible to fire and would have a high mortality rate. California red fir, western white pine, and Sierra lodgepole pine will germinate from wind or animal dispersed seed after a fire. California red fir seedling establishment may be delayed for 3 to 4 years after a fire. This may be due to the mortality of the seedlings during the first few years or be related to the timing of cone production, which occurs in 2 to 6 year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or in light litter in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. The winged red fir seeds are wind dispersed 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993). The seeds of western white pine can be dispersed over 2,000 feet by wind. The seeds can remain viable in the litter for up to 4 years, but viability decreases quickly (Griffith, 1992). Sierra lodgepole pine produces abundant viable seeds that are wind dispersed up to 200 feet from the parent tree (Cope, 1993). Birds, squirrels and other rodents cache some of these seeds in the soil, which may germinate in bunches if not consumed. The severity and size of a fire influence the structure of regeneration. California red fir seems to regenerate better after a low to moderate intensity fire, or in high intensity fires of smaller size. This is most likely due to proximity to a seed source and the benefits from partial shade (Chappell and Agee 1996).

Pinemat manzanita is killed by fire. It does not re-sprout from the root crown but re-establishes itself from seed. It colonizes disturbed sites and continues to grow well under an open canopy as long as there is sufficient sunlight (Howard, 1993). Other forbs and grasses germinate from onsite stored seed or wind dispersed seed from adjacent areas. Some of the understory species may re-sprout after low to moderate intensity fires.

Community Phase Pathway 1.2a

The natural pathway is to community 1.3, the young open California red fir forest. This pathway is followed with time and growth with small low to moderate intensity surface fires.

California red fir/pinemat manzanita - Community Phase 1.3

California red fir, Sierra lodgepole pine, and Western white pine continue to grow into an open forest due to the natural preference of sunlight and the occasional lightening induced surface fire. If fire spreads through this site, Sierra lodgepole pine would have a high mortality rate, reducing its abundance in the forests. This community experiences rapid growth in conifer height and canopy cover. California red fir reaches seed bearing age between 35 to 40 years, but western white pine can bear seed at 10 years and Sierra lodgepole pine between 4 to 8 years (Cope, 1993, and Griffith, 1992). Therefore California red fir needs a longer fire free interval to develop new seed crops. As canopy cover increases, California red fir and western white pine can overtop and eventually shade out the Sierra lodgepole pine (this is unlikely to have much affect on this naturally open site). This community begins with pole sized trees and lasts until the trees are about 100 to 150 years old. California red fir may continue to regenerate under the forest canopy during this time.

Community Phase Pathway 1.3a
This is the natural pathway for this community, which evolved with a historic fire regime of small low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to a mature open California red fir forest (Community 1.1).

Community Phase Pathway 1.3b
In the event of a canopy fire or mortality of older trees (e.g. drought combined with a pathogen concentration), this community would return to Community 1.2.

Ecological Site Interpretations

Forest 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*	29	29	101	101	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.
Sierra lodgepole pine	*PICOM*	73	73	75	75	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.
western white pine	*PIMO3*	30	30	67	67	100	570	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.

Animal Community:
The mature open California red fir, western white pine, and Sierra lodgepole pine forest provides forage and shelter for many animals. Cavity-nesting birds utilize holes in snags and dying trees for their nests, while ground nesting birds and animals find homes in the fallen trees.

Animals that use California red fir forests include: martin, fisher, wolverine, black bear, squirrels, 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.

Plant Preference by Animal Kind:

Hydrology Functions:
This site is in hydrological soil group B.

Recreational Uses:
This ecological site provides scenic vistas with partial shade for hiking trails. There may be suitable campsites on the gently sloped to flat areas.

Wood Products:
The wood from California red fir, western white pine and Sierra lodgepole pine is straight-grained and light. California red fir wood 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, and high-quality wrapping paper, and is preferred for pulping (Cope, 1993).

Western white pine wood is used to make window and door sashes, doors, paneling, dimension stock, matches, wood carvings and toothpicks (Griffin).

The wood of Sierra lodgepole pine is used for lumber, light framing materials, interior paneling, exterior trim, posts, railroad ties, pulp and paper (Cope, 1993).

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 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 also 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 (Graham, 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 (Graham, 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 get to epidemic levels when the trees are stressed due to drought, annosus root rot, dwarf mistletoe, or fire damage. (Graham, 1990).

SITE INDEX DOCUMENTATION:

Schumacher (1928) and Alexander (1966) were used to determine forest site productivity for red fir 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. 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 younger stands in 1.1. Red fir and lodgepole pine site trees are selected according to guidance in Schumacher (1928) and Alexander (1966), respectively.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Loam Moraines Or Lake Terraces	F022BI112CA	This site is associated with the Juniperlake soils which are deeper, and have a dense California red fir forest.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid And Cryic Gravelly Slopes	F022BI115CA	This site is associated with an open California red fir and western white pine forest, with less Sierra lodgepole pine.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789150
789151
789180 (modal- site location)
789280
789293
789301

Type Locality:

State:	CA
County:	Plumas
Township:	T30N
Range:	R6E
Section:	23
Datum:	NAD83
Zone:	10
Northing:	4478059
Easting:	645871
General Legal Description:	The site location is just to the west of the road to Juniper Lake, about 5,100 feet south southeast of the new Juniper Lake ranger station, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104478059645871

Relationship to Other Established Classifications:
Forest Alliance = Abies magnifica – Red fir forest; Association = Abies magnifica/Arctostaphylos nevadensis. (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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	6/26/2007	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	7/27/2010	Kendra Moseley	1/14/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Tephra Over Slopes And Flats

Abies concolor - Pinus jeffreyi / *Arctostaphylos patula - Ceanothus velutinus* /
(white fir - Jeffrey pine / greenleaf manzanita - snowbrush ceanothus /)

Site ID: F022BI103CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Mountain slope, (2) Moraine, (3) Outwash plain
Elevation (feet): 5,460-7,490
Slope (percent): 1-90, but generally 1-60
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 37-93, but average is 41
Primary Precipitation: Snow from November to April
Mean annual temperature: 40 to 45 degrees F (6 to 7 degrees C)
Restrictive Layer: Densic layer or duripan in the moderately deep and deep soils
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra deposits over colluvium, glacial till or glacial outwash
Surface Texture: (1) Loamy coarse sand, (2) Ashy Loamy coarse sand, (3)Ashy Sandy loam
Surface Fragments <=3" (% Cover): 1-55
Surface Fragments > 3" (% Cover): 0-30
Soil Depth (inches): 20-60+
Vegetation: Mid-montane coniferous forest dominated by white fir (Abies concolor) and Jeffrey pine (Pinus jeffreyi); cover of montane shrubs such as greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus velutinus), and sierra chinquapin (Chysolepis sempervirons) can be high in canopy openings; scattered grasses are found under the forest canopy.
Notes: Northwest portion of Lassen Volcanic National Park.

Physiographic Features

This ecological site is found on several geomorphic features and positions including unglaciated volcanic mountain slopes, moraines, and outwash plains. It is found between 5,460 feet and 7,490 feet in elevation on all aspects. This site is generally found on 1 to 60 percent slopes, but can be found on slopes up to 90 percent.

Landform:	(1) Mountain slope
	(2) Moraine
	(3) Outwash plain

	Minimum	Maximum
Elevation (feet):	5460	7490
Slope (percent):	1	50
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very low	Medium
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 37 to 93 inches (584 to 1,092 mm), but the average is 41 inches (1,041.4 mm). The mean annual temperature ranges from 40 to 45 degrees F (6 to 7 degrees C). The frost free (>32 degrees F) season is 60 to 90 days in the soil survey, and 31 to 132 days as recorded at the Manzanita Lake Climate Station. The freeze free (>28 degrees F) season is 79 to 202 days (MZL).

The information in the tables below is from the Manzanita Lake Climate Station, which is located toward the lower elevation of this ecological site. The average annual snow depth (as recorded at the Manzanita Lake climate station) reaches its peak depth of 25 inches in February. Snow normally melts by June and does not begin to accumulate again until November.

	Minimum	Maximum
Frost-free period (days):	31	132
Freeze-free period (days):	79	202
Mean annual precipitation (inches):	22.08	71.4

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.21	0.3	1.37	0.56	0.16	0.0	0.0	0.0	0.0	0.0	0.04	0.0
Precip. Max.	18.54	13.68	14.05	10.78	10.23	6.09	2.52	4.57	6.36	14.76	15.45	19.42
Temp. Min.	20.2	21.0	23.1	27.6	34.6	40.9	45.5	44.1	40.4	34.0	26.7	22.1
Temp. Max.	41.0	42.7	45.0	51.2	60.5	69.9	78.9	77.6	71.6	60.5	47.2	42.0

Climate Stations: (1) 045311, Manzanita Lake. Period of record 1949 - 2005

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This ecological site is associated with several soil components. The soil components can be grouped into five soil subgroups: Typic Haploxerands, Humic Haploxerands, Typic Vitrixerands, Humic Vitrixerands, and Vitrandic Xerorthents. Most of these soils have developed in tephra deposits over colluvium, glacial till or glacial outwash. A few have developed in avalanche debris (from the 1914 to 1917 eruptions of Lassen Peak) over till. These soils range from moderately deep to very deep. A densic layer (or in one case a duripan) is encountered in the moderately deep and deep soils. These soils are well drained to excessively drained. Surface textures include loamy coarse sand, ashy loamy coarse sand, ashy sandy loam, ashy sand, sandy loam, and fine sandy loam, with coarse subsurface textures. Permeability is generally rapid, but is very low through densic layers. Available water capacity (AWC) is very low to low.

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

Map Unit Component Comp %
141 Humic Haploxerands 40
141 Typic Haploxerands 35
142 Cragwash 85
145 Sueredo 85
146 Sueredo 90
147 Summertown 85
153 Typic Vitrixerands 50

153 Vitrandic Xerorthents, moraine 45
154 Typic Vitrixerands 45
154 Vitrandic Xerorthents, moraine 35
157 Typic Vitrixerands, very deep 90
159 Typic Vitrixerands, bouldery 40
159 Typic Vitrixerands, tephra over colluvium 35
162 Humic Haploxerands, outwash 95
169 Sueredo 50

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

Parent Materials:
Kind: Tephra, Colluvium, Outwash
Origin: Volcanic rock

Surface Texture: (1) Loamy coarse sand
(2)Ashy Loamy coarse sand
(3)Ashy Sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	1	55
Surface Fragments > 3" (% Cover):	0	30
Subsurface Fragments <=3" (% Volume):	10	60
Subsurface Fragments > 3" (% Volume):	10	40

Drainage Class: Well drained To Excessively drained
Permeability Class: Rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.2	4.0

Plant Communities

Ecological Dynamics of the Site

This ecological site is found in the northwest portion of Lassen Volcanic National Park. The interpretive plant community is mid-montane coniferous forest dominated by white fir (Abies concolor) and Jeffrey pine (Pinus jeffreyi). The cover of montane shrubs such as greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus velutinus), and sierra chinquapin (Chysolepis sempervirons) can be high in canopy openings. Scattered grasses are found under the forest canopy.

White fir is a large long lived tree in this area. It commonly reaches heights of 120 to 140 feet and can live for 300 to 400 years. It produces single needles1.2 to 2.8 inches long that are distributed along the young branches. Because the female seed cones open and fall apart while still attached to the tree, cones are not often seen on the forest floor. White fir tends to develop a shallow root system that can graft to other white fir roots and spread root rots (Zouhar, 2001).

Jeffrey pine is also a relatively large and long lived tree, attaining heights of 200 feet and living 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) that 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. Ponderosa pine (Pinus ponderosa) is also present within this area. Jeffrey pine is shade intolerant and can be replaced over time by white fir if fire is excluded from the system. Older trees are somewhat adapted to fire as the bark is thick enough to provide protection from moderate intensity fires. Also, the branches of Jeffrey pine tend to thin out along the lower portion of the tree trunk, leaving the crown 20 to 30 meters above the forest floor.

Several factors combine to create a habitat suitable for white fir and Jeffrey pine growth. A study on conifer growth phenology in the Southern Sierra Nevada describes the environmental factors that affect the initiation and seasonal growth of several conifer species. Jeffrey pine and white fir are included within this study. Temperature is critical in initiating conifer growth after snowmelt. In the study, trees generally started 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 was unusually early, the trees did not begin annual growth until specific air temperatures were reached. It was hypothesized that heavy shrub cover delayed the start of annual growth because the shade kept the soil from warming as fast. The pines in the study began leader growth when the air temperatures reached -4 degrees C (24.8 degrees F), and the firs responded after temperatures reached 2 to 3 degrees C (35.6 to 37.4 degrees F). Pines have heavily insulated terminal buds, whereas the terminal buds of fir trees are less insulated and more susceptible to frost damage. The length of the leader growth is predetermined by growth conditions of the prior year. Primordia of fir needles and pine fascicles are developed the year before leader growth. The internode length between fir needles or pine fascicles is determinate, therefore the leader length is determined by the number of primordia developed. It appears that some conifers will not start leader growth until a specific photoperiod (a ratio of light hours to dark hours during one 24 hour period) is met, even if the snow has melted and the temperatures are warm enough. 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).

This site receives 41 inches average annual precipitation, mostly in the form of snow in winter. As the snow melts it fills macropores in the soil with water. Soil characteristics such as depth and texture determine how much water the soil can hold and how long it will remain before filtering through, evaporating away, or being lost to evapotranspiration. The soils associated with this site have very low to low water holding capacities. Under the same climatic conditions, drought would come earlier to these soils than those with higher water holding capacities. These trees have a short growing season due to early drought conditions. Site index data collected for this ecological site indicate better growth rates in low lying areas on glacial outwash, where water is available for a longer period of time during the growing season.

Most of the forest within the present park boundary was never logged, but fire suppression has created a change in the stand structure and composition. Historically, with a natural fire regime, this forest was most likely dominated by large Jeffrey pine in the overstory with a minor component of white fir and/or ponderosa pine. Low to moderate intensity fires maintain an open forest, with patches of montane shrubs and forbs in the canopy openings. In the absence of fire, white fir continues to regenerate in the understory, increasing forest density and fuels. Today the forest is multilayered, dense and shady, dominated by white fir. Vegetation on the forest floor is almost nonexistent.

Fire regime studies, using tree rings and fire scars, report historic median fire return intervals in Jeffrey pine- white fir forests of 14, 18.8, and 70 years (Bekker and Taylor; Skinner and Chang; Taylor and Solem respectively). Beaty and Taylor report that fire frequency and intensity is additionally associated with slope position, aspect, and climatic fluctuations. Fire return intervals are longer on north facing slopes than south facing slopes, and fire intensity increased 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. The fire scars in the Southern Cascade are primarily found at the annual tree ring boundary, indicating the trees were dormant at the time of the fire, whereas in the Sierra Nevada fires scars are often found in the late-season wood. This timing shift may be due to the timing of summer drought conditions, which begin earlier in the south. In July and August, thunderstorms are common in Lassen Volcanic National Park and the 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). Beaty and Taylor report that 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 (Beaty and Taylor, 2001). After a stand replacing fire, evenly aged forests are formed. The current management practice of fire suppression has shifted forest density and composition. Fire suppression creates 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 and shade intolerant pines (Taylor and Solem, 2001).

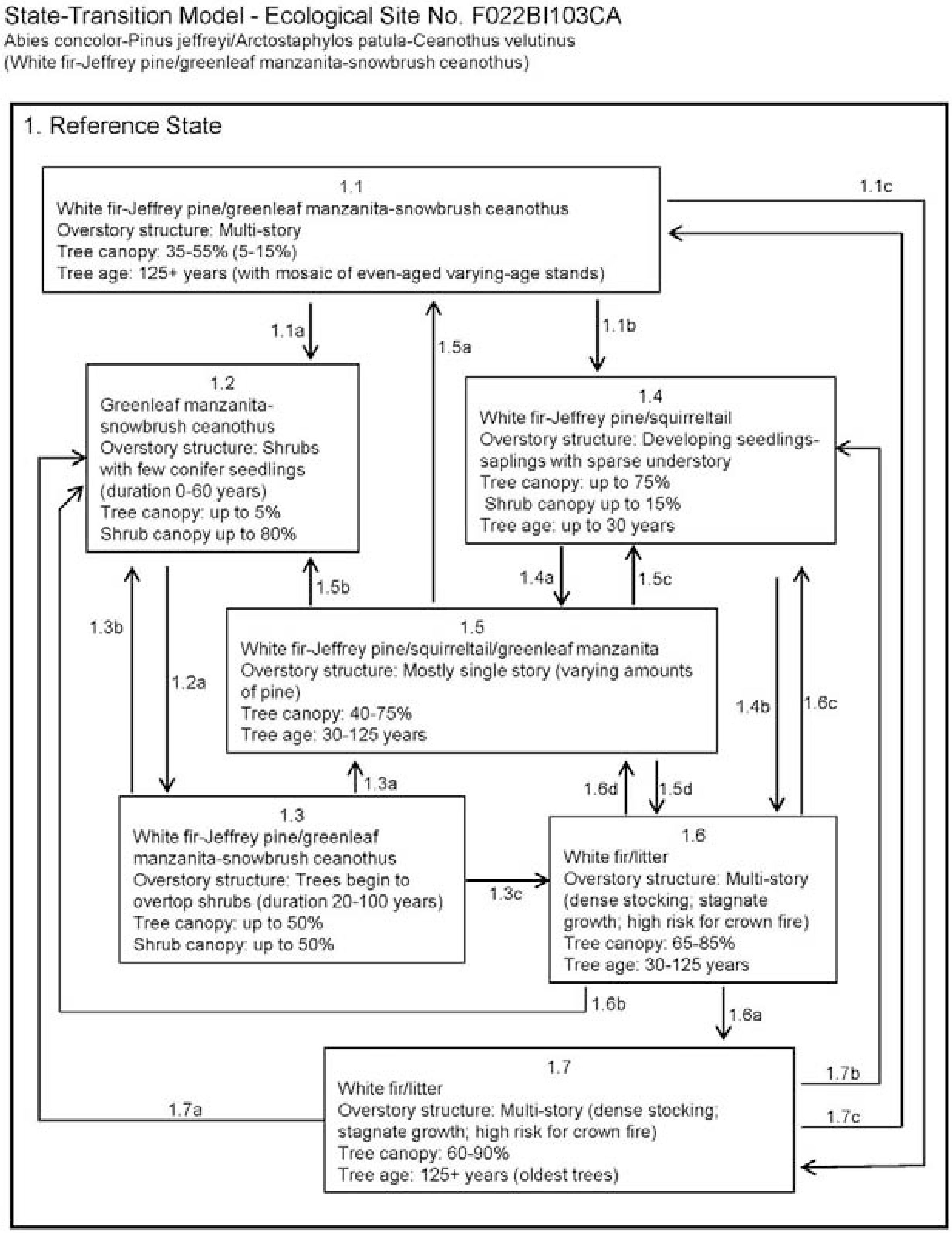
Tree pathogens and insect infestations can have significant impacts on the composition and structure of mid and upper montane coniferous forests. Small infestations may affect just a few trees but large outbreaks may kill the dominant trees over large areas of forest, creating large canopy openings and stand regeneration. Most of these pathogens are a natural cycle of regulation and can push the closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests. Fuel loads are frequently 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 the 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 the dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporlla caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), 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 Diagram



Reference - State 1

White fir-Jeffrey pine/greenleaf manzanita-snowbrush ceanothus - Community Phase 1.1

White Fir - Jeffrey Pine Model

This community phase is the interpretive plant community phase and is similar to the historic plant community phase. It is dominated by mature white fir and Jeffrey pine, with a few ponderosa pines in some areas. Montane shrubs such as greenleaf manzanita (Arctostaphylos patula) and snowbrush ceanothus (Ceanothus velutinus) are present in canopy openings.

This community phase is maintained by low and moderate intensity fires that remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires can kill some of the overstory trees as well, leaving canopy openings that are favorable for Jeffrey pine and shrub regeneration. The moderate intensity fires therefore breakup the uniformity of the older stands with pockets of young forests intermixed.

Community Phase Pathway 1.1a
In the event of a severe fire there may be significant tree mortality, leaving a charred landscape with many standing dead trees. Growth of shrubs fills in relatively quickly leading to community phase 1.2.
Community Phase Pathway 1.1b
In the event of a severe fire there may be significant tree mortality, leaving a charred landscape

with many standing dead trees. Eventually there is infill of trees and sparse understory (community phase 1.4).

Community Phase Pathway 1.1c

If fire is excluded from the old growth community, white fir continues to regenerate in the understory, increasing tree density and shifting this community toward a closed white fir community (phase 1.7).

White fir-Jeffrey pine/greenleaf manzanita-snowbrush ceanothus Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**14**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	5	0	1
		spreading groundsmoke	GADI2	*Gayophytum diffusum*	0	5	0	2
		pinewoods lousewort	PESE2	*Pedicularis semibarbata*	0	4	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**86**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	30	0	7
		sedge	CAREX	*Carex*	0	20	0	5
		squirreltail	ELEL5	*Elymus elymoides*	0	36	0	9

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**25**	**507**		
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	25	200	1	7
		snowbrush ceanothus	CEVE	*Ceanothus velutinus*	0	150	0	8
		granite prickly phlox	LIPU11	*Linanthus pungens*	0	2	0	1
		mountain monardella	MOOD	*Monardella odoratissima*	0	120	0	20
		slender penstemon	PEGR4	*Penstemon gracilentus*	0	30	0	6
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	5	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**40**		
		white fir	ABCO	*Abies concolor*	0	30	0	2
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	10	0	4
		ponderosa pine	PIPO	*Pinus ponderosa*	0	0	0	0

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	39	86
Forb	0	6	14
Shrub/Vine	25	236	507
Tree	0	20	40
Total:	25	301	647

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	30%
Forb	0%	37%
Shrub/ Vine	0%	15%
Tree	35%	55%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	75%	100%
Surface Fragments > 0.25" and <= 3"	0%	10%
Surface Fragments > 3"	0%	15%
Bedrock		
Water		
Bare Ground	0%	5%

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	5%	0%	6%				
> 0.5 - < 1 feet	0%	16%	0%	5%				
> 1 - <= 2 feet			0%	26%				
> 2 - < 4.5 feet					1%	15%	0%	2%
> 4.5 - <= 13 feet							0%	2%

> 13 - < 40 feet							0%	5%
< 40 - >= 80 feet							5%	8%
> 80 - < 120 feet							30%	45%
>= 120 feet							0%	2%

Forest Overstory:

The upper canopy is a mix of Jeffrey pine and white fir, with an occasional ponderosa pine. White fir is in the understory. Canopy heights range from 90 to 120 feet, with diameters ranging from 25 to 35 inches at breast height. The largest and oldest trees were not measured. Basal area for this community type ranged from 110 to 270 ft2/ acre with an average of 190 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	45	55

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	10.0	20.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	25.0	33.0						
ponderosa pine *Pinus ponderosa*	PIPO	N	0	2.0						

Forest Understory:

The understory is generally sparse, although there is more cover and diversity in canopy openings. Common grasses are western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides), and California brome (Bromus carinatus). Greenleaf manzanita (Arctostaphylos patula) and snowbrush ceanothus (Ceanothus velutinus) were present in areas providing adequate sunlight. Other plants frequently encountered include pioneer rockcress (Arabis platysperma), carex (Carex spp.), spreading groundsmoke (Gayophytum diffusum), white hawkweed (Hieracium albiflorum) pinewoods lousewort (Pedicularis semibarbata), whitevein shinleaf (Pyrola picta), and lettuce wirelettuce (Stephanomeria lactucina).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	7.0		
sedge *Carex*	CAREX	N	0	5.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	9.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	1.0		
spreading groundsmoke *Gayophytum diffusum*	GADI2	N	0	2.0		
pinewoods lousewort *Pedicularis semibarbata*	PESE2	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
greenleaf manzanita *Arctostaphylos patula*	ARPA6	N	1.0	7.0		
snowbrush ceanothus *Ceanothus velutinus*	CEVE	N	0	8.0		
granite prickly phlox *Linanthus pungens*	LIPU11	N	0	1.0		
mountain monardella *Monardella odoratissima*	MOOD	N	0	20.0		
slender penstemon *Penstemon gracilentus*	PEGR4	N	0	6.0		
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	2.0		

Greenleaf manzanita-snowbrush ceanothus - Community Phase 1.2

When large fires burn into the forest canopy and kill the majority of the overstory trees, a montane shrub community thrives in the new openings. Even if shrubs were not present at the time of a fire, their seeds may be stored in the soil. Greenleaf manzanita and snowbrush ceanothus seeds can lie dormant in the soil for several hundred years, until the heat from a fire scarifies the seed coat and initiates germination. These seeds also require light and cold stratification for germination. If present at the time of a fire, snowbrush ceanothus, bush chinquapin, and bittercherry can resprout. Hauser (2007) states that greenleaf manzanita does not resprout after fire in this area.

The size and the intensity of a burn may influence the shrub expression. Shrubs were found associated with large burn size, whereas trees were not able to establish across the landscape (Royce and Barbour, 2001). The intensity of burn may affect the scarification of seeds. Shrubs can prevail in areas prone to frequent fire, such as ridges and wind tunnels. Greenleaf manzanita is a strong competitor for water. It continues to deplete water after conifer species have gone dormant for the drought season. This competition for water and sunlight between the shrubs and conifer seedlings can delay the establishment of a forest (Royce and Barbour, 2001).

The shrub community phase can be perpetuated by frequent fire or other disturbances.

Community Phase Pathway 1.2a

The natural pathway is to community phase 1.3, the white fir- Jeffrey pine forest with shrubs. This pathway is followed with time and establishes the tree canopy over the shrubs.

Greenleaf manzanita-snowbrush ceanothus Plant Species Composition:

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**410**	**2100**		
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	250	650	20	55
		snowbrush ceanothus	CEVE	*Ceanothus velutinus*	100	750	5	35
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	60	350	5	30
		bitter cherry	PREM	*Prunus emarginata*	0	350	0	15

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree					**0**	**35**		
		white fir	ABCO	*Abies concolor*	0	25	0	5
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	10	0	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Shrub/Vine	410	1025	2100
Tree	0	10	35
Total:	410	1035	2135

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	5%
Forb	0%	1%
Shrub/ Vine	35%	80%
Tree	0%	10%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	20%	100%
Surface Fragments > 0.25" and <= 3"	0%	5%
Surface Fragments > 3"	0%	5%
Bedrock		
Water		

Bare Ground	0%	15%

Forest Overstory:

There may be select overstory trees that survive a canopy fire. These trees are crucial for seedling recruitment, shade, and litter accumulation. The overstory trees can be completely absent or provide up to 10 percent canopy cover.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	0	2	5

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	0	4.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	6.0						

Forest Understory:

Greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus velutinus), Sierra chinquapin (Chrysolepis sempervirens), and bitter cherry (Prunus emarginata) can form dense shrublands with up to 90 percent cover. Grasses and forbs are not common at this time. Young Jeffrey pine and white fir seedlings are present but may have difficulty competing with the shrubs for sunlight.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
greenleaf manzanita *Arctostaphylos patula*	ARPA6	N	20.0	55.0		
snowbrush ceanothus *Ceanothus velutinus*	CEVE	N	5.0	35.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	5.0	30.0		
bitter cherry *Prunus emarginata*	PREM	N	0	15.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	5.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	5.0		

White fir-Jeffrey pine/greenleaf manzanita-snowbrush ceanothus - Community Phase 1.3

White fir- Jeffrey pine forest with shrubs

This community phase develops as the white fir and Jeffrey pine trees gain dominance over the shrubs. The trees have either been able to establish in the openings in the shrubs or are encroaching upon them from the edges of the shrub field. This is a slow process and could take up to 100 years. As the shade from the tree canopy increases, the shrubs reduce leaf production and eventually become twiggy skeletons of the former shrubs.

Community Phase Pathway 1.3a
This pathway leads to community phase 1.5, the young open white fir- Jeffrey pine forest. This pathway is created with time by the dominance of the trees over the shrubs. Low to moderate intensity fires may occur to clear the understory of dead brush, young seedlings and saplings.

Community Phase Pathway 1.3b
A high intensity severe fire has a high likelihood of leading to the shrubland regeneration community (Community phase 1.2).

Community Phase Pathway 1.3c
This pathway is created when fire is excluded from the system and leads to the young closed white fir forest (Community phase 1.6).

White fir-Jeffrey pine/greenleaf manzanita-snowbrush ceanothus Plant Species Composition:

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**2**		
		sedge	CAREX	*Carex*	0	2	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**15**	**1651**		
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	5	550	1	25
		snowbrush ceanothus	CEVE	*Ceanothus velutinus*	5	750	1	20
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	5	150	1	20
		bitter cherry	PREM	*Prunus emarginata*	0	200	0	10
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	1	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**2**	**80**		
		white fir	ABCO	*Abies concolor*	2	60	1	10
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	20	0	8

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	1	2
Shrub/Vine	15	745	1651
Tree	2	40	80
Total:	17	786	1733

Forest Overstory:

White fir and Jeffrey pine cover ranges from 25 to 55 percent. Trees may be 85 feet tall, with a wide range of heights in the understory due to the slow establishment of conifers through the shrub layer.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	15	40	50

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	10.0	30.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	5.0	20.0						

Forest Understory:

Greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus velutinus), Sierra chinquapin (Chrysolepis sempervirens), and bitter cherry (Prunus emarginata) are present but are beginning to die under the forest canopy.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
sedge *Carex*	CAREX	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
greenleaf manzanita *Arctostaphylos patula*	ARPA6	N	1.0	25.0		
snowbrush ceanothus *Ceanothus velutinus*	CEVE	N	1.0	20.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	1.0	20.0		
bitter cherry *Prunus emarginata*	PREM	N	0	10.0		
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	1.0	10.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	8.0		

White fir-Jeffrey pine/squirreltail - Community Phase 1.4

White fir- Jeffrey pine forest regeneration

This community phase is dominated by white fir and Jeffrey pine seedlings and saplings, with a few scattered grasses, forbs and shrubs. It is not clearly understood why, but sometimes the shrubland community phase does not develop after a fire and regeneration begins directly with forest development. The most likely reason for the lack of shrubs in some areas is a deficiency of a seed bank, which may be tied to the fire history of the area.

Community Phase Pathway 1.4a

The natural pathway is to community phase 1.5, the young open white fir-Jeffrey pine forest. This pathway is followed with natural fire regime. Manual thinning with prescribed burns can imitate the natural cycle and lead to the same open community.

Community Phase Pathway 1.4b

An alternate pathway is created when fire is excluded from the system, which leads to the young closed white fir forest (Community phase 1.6).

White fir-Jeffrey pine/squirreltail Plant Species Composition:

Grass/Grasslike	Annual Production in Pounds Per Acre	Foliar Cover Percent

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
0 -Grass/Grasslike					**0**	**200**		
		squirreltail	ELEL5	*Elymus elymoides*	0	200	0	35

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
0 -Shrub					**0**	**1**		
		spurry buckwheat	ERSP6	*Eriogonum spergulinum*	0	1	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
0 -Tree (understory only)					**2**	**30**		
		white fir	ABCO	*Abies concolor*	0	15	0	3
		Jeffrey pine	PIJE	*Pinus jeffreyi*	2	15	3	20

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	50	200
Shrub/Vine	0	0	1
Tree	2	10	30
Total:	2	60	231

Forest Overstory:

There may be a few surviving overstory trees, crucial for seed recruitment. A small patch of a severe burn is visible in this photo. Jeffrey pine seedlings are establishing well after the fire.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	3	5	75

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	1.0	3.0						

Jeffrey pine *Pinus jeffreyi*	PIJE	N	2.0	4.0

Forest Understory:

Other than the Jeffrey pine seedlings, squirreltail (Elymus elymoides) is the only significant understory species in our plot.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
squirreltail *Elymus elymoides*	ELEL5	N	0	35.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
spurry buckwheat *Eriogonum spergulinum*	ERSP6	N	0	1.0		

White fir-Jeffrey pine/squirreltail/greenleaf manzanita - Community Phase 1.5

This forest community phase develops with the natural fire regime, or with manual thinning and prescribed fires. Low to moderate intensity fires clear the understory and remove fuels before they reach hazardous levels, although severe high-intensity canopy fires are possible. Jeffrey pine has difficulty regenerating and growing well in the understory of the canopy. The presence of Jeffrey pine is dependent upon fire or other disturbances to maintain an open forest structure with canopy openings.

Community Phase Pathway 1.5a

This is the natural pathway for this community, which evolved with a historic fire regime of relatively frequent surface and moderate severity 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 reference community (Community phase 1.1).

Community Phase Pathway 1.5b

A severe canopy fire could initiate shrubland regeneration (Community phase 1.2) depending on shrub species/seed presence.

Community Phase Pathway 1.5c

A severe canopy fire could initiate white fir and Jeffrey pine forest regeneration (Community phase 1.4).

Community Phase Pathway 1.5d

If fire does not occur, the density of the forest increases. This favors white fir over Jeffrey pine. The increased density shifts this community toward the closed white fir community (Community phase 1.6).

White fir/litter - Community Phase 1.6

This community phase is defined by a dense canopy and high basal area of white fir. 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.

Community Phase Pathway 1.6a

If fire continues to be excluded from this system the mature closed white fir forest community develops (Community 1.7).

Community Phase Pathway 1.6b

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 stand regeneration and create the shrubland community (Community phase 1.2) provided shrub species/seed is present.

Community Phase Pathway 1.6c

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 stand regeneration and create the white fir and Jeffrey pine regeneration (Community phase 1.4).

Community Phase Pathway 1.6d

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 had it 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 an open white fir-Jeffrey pine forest (Community phase 1.5). A partial mortality disease or pest infestation could also create a shift towards Community phase 1.5.

White fir/litter - Community Phase 1.7

White fir Forest

The mature closed white fir forest develops with the continued exclusion of fire, allowing the tree density to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases.

Community Phase Pathway 1.7a

At this point a severe fire is likely and would initiate stand regeneration, which can create a shrubland community (Community phase 1.2) provided shrub species/seed is present.

Community Phase Pathway 1.7b

At this point a severe fire is likely and would initiate stand regeneration, which can create the white fir and Jeffrey pine regeneration community (phase 1.4).

Community Phase Pathway 1.7c

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 had it 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 an open white fir-Jeffrey pine community (Community phase 1.1). A partial mortality disease or pest infestation could also create a shift towards Community phase 1.1.

White fir/litter Plant Species Composition:

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**2**	**17**		
		white fir	ABCO	*Abies concolor*	2	15	1	8
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	2	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Shrub/Vine					**0**	**20**		
		prince's pine	CHIMA	*Chimaphila*	0	10	0	2
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	10	0	2

Annual Production by Plant Type:

	Annual Production (lbs/AC)		
Plant Type	Low	Representative Value	High
Shrub/Vine	0	10	20
Tree	2	4	17
Total:	2	14	37

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	1%
Forb	0%	1%
Shrub/ Vine	0%	1%
Tree	60%	90%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	80%	100%
Surface Fragments > 0.25" and <= 3"	0%	1%
Surface Fragments > 3"	0%	5%
Bedrock		
Water		
Bare Ground	0%	1%

Forest Overstory:

This forest is very dense with multiple layers of white fir. Jeffrey pine has, for the most part, been shaded out and is not regenerating under the dense canopy. There is a thick layer litter and piles of debris from dead trees and branches. The suppressed trees are slowly dying, adding to the fuels. Large dead snags are present. There may be a high incidence of disease.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	60	75	90

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	60.0	88.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	2.0						

Forest Understory:

Understory cover is almost absent except for a few prince's pines (Chimaphila spp.) and whitevein shinleafs (Pyrola picta).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
prince's pine *Chimaphila*	CHIMA	N	0	2.0		
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	2.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	1.0	8.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	2.0		

Ecological Site Interpretations

Forest 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	131	109	305	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.
Jeffrey pine	PIJE	81	109	71	120	40	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:

White fir forests provide browse, cover and nesting sites for a variety of wildlife species. The type and quality of the wildlife habitat varies with the community type. Mature open forests, closed dense white fir forests, young forests, and shrublands provide different habitats and forage for wildlife. Deer and bear can heavily browse the young white fir shoots. Porcupines eat the bark of white fir and can kill saplings. Rodents feed on the cambial tissue. Young seedlings and seeds are eaten by animals as well. Douglas squirrels cut and cache white fir cones before the cones are fully mature.

There are about 33 species of mammals commonly present in the white fir forest type in California and, of these, 7 are generally associated with mature forests. About 123 species of birds are found in the white fir forest type of California and southern Oregon, about 50 of which are associated primarily with mature forests. Many of these bird use mature white fir trees and snags for foraging, roosting, nesting and/or breeding. Included are bald eagle, California spotted owl, brown creeper, pileated woodpecker, white-headed woodpecker, and, when near lakes or streams, osprey. Reptiles in white fir forests are represented by 17 species, mostly at lower elevations, 8 of which are associated with mature forests (Zouhar, 2001).

Although the leaves of the montane shrubs are not a highly desired browse, their berries and seeds are eaten in large quantities. Greenleaf manzanita berries and seeds are eaten in large quantities by bears and other wildlife. Bush chinquapin seeds are a staple food for several birds and rodents. Huckleberry oak acorns are eaten by small mammals.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:

This area is pleasant with shade and has small streams and lakes nearby, supporting a variety of wildlife. It is suitable for hiking trails and campgrounds (in flatter areas).

Wood Products:

White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production, hence it provides poor firewood compared to other conifers (Zouhar, 2001).

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber (Gucker, 2007).

Other Products:
Jeffrey pine seeds are edible. Jeffrey pine sap was used by Native Americans to treat pulmonary disorders, and later heptane was distilled from the sap and sold to treat pulmonary problems and tuberculosis. Jeffrey pine heptane was also used to develop the octane scale used to rate petroleum used in automobiles (Gucker, 2007).

The fruits of greenleaf manzanita can be eaten whole or made into cider and jelly. The Native Americans brewed the berries into tea to treat poison-oak (Toxicodendron diversilobum). The leaves were used to make remedies for several diseases (Hauser, 2007). Bush chinquapin seeds are edible raw or roaster and were part of the Native American diet (Howard, 1992).

Other Information:

SITE INDEX DOCUMENTATION:

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

Trees appropriate for site index measurement typically occur in stands of community phases 1.5 and 1.6. White fir and Jeffrey pine site trees are selected according to guidance in Schumacher (1926) and Meyer (1961), respectively.

Site index for white fir was variable across this area, ranging from 55 to 131 (Schumacher, 1926). Shrub competition, overcrowding and disease lowered site index. Low lying areas or areas near streams had higher site index due to the availability of water. Please refer to the Lassen Volcanic National Park Soil Survey for detailed site index information by soil component.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Humic Loamy Gentle Slopes	F022BI110CA	This is a white fir mixed conifer forest found on the east side of the park. This site has more conifer diversity and lacks the heavy shrub component.
Low Precip Frigid Sandy Moraine Slopes	F022BI119CA	This is a white fir Jeffery pine site found on the slopes above Buttelake. This site has more Jeffrey pine and fewer shrubs.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

There are 28 vegetation plots that were used to describe this ecological site. These plots represent the following community types:

1.1- Mature open white fir Jeffrey pine forest
144
197
240

1.2 and 1.3 - Shrubland and Shrubland with trees
123
125
126
222- Typic Vitrixerands, very deep modal
237- Summertown modal pit
341
386

1.6 and 1.7- Dense white fir forest
138- Typic Vitrixerands, Tephra over Colluvium modal pit
213- Typic Haploxerands modal pit
264
271
277
278- Humic Haploxerands,Outwash- modal pit
329
340
352
365-burn
366-burn
371
381
L357- Cragwash, modal pit
L358- Sueredo modal- Site location

1.4- Forest regeneration
214

Plots not assigned to community type:
131- Typic Vitrixerands, Bouldery modal pit
132
143

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	4 E
Section:	10
Datum:	NAD83
Zone:	10
Northing:	4490409
Easting:	626602
General Legal Description:	This site is just east of the Lassen Park Road, about .82 miles southeast of Lost Creek Organizational Campground.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104490409626602

Relationship to Other Established Classifications:

Forest Alliance = Abies concolor - White fir forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/18/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	7/27/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Cryic Coarse Loamy Colluvial Slopes

Tsuga mertensiana / / Lupinus obtusilobus - Cistanthe umbellata var. umbellata
(mountain hemlock / / bluntlobe lupine - Mt. Hood pussypaws)

Site ID: F022BI104CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Moraine, (2) Mountain slope, (3) Cinder cone
Elevation (feet): 6,960-9,160
Slope (percent): 1-80, but generally 15-60
Water Table Depth (inches): N/A
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, East, West
Mean annual precipitation (inches): 37.0-125.0
Primary Precipitation: Snow from November to May
Mean annual temperature ranges from 38 to 43 degrees F (3 to 6 degrees C)
Restrictive Layer: Densic layer or bedrock between 20 to 60 inches or more
Temperature Regime: Cryic
Moisture Regime: Xeric
Parent Materials: Tephra over till, tephra over colluvium, or in colluvium derived from volcanic rock
Surface Texture: (1) Stony medial loamy sand, (2) Gravelly ashy sandy loam, (3) Very gravelly ashy fine sandy loam
Surface Fragments <=3" (% Cover): 20-65
Surface Fragments > 3" (% Cover): 0-10
Soil Depth (inches): 20-60+
Vegetation: Mountain hemlock (Tsuga mertensiana) forests dominate this ecological site, located just below or intermixed with whitebark pine forests.
Notes: This site is found near timberline on the flanks of Lassen Peak and on some of the nearby peaks.

Physiographic Features

This ecological site is found on glacial headlands, moraines, and cinder cones between 6,960 and 9,160 feet in elevation. Slopes range from 1 to 80 percent, but the majority of this site is on 15 to 60 percent slopes. This site is associated with northern aspects but is found in cooler positions on all aspects.

Landform:	(1) Moraine
	(2) Mountain slope
	(3) Cinder cone

	Minimum	Maximum
Elevation (feet):	6960	9160
Slope (percent):	1	80
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	High
Aspect:	North East West	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to May. The mean annual precipitation ranges from 37 to 125 inches (940 to 3,175 mm) and the mean annual temperature ranges from 38 to 43 degrees F (3 to 6 degrees C). The frost free (> 32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 60 to 110 days. Although this data is from several GIS prism layers it may reflect inaccurate levels for the temperature and precipitation of the upper cinder cones on the east side of the park. It seems that the precipitation is low and the temperatures are high for this area, but the prism data may not be detailed enough to capture small cinder cones.

There are no representative climate stations available for this site.

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	60	110
Mean annual precipitation (inches):	37.0	125.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

The Terracelake, Humic Xeric Vitricryands, Xeric Vitricryands, tephra over till, and the Xeric Vitricryands, colluvium soil components are associated with this site. These soils are moderately deep to very deep, with very low to low AWC. The moderately deep soils have a densic layer or bedrock between 20 to 40 inches. Permeability is rapid in the upper horizons, but very slow to impermeable through the densic layer or bedrock. The surface textures are stony medial loamy sand, gravelly ashy sandy loam, very gravelly ashy fine sandy loam, or gravelly medial sandy loam, with sandy subsurface textures. These soils formed in tephra over till, tephra over colluvium, or in colluvium derived from volcanic rock.

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

Map Unit/ Component /Comp %
116 Xeric Vitricryands, tephra over till 30
116 Terracelake (highest elevation of this component) 25
116 Humic Xeric Vitricryands, 10
122 Xeric Vitricryands, colluvium 35
136 Xeric Vitricryands, tephra over till, 10
144 Humic Xeric Vitricryands 30

Parent Materials:
Kind: Tephra, Till, Colluvium

Origin: Volcanic rock

Surface Texture: (1) Stony medial loamy sand
(2) Gravelly ashy sandy loam
(3) Very gravelly ashy fine sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	20	65
Surface Fragments > 3" (% Cover):	0	10
Subsurface Fragments <=3" (% Volume):	15	65
Subsurface Fragments > 3" (% Volume):	10	40

Drainage Class: Well drained To Well drained

Permeability Class: Rapid To Impermeable

	Minimum	Maximum
Depth (inches):	20	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	3.5	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	2.1	3.5

Plant Communities

Ecological Dynamics of the Site

Mountain hemlock (Tsuga mertensiana) forests dominate this ecological site, located just below or intermixed with whitebark pine forests. This site is found near timberline on the flanks of Lassen Peak and on some of the nearby peaks.

This area is buried with deep snow from November to June and remains cool for most of the year. Several physiological adaptations allow mountain hemlock to survive in this cold environment. It has maximum photosynthesis rates at colder temperatures than lower elevation trees; it closes its stomata to reduce water loss during its dormant period; and the tips of Mountain hemlock are very flexible, which reduce snow build up and stem breakage (Arno and Hammerly, 1984).

Timberline trees are able to withstand extremely cold winter conditions when they are dormant but need at least a 2 month frost free growing season in the summer. During this short growing season, usually in July and August, the new growth of mountain hemlock is susceptible to frost. The new shoots are soft and succulent and need time to "ripen" (Arno and Hammerly, 1984).

The duration of the growing season is crucial for seedling establishment.

Snow burial can help protect the trees from strong winter winds, desiccation from warm winter winds and sunny winter days, from extreme cold, and from repeated freezing and thawing (Arno and Hammerly, 1984). Snow burial, however, can be detrimental as well. In some areas, the portion of the tree exposed above the snow can die back leaving, short multi-stemmed trees. Snow creep can create pistol butted trees, and avalanches can destroy swaths of forest.

The fire return intervals for mountain hemlock forests in this area are poorly documented but they may be between 400 to 800 years (Tesky, 1992). Nine fires are documented for the mountain hemlock zone in Lassen Volcanic National Park between 1933 and 1977, resulting in a single tree being burned. Lightning strikes are very common in this area but the fuel loads and their capacity to carry fire is low. Even if fire started to spread, these forests are often dissected by wind exposed ridges and rock outcrops.

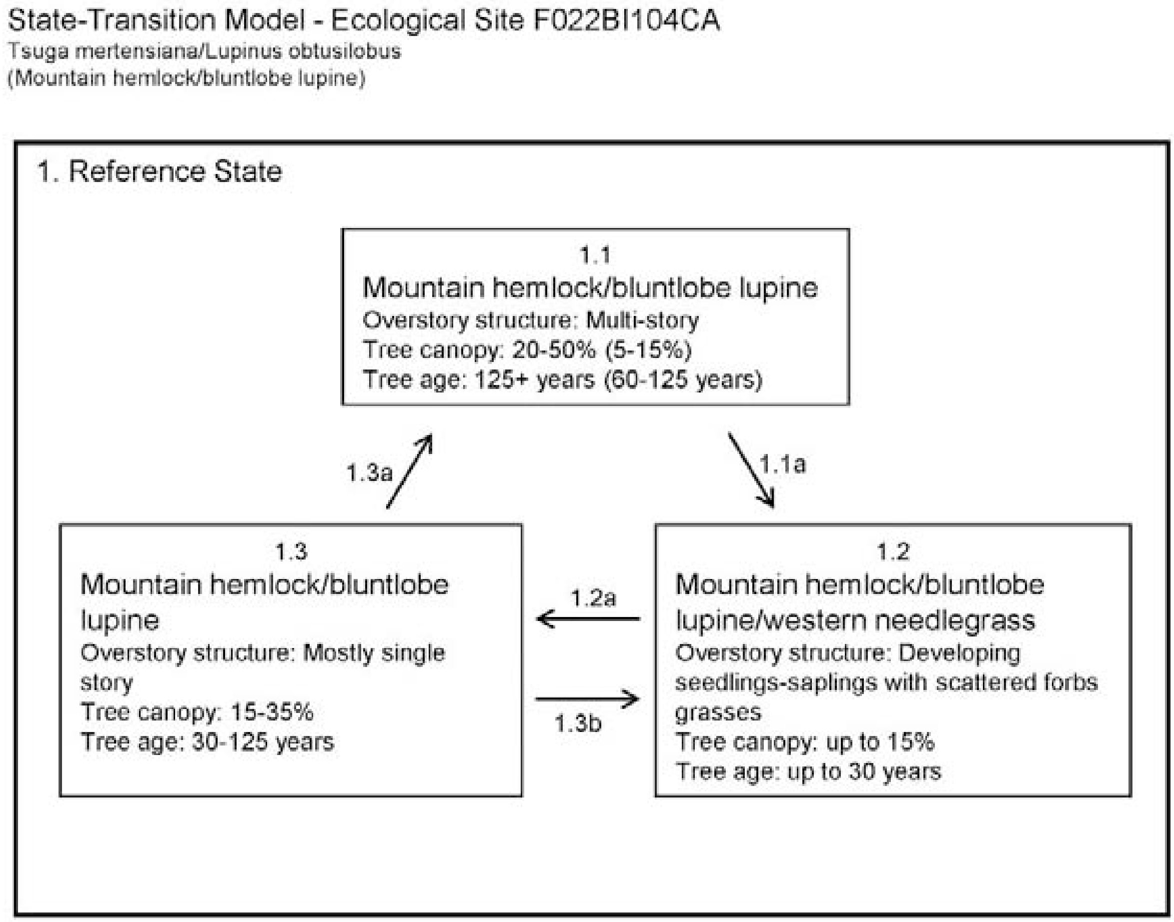
Reestablishment of mountain hemlock after a fire or other disturbance is often slow, and in some areas, it never regains its tree-like stature (Arno and Hammerly, 1984).

Mountain hemlock is not generally as susceptible to forest pathogens as the lower elevation conifers, but trees over 80 years old are very susceptible to laminated root rot (Phellinus weiri). Laminated root rot can rapidly spread by root contact and kill acres of forests (Tesky, 1992).

Other common fungal and parasitic pests of mountain hemlock include several heart rots, of which Indian paint fungus (Echinodontium tinctorum) is the most common and damaging, various needle diseases, snow mold (Herpotrichia nigra), and dwarf-mistletoe (Arceuthobium tsugense) (Tesky, 1992).

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 Diagram



Reference - State 1

Mountain hemlock/bluntlobe lupine - Community Phase 1.1

Mountain Hemlock Forest

This is a long lived stable mountain hemlock (Tsuga mertensiana) forest. Trees can live for 800 years but a mature forest may be 100 to 400 years old. In protected areas trees may be over 90 feet tall with 50 percent canopy cover. In areas exposed to wind, the forest remains more open with shorter trees.

Community Phase Pathway 1.1a

Fire, disease, wind-throw, avalanches, and/or winter desiccation create small canopy gaps for regeneration.

Mountain hemlock/bluntlobe lupine Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Forb**				**16**	**433**		
		Holboell's rockcress	ARHO2	*Arabis holboellii*	0	1	0	1
		Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0	2	0	1
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	16	430	2	50

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Grass/Grasslike**				**0**	**121**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	55	0	7
		sedge	CAREX	*Carex*	2	16	1	8
		spike trisetum	TRSP2	*Trisetum spicatum*	0	50	0	10

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Shrub**				**0**	**2**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	2	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Tree (understory only)**				**2**	**25**		
		mountain hemlock	TSME	*Tsuga mertensiana*	2	25	1	10

Annual Production by Plant Type:

Plant Type	Low	Representative Value	High
	Annual Production (lbs/AC)		
Grass/Grasslike	0	24	121
Forb	16	302	433
Shrub/Vine	0	1	2
Tree	2	10	25
Total:	18	337	581

Structure and Cover:

Ground Cover

Vegetative Cover	**Minimum**	**Maximum**
Grass / Grasslike	1%	9%
Forb	2%	65%
Shrub/ Vine	0%	1%
Tree	25%	60%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	40%	60%
Surface Fragments > 0.25" and <= 3"	5%	30%
Surface Fragments > 3"	5%	45%
Bedrock	0%	10%
Water	0%	0%
Bare Ground	2%	10%

Structure of Canopy Cover

Height Above Ground	**Grasses/Grasslike**		**Forbs**		**Shrubs/Vines**		**Trees**	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	1%	8%	0%	1%				
> 0.5 - < 1 feet	0%	5%	0%	2%				
> 1 - <= 2 feet			2%	65%			0%	1%
> 2 - < 4.5 feet							0%	1%
> 4.5 - <= 13 feet							0%	5%
> 13 - < 40 feet							5%	15%
< 40 - >= 80 feet							20%	60%
> 80 - < 120 feet							0%	5%
>= 120 feet								

Forest Overstory:

Canopy cover ranges from 20 to 50 percent with an average of 25 percent. Basal area ranges from 110 to 200 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	20	25	50

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
mountain hemlock *Tsuga mertensiana*	TSME	N	20.0	50.0						

Forest Understory:

The understory is generally sparse but bluntlobe lupine (Lupinus obtusilobus) flourishes in some areas. Other common plants are western needlegrass (Achnatherum occidentale), Holboell's rockcress (Arabis holboellii), pioneer rockcress Arabis platysperma carex (Carex SP.), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), and spike trisetum (Trisetum spicatum).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	7.0		
sedge *Carex*	CAREX	N	1.0	8.0		
spike trisetum *Trisetum spicatum*	TRSP2	N	0	10.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Holboell's rockcress *Arabis holboellii*	ARHO2	N	0	1.0		
Mt. Hood pussypaws *Cistanthe umbellata var. umbellata*	CIUMU	N	0	1.0		
bluntlobe lupine *Lupinus obtusilobus*	LUOB	N	2.0	50.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	2.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
mountain hemlock *Tsuga mertensiana*	TSME	N	1.0	10.0		

Mountain hemlock/bluntlobe lupine/western needlegrass - Community Phase 1.2

Small scale disturbances from wind-throw, disease, single tree mortalities from lightning strikes, snow creep, and small avalanches are possible in this ecological site. Mountain hemlock has a shallow root system and is susceptible to wind-throw. These disturbances create small gaps for mountain hemlock regeneration.

Canopy fires are uncommon in this mountain hemlock community phase but may occur if there are sufficient fuels and the right climatic conditions for fire to spread.

Mountain hemlock is able to reproduce by layering and by seed. Trees that reproduce by layering create a circle of young trees around the original tree. Mountain hemlock seedlings prefer partial shade. Seeds are winged and are wind dispersed. Mountain hemlock produces cones in 3 year intervals with almost no cone production between intervals. For the seeds to establish, a good seed crop is needed with favorable temperature and moisture conditions. Mountain hemlock establishes well during years of lower than normal April snowpack depths, which provides a longer snow-free growing season (Taylor, 1995). Adequate summer moisture is also important.

Growth of the seedlings is very slow at first. In a study of mountain hemlock recruitment in Lassen Volcanic Park, 30 cm tall seedlings were 29 years old (Taylor, 1995).

Lupines, grasses, and other forbs are present.

Community Phase Pathway 1.2a

With time and growth mountain hemlock increases in basal area, height and cover.

Mountain hemlock/bluntlobe lupine - Community Phase 1.3

Even under favorable conditions this community phase may require over 100 years for the slow growing hemlocks to slowly regain a forest structure. In one study of the regrowth of mountain hemlock after a laminated root rot die-off, regrowth of the forest was very slow. Due to the slow and continual recruitment of mountain hemlock, an unevenly aged forest will develop (Boone et. al. 1988).

If disturbances such as fire, clear-cutting or disease create large canopy openings, the trees may have difficulty reestablishing as a forest site. The lack of a nearby seed source, exposure to severe winds, or lack of protective shade may reduce a formerly forested site to a more open Krummholz statured forest.

Community Phase Pathway 1.3a
With time and growth, mountain hemlock increases in basal area, height and cover.

Community Phase Pathway 1.3b
Fire, disease, wind-throw, avalanches, and/or winter desiccation create small canopy gaps for regeneration.

Ecological Site Interpretations

Forest 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
mountain hemlock	*TSME*	61	65	58	67	70	990	100TA	Barnes, George H. 1962. Yield of even-aged stands of western hemlock. USDA, Forest Service. Pacific Northwest Forest and Range Experiment Station Technical Bulletin 1273.

Animal Community:
Mountain hemlock forests provide cover and forage for wildlife species. Some birds eat the mountain hemlock seeds. In some areas the understory provides decent forage (Tesky, 1992).

Plant Preference by Animal Kind:

Hydrology Functions:
This site is in the soil hydrologic groups A and B.

Recreational Uses:
This site is located on or near alpine peaks and ridges. This area is often steep but provides scenic views. Trails may need special planning to avoid erosion.

Wood Products:
Mountain hemlock is rarely harvested for commercial uses because of its inaccessibility. If harvested, it is usually sold with western hemlock. The wood is moderately strong and used as small lumber, pulp, interior finish, cabinetry, crates, flooring and ceilings (Tesky, 1992).

Other Products:
Mountain hemlock is sometimes planted as an ornamental tree.

Other Information:
Site index documentation:

Barnes (1962) developed site curves and yield estimates for western hemlock which were used to roughly approximate forest site productivity for mountain hemlock. 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 older stands of community phase 1.3. They are selected according to guidance in Barnes (1962).

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes	F022BI111CA	This ecological site is a sub-alpine mixed conifer forest generally found just below the pure hemlock forests, but it intermingles in some areas.
Cirque Floor	R022BI205CA	This rangeland site has high cover of lupine and is found on cirque bottoms.

Similar Sites:

Site Name	Site ID	Site Narrative
Upper Cryic Slopes	F022BI124CA	This open mountain hemlock-whitebark pine forest is often stunted and windblown and is found at timberline.

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
There following vegetation plots were used to describe this ecological site:

789149
789171- Site location
789207
789265
789326
789345
789387
789398

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	4 E
Section:	12
Datum:	NAD83
Zone:	10
Northing:	4482249
Easting:	629292
General Legal Description:	This site is about 650 feet north of the trailhead that starts at Highway 89 and goes down to Paradise Meadows and Terrace Lake.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104482249629292

Relationship to Other Established Classifications:

Forest Alliance = Tsuga mertensiana – Mountain hemlock forest; Association = (no matching 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.)

Other References:

Arno, Stephen F. and Hammerly, Ramona p. 1984. Timberline, Mountain and Artic Forest Frontiers. The Mountaneers, Seattle, WA.

Barnes, George H. 1962. Yield of even-aged stands of western hemlock. USDA, Forest Service. Pacific Northwest Forest and Range Experiment Station Technical Bulletin 1273.

Boone, Richard D.; Sollins, Phillip; and Cromack, Kermit Jr, 1988. Stand and Soil Changes Along A Mountain Hemlock Death and Regrowth Sequence. Ecology, Vol. 69, No. 3 (Jun., 1988), pp. 714-722.

Means, Joseph E. Tsuga mertensiana (Bong.) Carr. Mountain Hemlock. In. Burns, Russell M; Honkala, Barbara H.; [Technical coordinators] 1990. Silvics of North America: Volume 1. Conifers. United States Department of Agriculture (USDA), Forest Service, Agriculture Handbook 54.

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Taylor, Alan H. 1995. Forest Expansion and Climate Change in the Mountain Hemlock (Tsuga mertensiana) Zone, Lassen Volcanic National Park, California, U.S.A. Artic and Alpine Research, Vol. 27, No. 3, 1995, pp. 207-216.

Tesky, Julie L. 1992. Tsuga mertensiana. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2008, June 16].

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/18/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	9/13/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Sandy Loam Debris Flow On Stream Terraces

Pinus contorta var. murrayana - Populus tremuloides / / *Elymus glaucus*
(Sierra lodgepole pine - quaking aspen / / blue wildrye)

Site ID: F022BI105CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Stream terrace
Elevation (feet): 6,120-6,350
Slope (percent): 0-8
Water Table Depth (inches): 10 to 60
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 45.0-61.0
Primary precipitation: Snow from November to April
Mean annual temperature: 41 to 44 degrees F (5 to 6.6 degrees C)
Restrictive Layer: None
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Material: 1915 eruption debris deposited over preexisting alluvial soil
Surface Texture: (1) Ashy very fine sandy loam
Surface Fragments <=3" (% Cover): 0-20
Surface Fragments > 3" (% Cover): 0-10
Soil Depth (inches): >60
Vegetation: Quaking aspen (Populus tremuloides) and Sierra lodgepole pine (Pinus contorta var. murrayana); Sierra lodgepole pine is encroaching upon the aspen.
Notes: Primarily located along Hat Creek in Lassen Volcanic National Park.

Physiographic Features

This ecological site is found along Hat Creek on low stream terraces between 6,120 and 6,350 feet in elevation. Slopes range from 0 to 8 percent. This site has a water table that fluctuates from 10 inches below the surface to below 60 inches.

Landform: (1) Stream terrace

	Minimum	Maximum
Elevation (feet):	6120	6350
Slope (percent):	0	8
Water Table Depth (inches):	10	60
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 45 to 61 inches (1,143 to 1,549 mm). The mean annual temperature ranges from 41 to 44 degrees F (5 to 6.6 degrees C). The frost free (>32 degrees F) season is 60 to 85 days. The freeze free (>28 degrees F) season is 79 to 202 days (MZL).

The information in the tables below is from the Manzanita Lake Climate Station, which is located approximately 6 miles east of this site and 400 feet higher in elevation. The average annual snow depth (at the Manzanita Lake climate station) reaches its peak depth of 25 inches in February. Snow is normally melted by June and does not begin to accumulate again until November.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	79	202
Mean annual precipitation (inches):	45.0	61.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	21.0	0.3	1.37	0.56	0.16	0.0	0.0	0.0	0.0	0.0	0.04	0.0
Precip. Max.	18.54	13.68	14.05	10.78	10.23	6.09	2.52	4.57	6.36	14.76	15.45	19.42
Temp. Min.	20.2	21.0	23.1	27.6	34.6	40.9	45.5	44.1	40.4	34.0	26.7	22.1
Temp. Max.	41.0	42.7	45.0	51.2	60.5	69.9	78.9	77.6	71.6	60.5	47.2	42.0

Climate Stations: (1) 045311, Manzanita Lake, CA. Period of record 1949 - 2005

Influencing Water Features

This ecological site is not influenced by wetland or riparian water features, but it is found on stream terraces.

Wetland Description: System Subsystem Class

Representative Soil Features

This ecological site is associated with the Vitrandic Xerofluvents debris flows soil component. This component is very deep and somewhat poorly drained, with low AWC in the upper 60 inches of soil. 10 to 50 inches of debris from the 1915 eruption of Lassen Peak is deposited over the preexisting alluvial soil. There are a few inches of fresh organic material over several C horizons and one buried A horizon. The upper C horizons have ashy-very fine sandy loam textures. This material is from reworked debris material that overlays the coarser textured initial debris material. The initial debris material in the lower C horizons has ashy loamy coarse sand textures and gravel increases with depth, from 6 to 60 percent. The buried A horizon has a very gravelly ashy fine sandy loam texture.

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

Map unit Component / Component %
138 Vitrandic Xerofluvents, debris flows / 80

Parent Materials:
Kind: Debris fall deposits, Alluvium
Origin: Volcanic rock

Surface Texture: (1)Ashy very fine sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	20
Surface Fragments > 3" (% Cover):	0	10

Subsurface Fragments <=3" (% Volume):	0	45
Subsurface Fragments > 3" (% Volume):	0	5

Drainage Class: Somewhat poorly drained To Somewhat poorly drained
Permeability Class: Moderate To Moderate

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.06	7.43

Plant Communities

Ecological Dynamics of the Site

This ecological site is characterized by the presence of quaking aspen (Populus tremuloides) and Sierra lodgepole pine (Pinus contorta var. murrayana). It is primarily located along Hat Creek in Lassen Volcanic National Park. Sierra lodgepole pine is encroaching upon the aspen throughout this area.

The 1915 eruption of Lassen Peak buried this area with 10 to 50 inches of coarse debris material. After deposition, the water that was held in the debris drained out and caused flooding and erosion across the valley. To varying degrees, these disturbances buried and removed the preexisting vegetation. As a consequence the valley bottom opened for colonization by pioneer plant species. Quaking aspen and Sierra lodgepole pine are both shade intolerant species that regenerate well after disturbances. It is not documented, but the presence, distribution, and age of the aspen and Sierra lodgepole pine indicate that they may have established concurrently after the debris flow. Proximity to Sierra lodgepole pine and aspen seed sources, or surviving aspen roots, would affect the distribution of aspen and lodgepole pine across the valley. Aspen grow taller more quickly than Sierra lodgepole pine and may have initially been more dominant. After aspen reaches its maximum height however, Sierra lodgepole pine will continue to grow and eventually dominate the aspen canopy. Hat Creek may have braided through the original debris deposits until it developed its current channel. If aspen were already established nearby, suckers could shoot up in the abandoned channel before lodgepole pine could compete, which could account for some of the pure aspen stands.

Quaking aspen is unique because of its clonal growth characteristics. This is best seen in fall when separate patches of trees will exhibit different colors of yellow, gold, and orange. The different colors represent the different genetic clones, which respond differently to stress factors and seasonal changes. It is commonly believed that aspen was a pioneer on glacial outwash plains after the glaciers retreated. The fresh glacial outwash would have provided the ideal substrate of deep, exposed moist soils for aspen seedling development. Genetic studies have indicated that aspen rarely reproduce from seed and may not have produced many new seedlings since the last major ice age. Although aspen doesn't regenerate often from seed, it spreads prolifically by root sprouts called suckers. The suckers are part of a clone. Although clones tend to be either male or female, some are hermaphrodites. The clones regenerate after sudden canopy removal caused by disturbances such as fire, disease or insect infestations. Without fire or other disturbances, aspen stands fail to produce suckers because of hormonal inhibitors. The movement of the hormone that suppresses suckering is reduced when the tree canopy is killed or stressed, which allows another hormone to stimulate suckering (Bartos, 2001). Young aspen clones and mature trees grow best in full sunlight. Aspen trees can to live to be 150 years or older, but often aspen stands tend to deteriorate after 80 to 100 years without disturbance. One report documents a male aspen clone in Utah that covers 17.2 acres and has 47,000 stems. They estimate the age of this clone to be 1 million years old (Howard, 1996; Mitton and Grant, 1996).

Aspen stands can be seral to conifer or stable climax communities depending on the site characteristics. This site is a seral aspen site because of the ability of Sierra lodgepole pine to establish in the area. While stable aspen stands tend to be associated with Mollisols exhibiting pachic, argic or boralfic characteristics, which have high organic matter content and relatively high pH ranges, the soils of the seral stands tend to be associated more often with typic Alfisols, some with mollic characteristics but with lower organic matter content and lower pH ranges. The soils associated with this seral aspen site are Vitrandic Xerofluvents, debris flows. These soils are young and poorly developed, composed of relatively fresh debris flow material. They have not developed an A horizon and have only a few inches of fresh organic matter on the surface. The buried soil encountered at about 50 inches has an Ab horizon with a very gravelly ashy fine sandy loam texture. High water tables often inhibit conifer encroachment and allow aspen to remain as a stable climax species. This site has a seasonally high water table at 10 inches but it lowers though-out the season and does not inhibit Sierra lodgepole pine.

Although soil morphology changes and is different for conifer and aspen forests, the changes do not seem to be significant enough to preclude either species from this site. (Bartos and Amacher, 1998). Soils under stable aspen sites tend to have higher pH values than those for conifer soils, and organic matter occurs within the soil profile rather than being concentrated at or above the surface as in conifer sites.

Water use may be less in aspen sites than for coniferous sites, creating the potential for more runoff and free water in aspen dominated forests.

Grazing by ungulates can severely impact regeneration of aspen, but at this time grazing does not seem to have a significant impact in Lassen Volcanic National Park.

Sierra lodgepole pine is a long lived conifer that commonly attains heights of 90 to 100 feet, with an average dbh of 16.5 inches. It has 1.2 to 2.4 inch long needles in bundles of two. The cones are non-serotinous, meaning that they release their seeds without fire. Older trees can be prolific, reliable seed producers, with good seed crops occurring every 1 to 3 years. Cones first appear between the ages of 4 and 8. Although usually seral to more shade tolerant conifers such as red fir and white fir, Sierra lodgepole pine forms an edaphic climax in cold pockets and wet areas typified by this site.

The historic fire regime for aspen is poorly understood. Pure seral aspen stands unsuitable for conifer encroachment are generally considered fire safe corridors and may not experience a canopy fire for 300 years. The seral aspen stands are self-perpetuating. When the overstory dies back from disease or natural senescence, the aspen will regenerate in the openings because there is no competition from conifers. When conifers encroach into an aspen stand, fuel loads accumulate and the potential for a canopy fire increases.

Different plant pathogens and pests can kill or severely impact the health of aspen, including several fungal stem canker diseases. The more common and serious cankers are the sooty-bark canker (Encoelia pruinosa), black canker (Ceratocystis fimbriata), Cryptosphaeria (Cryptosphaeria populina) and Cytospora canker (Cytospora chrysosperma). These stem cankers enter the aspen through wounds in the bark, creating abnormal growth and often blackish cankers. The sooty-bark canker and the Cryptosphaeria canker fungi can kill a tree in just one to ten years while others may never kill the tree. These fungi are a natural part of the aspen ecology and essential in bringing death to older trees and creating a new cycle of regeneration (Johnson et al.).

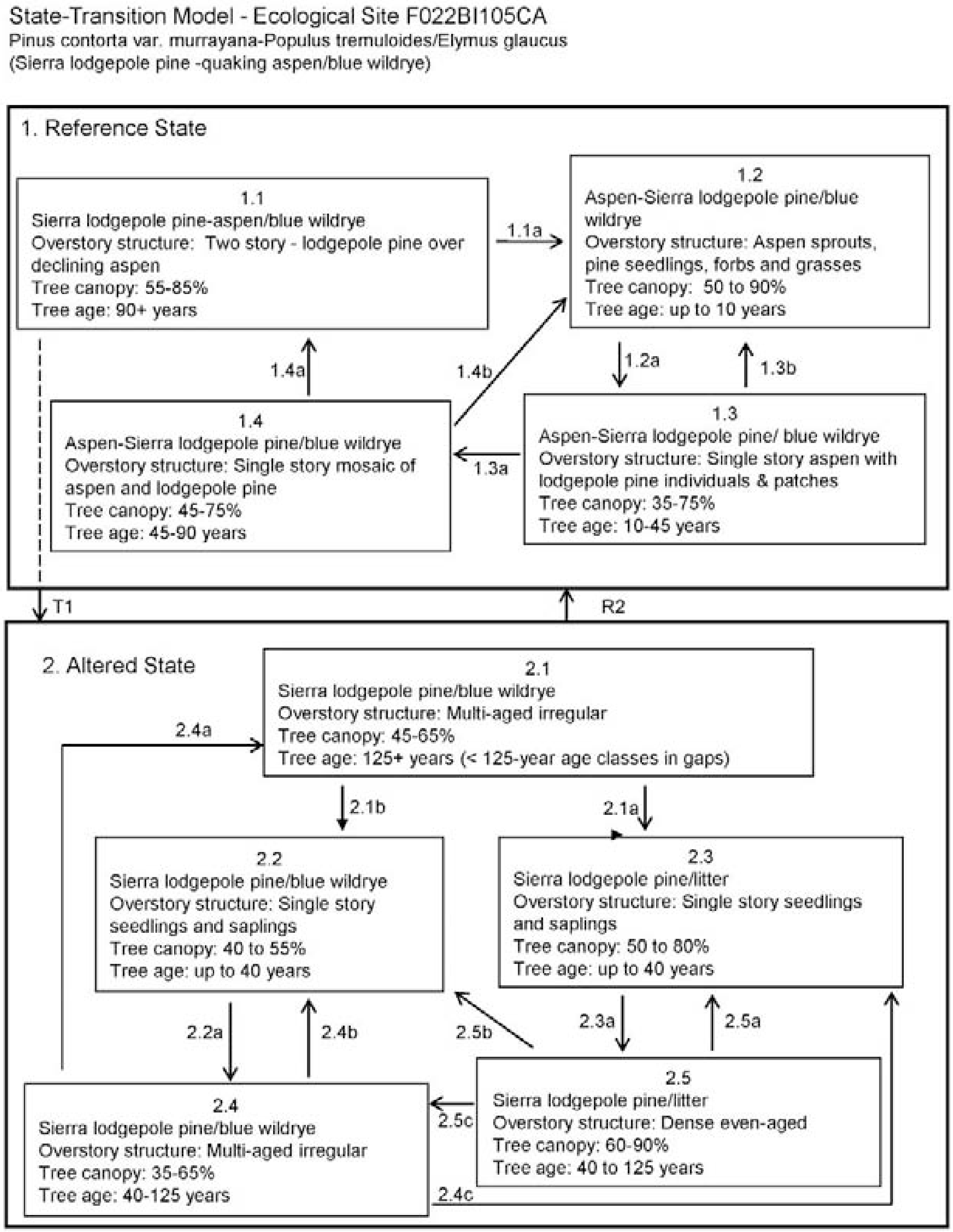
White trunk rot fungus (Phellinus tremulae) decays the base of the aspen tree, reducing wood quality and weakening the structure of the tree. This rot tends to infest older trees, making them susceptible to wind throw. The white truck rot fungus develops hoof shaped conks that can aid in identification of infected trees (Ostry et al., 1983).

Other pathogens are the root diseases like Armillaria spp., which can weaken the tree and often cause wind throw. Various boring insects and beetles also attack aspen but generally do not kill the tree. Attacks can lead to secondary infections by stem cankers when holes are created in the aspen bark. Foliage diseases such as ink-spot (Ciborina whetzelii) and defoliating insects such as aspen tortrix (Choristoneura conflictana) and western tent caterpillar (Malacosoma californicum) generally do not kill aspen trees unless severe infestations continue for several years. Again, all of these diseases and pests are parts of the natural cycle of aspen ecology (Shepperd et al., 2001).

The major pathogens that affect Sierra lodgepole pine are Annosus root disease (Heterobasidion annosum) Lodgepole pine dwarf mistletoe (Arceuthobium americanum) and the mountain pine beetle (Dendroctonus ponderosae).

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 Diagram



Reference - State 1

Sierra lodgepole pine-aspen/blue wildrye - Community Phase 1.1

Sierra lodgepole pine-aspen forest

This is the reference community phase for this ecological site. Most of the ecological site is presently in this community phase as there has been very little disturbance since the debris flow of 1915. A dense forest of 80 to 90 year old Sierra lodgepole pine is present with a grassy understory. Areas of bark beetle infestations and wind throw have created small gaps within the dense forests. These gaps may allow for regeneration of Sierra lodgepole pine and stimulate aspen suckers. In order for the aspen suckers to survive, the gaps would have to have a low recruitment of lodgepole pine seedlings and be large enough to allow for direct sunlight to reach the aspen through the surrounding canopy. These gaps break up the uniformity of the forest overtime, but are probably not sufficient for healthy aspen regeneration. The mature aspen and young suckers occur in the denser areas of the forest as well, but are crowded and overshadowed by lodgepole pine. Aspen stands begin to deteriorate after about 80 years due to the build up of pathogens. Without sudden canopy disturbance there will not be a flush of aspen suckers and Sierra lodgepole pine may fill in the decaying aspen stand rather than younger aspen. Fossorial animal activity enhances germination of lodgepole pine under the decaying aspen canopy. Nearby in Pine Creek, Sierra lodgepole pine and white fir are established within the aspen stand. The young aspen suckers have a powdery mildew on their leaves caused by a fungi (Uncinula adunca) and a disease, most likely shepherd's crook (Venturia macularis), is causing a blackening and wilting of the twigs and foliage of the young shoots. These are natural pathogens, but wetter than normal springs and/or increased shade from the conifer canopy may increase the rate of infection and reduce overall vigor of the aspens (Smith, et, 2006).

Community Phase Pathway 1.1a

In the event of a severe canopy fire or a clear-cut and prescribed burn, the old growth forest would return to the aspen regeneration community (Community 1.2). The overstory Sierra lodgepole pine will succumb to these fires because of their thin bark and shallow root systems (Kocher, 2005). A variable amount of Sierra lodgepole pine regeneration will co-develop with the aspen.

Transition - T1

The transition to State 2 may occur with the prolonged absence of fire or other disturbances, which would cause canopy mortality. If the lodgepole pine forest exists for a long enough period the aspen clones may completely die out and not regenerate after fire

Sierra lodgepole pine-aspen/blue wildrye Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Forb**				**3**	**45**		
		common yarrow	ACMI2	*Achillea millefolium*	1	5	1	3
		spreading groundsmoke	GADI2	*Gayophytum diffusum*	0	5	0	5
		Gray's licorice-root	LIGR	*Ligusticum grayi*	2	35	1	8

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Grass/Grasslike**				**22**	**260**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	2	30	1	5
		California brome	BRCA5	*Bromus carinatus*	0	30	0	5
		sedge	CAREX	*Carex*	5	50	1	10
		squirreltail	ELEL5	*Elymus elymoides*	5	50	1	8
		blue wildrye	ELGL	*Elymus glaucus*	10	100	2	30

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Shrub**				**0**	**65**		

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
		whitestem gooseberry	RIIN2	*Ribes inerme*	0	65	0	5

Tree

					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**
0 -Tree (understory only)					**2**	**110**		
		white fir	ABCO	*Abies concolor*	0	15	0	5
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	2	20	2	15
		quaking aspen	POTR5	*Populus tremuloides*	0	75	0	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	22	110	260
Forb	3	20	45
Shrub/Vine	0	10	65
Tree	2	50	110
Total:	27	190	480

Structure and Cover:

Ground Cover

Vegetative Cover	**Minimum**	**Maximum**
Grass / Grasslike	15%	65%
Forb	1%	15%
Shrub/ Vine	0%	10%
Tree	30%	65%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	85%	95%
Surface Fragments > 0.25" and <= 3"	0%	2%
Surface Fragments > 3"	0%	2%
Bedrock		
Water		
Bare Ground	0%	15%

Forest Overstory:

Sierra lodgepole pine dominates this forest with up to 80 percent canopy cover. Trees are 85 to 100 feet tall with 15 to 20 inch dbh. Basal area ranges from 120 to 190 ft2/ acre. The height for the quaking aspen ranges from 80 to 90 feet. There is much standing dead and downed trees from both species.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	50	85

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	0	0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	33.0	75.0						
quaking aspen *Populus tremuloides*	POTR5	N	2.0	10.0						

Forest Understory:

The understory is dominated by grasses such as blue wildrye (Elymus glaucus), western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides) and California brome (Bromus carinatus). Other common species include yarrow (Achillea millefolium), sedges (Carex spp.), spreading groundsmoke (Gayophytum diffusum), whitestem gooseberry (Ribes inerme) and Gray's licorice-root (Ligusticum grayi), with diverse other low cover plants. Quaking aspen (Populus tremuloides) sprouts are few and unhealthy.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	1.0	5.0		
California brome *Bromus carinatus*	BRCA5	N	0	5.0		
sedge *Carex*	CAREX	N	1.0	10.0		
squirreltail *Elymus elymoides*	ELEL5	N	1.0	8.0		
blue wildrye *Elymus glaucus*	ELGL	N	2.0	30.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
common yarrow *Achillea millefolium*	ACMI2	N	1.0	3.0		
spreading groundsmoke *Gayophytum diffusum*	GADI2	N	0	5.0		

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Gray's licorice-root *Ligusticum grayi*	LIGR	N	1.0	8.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
whitestem gooseberry *Ribes inerme*	RIIN2	N	0	5.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	2.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	2.0	15.0		
quaking aspen *Populus tremuloides*	POTR5	N	0	5.0		

Aspen-Sierra lodgepole pine/blue wildrye - Community Phase 1.2

After a canopy replacing event such as fire, disease or insect infestation, young aspen suckers will sprout prolifically from the surviving roots. Very dense root mats are possible, which may suppress growth of other plants for a short period. Many of the young suckers will die during this time but overall canopy cover will remain high.

Sierra lodgepole pine is a pioneer species and will also regenerate prolifically after fire via wind dispersed seed or from seeds stored in the soil. Seedling mortality will ordinarily be high during this phase, but young dog hair thickets can develop that will begin to self-thin and open up.

The presence of aspen or Sierra lodgepole pine seems to be dependent upon the nearness and health of aspen roots after a disturbance and the proximity of a Sierra lodgepole pine seed source.

After a fire, the cover of grasses and forbs will remain high since many of these species will re-sprout or germinate from seed. Disturbance dependent sun-loving annual and perennial forbs may have a short lived presence after a fire.

Fires are not frequent in aspen stands because of the high moisture content associated with these areas. Some reports indicate that the fire frequency for aspen stands is similar or longer than for the surrounding forest, however. In this case, the surrounding forest would be comprised of white fir, Jeffrey pine or red fir. The natural fire intervals in these forests range from 5 to 65 years (Bekker and Tayler, 2001; Bancroft, 1979; Taylor et al., 1991).

Community Phase Pathway 1.2a

With time and growth, Community 1.2 progresses to Community 1.3, the young aspen and Sierra lodgepole pine forest.

Aspen-Sierra lodgepole pine/blue wildrye - Community Phase 1.3

This is a healthy young aspen forest that quickly transitions to a mature aspen grove within 30 to

40 years. The understory is lush and diverse with patches of aspen suckers in areas of disturbance. Sierra lodgepole pine has established patches of forest on the upper stream terraces. The Sierra lodgepole pines are dense and overcrowded, in the absence of disturbance. The aspen and Sierra lodgepole pine forests form a patch-work across the flats. In areas where Sierra lodgepole pine and aspen co-exist they may have equal dominance in the upper canopy during this phase.

Community Phase Pathway 1.3a
This is the natural pathway for this community, which evolves with small patches of relatively frequent surface and moderate severity fires, and/or partial tree mortality from a pest outbreak. Manual thinning or prescribed burning can be implemented to replace the natural disturbances that would normally have removed portions of the tree canopy. This pathway leads to the aspen-lodgepole pine forest (Community 1.4).

Community Phase Pathway 1.3b
In the event of a canopy fire or high mortality pest attack, this community would return to Community 1.2.

Aspen-Sierra lodgepole pine/blue wildrye - Community Phase 1.4
This aspen forest tends to have a single canopy with 45 to 75 percent cover. Several clones may be present as well as suckers in the understory and a lush understory of grasses and forbs.

Sierra lodgepole pine is present throughout this area, generally in-filling from the perimeter of the aspen stand or in the understory of the aspen. The Sierra lodgepole pine becomes taller than the aspens, casting shade upon the aspen canopy and reducing their vigor and growth. White fir is occasionally present.

Community Phase Pathway 1.4a
In the absence of canopy disturbance a Sierra lodgepole pine dominated forest will develop with few aspen (Community 1.1).

Community Phase Pathway 1.4b
Natural disturbances such as fire, flood or disease remove the overstory canopy of aspen and Sierra lodgepole pine, allowing for regeneration (Community 1.2).

Altered - State 2
State 2 develops due to a long period with-out canopy disturbance, so when disturbance finally comes during this state Sierra lodgepole pine will dominate and aspen will be absent in the regeneration community. Without canopy disturbance, mature aspen die out in the shade of the Sierra lodgepole pine. The hormones required to induce suckering are not activated and, denied the sunlight needed for photosynthesis, the aspen roots eventually die. If there is not a nearby aspen seed source, it is eventually eliminated from the area. After a long period of rest, and elimination of aspen, Sierra lodgepole pine reproduces prolifically from seed after canopy removal. The actual time it takes to cross this threshold is unknown but possibly ranges from 200 to 300 years.

Sierra lodgepole pine/blue wildrye - Community Phase 2.1

This mature Sierra lodgepole pine forest develops with small scale disturbances which create gaps in the canopy. These gaps (single tree fall to 0.25 acre in size) provide suitable sites for Sierra lodgepole pine regeneration, and over time, create uneven forest structure and composition. Several age classes of Sierra lodgepole pine and white fir are present. Several Sierra lodgepole pines will persist in the tallest overstory and provide a seed source for gap areas.

Mountain pine beetle (Dendroctonus ponderosae) epidemics are common in older Sierra lodgepole pine forests. Epidemics often occur in 20 to 40 years cycles and may last for 5 to 7 years. 1/3 to 2/3 of large trees in the forest can be killed during a severe infestation. After an outbreak, there are many standing dead trees, which gradually fall and create high amounts of down wood. Fine fuels from recently killed trees (dead needles and twigs both on the ground and remaining on trees) increase the probability of high mortality fire from ignition sources for several years. Sierra lodgepole pine will succumb to these fires because of their thin bark and shallow root systems. After death of the lodgepole overstory from fire or pest attack, watersheds can release up to 30 percent more water (Cope, 1993).

Community Phase Pathway 2.1a

This pathway is created by a high mortality fire or forest infestation, followed by relatively dense Sierra lodgepole pine seedling regeneration (Community 2.3).

Community Phase Pathway 2.1b

This pathway is created by a high mortality fire or forest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community 2.2).

Sierra lodgepole pine/blue wildrye - Community Phase 2.2

This community is dominated by grasses and Sierra lodgepole pine seedlings.This site generally has less than 500 stems per acre, and develops into a relatively open forest. The seedlings develop into pole sized trees, with up to 55 percent canopy cover. Grasses and forbs may increase in cover for a few years.

Community Phase Pathway 2.2a

With time and growth, with small scale canopy disturbances Community 2.2 progresses to the open Sierra lodgepole pine forest, Community 2.4.

Restoration Pathway - R2

Restoration of this site would be easiest after a natural disturbance, but considerable expense and maintenance would be needed. Aspen seed or seedlings would need to be reintroduced to the area while the Sierra lodgepole pine seedlings may need to be removed to eliminate competition.

Sierra lodgepole pine/litter - Community Phase 2.3

This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined which distinguish the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. There are many variables which influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid October. These seeds can be stored in the soil for several years, but tend to regenerate from wind dispersed seeds deposited after the fire. Therefore, the season of burn and timing in relation to seed crop cycles may affect seedling density. Smaller fires may have higher seedling density, due to the proximity of an available seed source. Fires leave bare soil and disturbed duff with open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. Seasonal precipitation patterns and air temperatures, during the season and germination, influence the survival of seedlings.

As the seedlings develop they form dense thickets. The trees thin out there lower branches as they grow tall and thin. They self thin to some extent, but most trees persist even with limited sunlight on their canopy. Growth becomes stagnant, due to competition for light, water and nutrients. After a certain point in development Sierra lodgepole pine may not respond to competitive release from thinning, disease, or fire.

Community Phase Pathway 2.3a
With time and growth, in the absence of disturbance, Community 2.3 progresses to the dense lodgepole pine forest, Community 2.5.

<u>Sierra lodgepole pine/blue wildrye - Community Phase 2.4</u>
This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. This community phase is common at this time. Mountain pine beetle infestations are the most significant disturbance that can create canopy openings. After a pest infestation, patches of the stand die, leaving gaps for lodgepole pine regeneration. Low intensity fire is often fatal to mature lodgepole pine, so even low severity fire can be a stand replacing event. So the event of fire creating small gaps is uncommon. However low intensity smoldering fires have been documented which spread through downed trees after a mountain pine beetle infestation. Minor damage to the live trees was noted, but some with fire scars were more susceptible to mountain pine beetle attack. It does not seem that fire would ignite easily in the moist understory or in the nearby meadow until the end of summer. Shallow roots make lodgepole pine is susceptible to wind throw which also creates canopy gaps.

Community Phase Pathway 2.4a
With time and growth with small scale disturbances this forest continues to develop into a Sierra lodgepole pine forest (Community 2.1) with a multi-aged, complex forest structure.

Community Phase Pathway 2.4b
This pathway is triggered by a high mortality fire, which initiates open Sierra lodgepole pine regeneration (Community 2.2).

Community Phase Pathway 2.4c
This pathway is triggered by a high mortality fire, which initiates dense lodgepole pine regeneration (Community 2.3).

Sierra lodgepole pine/litter - Community Phase 2.5

Dense lodgepole pine forest

This dense Sierra lodgepole pine forest develops after dense seedling establishment and absence of canopy disturbance. This forest is even-aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. The self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees will enable the pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

Community Phase Pathway 2.5a
This pathway is triggered by a high mortality fire, with appropriate conditions for dense lodgepole pine regeneration (Community 2.3).

Community Phase Pathway 2.5b
This pathway is triggered by a high mortality fire, with appropriate conditions for open lodgepole pine regeneration (Community 2.2).

Community Phase Pathway 2.5c

This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low-mortality fires, or wind throw. The forest becomes a more open Sierra lodgepole pine forest (Community 2.4) with several age classes, with continued small scale disturbances can eventually develop into Community 2.1.

Sierra lodgepole pine/litter Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**2**		
		common yarrow	ACMI2	*Achillea millefolium*	0	1	0	1
		Lamarck's bedstraw	GADI	*Galium divaricatum*	0	1	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**183**		
		sedge	CAREX	*Carex*	0	3	0	1
		squirreltail	ELEL5	*Elymus elymoides*	0	10	0	2
		blue wildrye	ELGL	*Elymus glaucus*	0	170	0	15

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**20**		
		whitestem gooseberry	RIIN2	*Ribes inerme*	0	20	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**7**		
		white fir	ABCO	*Abies concolor*	0	2	0	1
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	5	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	35	183
Forb	0	1	2

Shrub/Vine	0	10	20
Tree	0	2	7
Total:	0	48	212

Forest Overstory:

Dense, even-aged lodgepole pine with canopy ranging from 60-90 percent.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	60	70	90

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	0	2.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	60.0	88.0						

Forest Understory:

Little to no understory vegetation; litter predominates.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
blue wildrye *Elymus glaucus*	ELGL	N	0	15.0	0	1.5
squirreltail *Elymus elymoides*	ELEL5	N	0	2.0	0	1.0
sedge *Carex*	CAREX	N	0	1.0	0	0.9

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Lamarck's bedstraw *Galium divaricatum*	GADI	N	0	1.0	0	1.0
common yarrow *Achillea millefolium*	ACMI2	N	0	1.0	0	0.3

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
whitestem gooseberry *Ribes inerme*	RIIN2	N	0	2.0	0	1.5

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	1.0	0.3	6.0
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0	1.0	6.0

Ecological Site Interpretations

Forest 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
Sierra lodgepole pine	*PICOM*	92	92	107	107	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.

Animal Community:

Several birds are found in aspen stands. Frequently associated specifically with aspen are warbling vireo (Vireo gilvus), Empidonax flycatcher (Empidonax spp.), house wren (Troglodytes troglodytes), and Oregon junco (Junco hyemalis thuberi). Several cavity nesting birds in this area include flickers (Colaptes spp.), woodpeckers (Picoides spp. and Melanerpes spp.), chickadees (Parus spp.), and nuthatches (Sitta spp.). Secondary colonizers like owls and sparrows also inhabit the cavities. Birds tend to be more frequent in aspen stands than in the neighboring conifer forest and seem to prefer the larger mature aspens (Shepperd et al. 2006). Deer browse the young aspen and other vegetation in the understory.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:

This area is suitable for hiking trails and camping. It provides wildflower and wildlife viewing opportunities with a diversity not seen in the upland conifer forests. This site is generally on older stream terraces, so a stream is often nearby.

Wood Products:

Although aspen is not used commercially in this area, in the eastern US the wood is used primarily for particleboard, especially waferboard and oriented strand board, and for pulp. Aspen fibers can be used to make fine paper and its lumber is used for making boxes, crates, pallets and furniture (Howard, 1996).

Other Products:

Other Information:
Site index documentation:

Alexander (1966) was used to determine forest site productivity for Sierra lodgepole pine. 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.

Lodgepole pine trees appropriate for site index measurement typically occur in community phase 2.4 and older stands in community phase 2.2. They are selected according to guidance in Alexander (1966). Aspen site index and CMAI could be determined using Edminster (1985) and Baker (1925).

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Debris Flow Gentle Slopes	F022BI106CA	This ecological site is associated with debris deposits in the Devastated Area and is drier.
Frigid Flat Outwash Terraces	F022BI123CA	This is a white fir- Sierra lodgepole pine ecological site, found in topographically higher positions.
Frigid Sandy Flood Plains	R022BI213CA	This riparian ecological site is found along the stream channel.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Moist Sandy Lake Or Stream Terraces	F022BI108CA	This is a wet Sierra lodgepole pine site, which lacks aspen.
Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	F022BI125CA	This is a drier Sierra lodgepole pine site, with a grassy understory.

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
The following NRCS vegetation plots represent this ecological site:

789227
789269- Type location
789270

789333
789370

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	5 E
Section:	20
Datum:	NAD83
Zone:	10
Northing:	4488590
Easting:	631808
General Legal Description:	The site location is about 450 feet west of Hat Creek, and approx. 2.25 miles northeast of Hat Lake in LVNP.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104488590631808

Relationship to Other Established Classifications:

Forest Alliance = Pinus contorta ssp. murrayana – Lodgepole pine forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/18/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	9/14/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Debris Flow Gentle Slopes

Pinus jeffreyi - Abies / / Achnatherum - Lupinus
(Jeffrey pine - fir / / needlegrass - lupine)

Site ID: F022BI106CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Debris flow
Elevation (feet): 5,800-7,210
Slope (percent): 0-30
Water Table Depth (inches): N/A
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, East, West
Mean annual precipitation (inches): 45.0-95.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 40 and 42 degrees F (4 to 5.5 degrees C)
Restrictive Layer: None
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Debris flows from volcanic rocks
Surface Texture: (1) Very gravelly ashy loamy coarse sand, (2) Gravelly ashy loamy sand
Surface Fragments <=3" (% Cover): 20-45
Surface Fragments > 3" (% Cover): 0-20
Soil Depth (inches): 20-80
Vegetation: The initial colonizer on this site is primarily Sierra lodgepole pine (Pinus contorta var. murrayana). California red fir (Abies magnifica), western white pine (Pinus monticola) and/or Jeffrey pine (Pinus jeffreyi) dominate in the later stages of forest development. There are some forbs and grasses present, but they are sparse.
Notes: The eruptions during May of 1915 produced lahar deposits and mud flows that buried the area with 6 to 30 feet of material. In areas of shallower debris deposits, trees are able to reach the

buried top soil and utilize the stored nutrients, enabling them to reestablish more quickly than those trees in deeper debris deposits. Trees in the deeper deposits must go through a slow progression of primary succession since the soils have not had time to develop.

Physiographic Features

This ecological site encompasses the areas affected by debris deposits primarily from the May 1915 eruption of Lassen Peak. The site is situated on deep debris flows, and debris flows over outwash terraces. It is between 5,800 and 7,210 feet in elevation, on 0 to 30 percent slopes.

Landform: (1) Debris flow

	Minimum	Maximum
Elevation (feet):	5800	7210
Slope (percent):	0	30
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very low	Medium
Aspect:	North East West	

Climatic Features

This ecological site receives most of its annual precipitation in the winter months in the form of snow. The mean annual precipitation is between 45 and 95 inches (1,143 mm to 2,413 mm) and the mean annual temperature is between 40 and 42 degrees F (4 to 5.5 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. The nearest one is Manzanita Lake.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	45.0	95.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is not influenced by water features.

Wetland Description: System	Subsystem	Class

Representative Soil Features

The Vitrandic Xerorthents-debris fan and Vitrandic Xerofluvents soil components are associated with this site. These soils formed in debris flows from volcanic rocks. They are moderately deep to very deep and well drained. The Vitrandic Xerofluvents are found on debris flows and have about 50 inches of debris over the buried soil. The Vitrandic Xerorthents-debris fan component has more than 6 feet of debris material and buried soil was not encountered. Surface textures are very gravelly ashy loamy coarse sand and gravelly ashy loamy sand with coarse subsurface textures. These soils have very low to low AWC in their upper 60 inches.

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

Map unit Component, Component %
111 Vitrandic Xerorthents-debris fan, 95
133 Vitrandic Xerofluvents, 55
133 Vitrandic Xerofluvents(steeper), 5
133 Vitrandic Xerorthents-debris fan, 5
146 Vitrandic Xerorthents-debris fan, 2
153 Vitrandic Xerorthents-debris fan, 1
162 Vitrandic Xerorthents-debris fan, 3

Parent Materials:
Kind: Debris flow deposits
Origin: Volcanic rock
Surface Texture: (1)Very gravelly ashy loamy coarse sand
(2)Gravelly ashy loamy sand
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	20	45
Surface Fragments > 3" (% Cover):	0	20
Subsurface Fragments <=3" (% Volume):	20	60
Subsurface Fragments > 3" (% Volume):	0	35

Drainage Class: Well drained To Well drained
Permeability Class: Moderately rapid To Rapid

	Minimum	Maximum
Depth (inches):	20	80
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.8	3.9

Plant Communities

Ecological Dynamics of the Site

This is a unique ecological site because it is found on volcanic deposits from Lassen Peak. The largest extent of the site developed from the 1915 eruptions of Lassen Peak in an area referred to as the Devastated Area. It is an area of interest because it provides an opportunity to study true primary succession on a volcanic substrate. The eruptions during May of 1915 produced lahar deposits and mud flows that buried the area with 6 to 30 feet of material. In areas of shallower debris deposits, trees are able to reach the buried top soil and utilize the stored nutrients, enabling them to reestablish more quickly than those trees in deeper debris deposits. Trees in the deeper deposits must go through a slow progression of primary succession since the soils have not had time to develop. Other factors, such as proximity to a seed or water source, influence species composition and recovery time.

The initial colonization of plants on newly exposed parent material initiates a wide range of processes. Nitrogen fixation is commonly one of the first processes initiated by pioneering plant species and microorganisms. This process converts atmospheric nitrogen gas into ammonia (NH_4^+) through chemical and biological reactions. The resulting ammonia is converted to nitrate (NO_3^-) by microorganisms through a process called nitrification. Plants assimilate inorganic nitrogen in the form ammonia and nitrate. As plants continue to establish on the new substrate, they absorb CO_2 from the atmosphere and convert it to plant carbon through the process of photosynthesis. The carbon is sequestered in either above-ground or below- ground biomass, or as soil carbon. Soil organisms are responsible for the decomposition of plant material. When soil organisms die and decompose, nutrients are processed back into the soil. Plant material and dead soil organisms provide the bulk of organic matter in soil. The process of CO_2 production and the accumulation of organic matter begin to transform freshly exposed parent material by providing nutrients and creating better water availability for plants and microorganisms, affecting pH and weathering minerals. Over time, as these organisms eat, grow and move through the soil, they transform it into a more vibrant biologic substrate. Most of these processes are concentrated in the A horizon, in the upper horizons of the soil. The B horizon, located directly below, is influenced by the leaching of acids and other products from the A horizon.

The living and dead material of plants stabilize the soil surface by physically buffering raindrop impact and impeding surface runoff. Within the soil, plants, animals and microbes bind the soil together as aggregates with roots, hyphae, fecal pellets and decomposed organic matter. The micro-structure formed by the combined processes of buffering and binding increases soil stability, porosity, water infiltration and water holding capacity (NRCS, 2009).

Trees and burrowing animal activity produce larger pores and mix soil at a greater scale. Ants and gophers transport soil material by depositing subsoil on the surface as they build tunnels and nests. Dead tree roots produce macropores that often accumulate surface material and incorporate organic matter deeper down in the profile (NRCS, 2009).

The Natural Resources Conservation Service (NRCS) collected soil and vegetation data for this area in 2006, 91 years after the eruptions. While some of this area remains bare of vegetation, many stages of conifer succession are present in other areas.

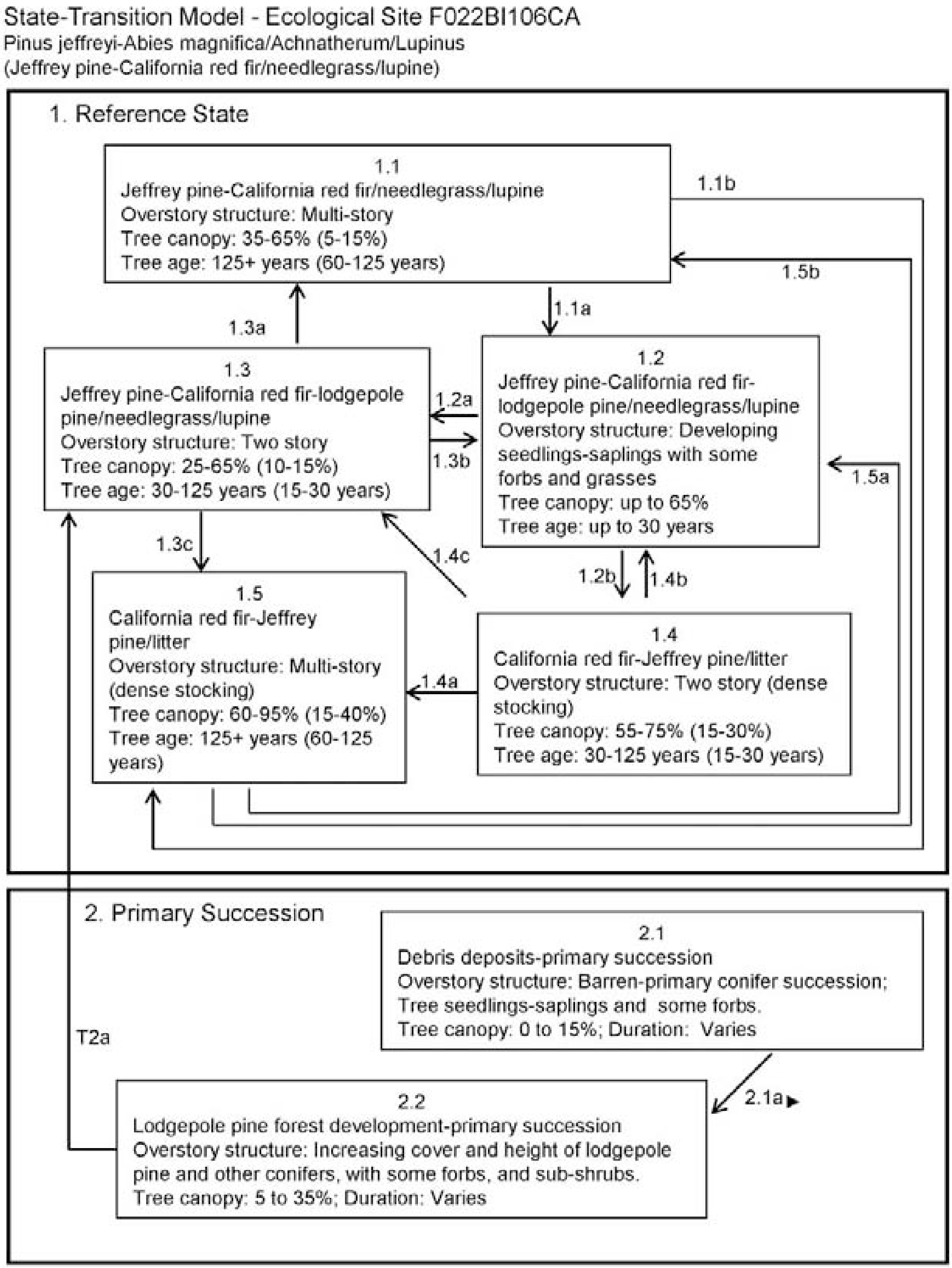
The initial colonizer on this site is primarily Sierra lodgepole pine (Pinus contorta var. murrayana). Conifers are rarely documented as the initial colonizers during primary succession. More common is a forb and grass phase with species that are able to fix nitrogen. An interesting study was conducted on an ectomycorrhizal association of the blue staining slippery jack fungi (Suillus tomentosus) with a variety of lodgepole pine (Pinus contorta var. latifolia) found north of California and extending into Canada and Alaska. Lodgepole pine (Pinus contorta var. latifolia) formed tuberculate ectomycorrhizae (TEM) with Suillus tomentosus, and the nitrogen-fixing bacteria Paenibacillus amylolyticus and Methylobacterium mesophilicum were shown to reside within the TEM (Paul, 2002). The results of the study indicate high nitrogenase activity, which was attributed to the TEM association. This indicates a symbiotic relationship similar to that of alder (Alnus spp.) and lupine (Lupinus spp.) with nitrogen fixing bacteria (Frankia spp. and Rhizobium spp. respectively) found within root nodules. Several studies indicate a direct correlation between nitrogen fixation and nitrogen demand that varies depending upon season, soil chemistry, and stand age. (Paul et al., 2007). The study of the symbiotic relationship between Lodgepole pine (Pinus contorta var. latifolia) and Suillus tomentosus may not apply directly to this area or to the Sierra lodgepole pine (Pinus contorta var. murrayana) variety. However, Suillus tomentosus is a common mushroom throughout the area and is documented in lodgepole pine forests in northern California and the Sierra Nevada (Arora, 1986).

All the tree species found in Lassen Volcanic National Park are found within the Devastated Area except whitebark pine. California red fir (Abies magnifica), western white pine (Pinus monticola) and/or Jeffrey pine (Pinus jeffreyi) dominate in the later stages of forest development. There are some forbs and grasses present, but they are sparse.

The debris flows buried what would have been several ecological sites. Historical records indicate that Jessen Meadow was buried by debris in 1915. Several streams and outwash terraces must have been buried as well. Due to deep coarse infertile debris deposits, most of the area is now an upland site that needs time for soil development. The small stream corridors that developed within the debris deposits are a wet exception. Please see the Sandy Floodplains ecological site, R022BI213CA for more information.

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 Diagram



Reference - State 1

Jeffrey pine-California red fir/needlegrass/lupine - Community Phase 1.1

This community phase is considered to be the likely future reference community phase. It is difficult to determine the exact species that will dominate this community phase. Within the Devastated Area Jeffrey pine (Pinus jeffreyi), white fir (Abies concolor), California red fir (Abies magnifica), and western white pine (Pinus monticola) coexist. It is likely that the upper elevation tree species (California red fir and western white pine) will not persist on the lower elevation debris flows and will be replaced by a Jeffrey pine-white fir forest. California red fir and western white pine may persist at the upper elevations of this site.

There are a few areas with older debris deposits mapped in the Manzanita Lake drainage. The older areas have developed mature Jeffrey pine or Jeffrey pine- California red fir forests. A small portion of the older debris material is located at higher elevations and is currently vegetated with dense California red fir thickets. The California red fir forests would normally be considered a separate ecological site, but is not in this case since the extent of debris deposits at upper elevations is minimal. The upper slope of the eruption is generally associated with debris flows, rather than debris fans and deposits. The ecological site associated with the upper elevations is F022BI115CA, a California red fir western white pine forest.

This community phase is maintained by low and moderate intensity fires that remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires can kill some of the overstory trees as well, leaving canopy openings that are favorable for Jeffrey pine and western white pine regeneration. These moderate intensity fires breakup the uniformity of the older stands with pockets of young forests intermixed.

Community Phase Pathway 1.1a

If this forest has a severe canopy fire, it will initiate forest regeneration (Community 1.2).

Community Phase Pathway 1.1b

This pathway is created when fire is excluded from this old growth community. White fir and/or California red fir continues to regenerate in the understory, increasing tree density and shifting this community toward the closed fir and Jeffrey pine forest (Community 1.5).

Forest Overstory:

Expected ovestory canopy will range from 35 to 65% with the possibility of multiple canopies beneath ranging from 5 to 15% cover. Age would be 125+ years and 60-125 years for lower tree canopies.

Forest Understory:

A number of species could develop with needlegrass and lupine expected.

Jeffrey pine-California red fir-lodgepole pine/needlegrass/lupine - Community Phase 1.2

This regeneration community phase develops after a severe crown fire. It differs from primary succession because the soil has developed structure and accumulated organic matter, providing nutrients in the upper horizon. Seeds may be onsite that survived the fire, allowing tree seedlings, grasses, and forbs to establish quickly. The few surviving canopy trees are a valuable source of seed for tree regeneration. Nearby trees disperse their seed downwind to distances about twice their height, and possibly farther under windy conditions.

Community Phase Pathway 1.2a
The natural pathway is to community phase 1.3, a young open Jeffrey pine and fir forest. This pathway is followed with natural fire regime. Manual thinning with prescribed burns can imitate the natural cycle and lead to the same open community phase.

Community Phase Pathway 1.2b
An alternate pathway is created when fire is excluded from the system and leads to the closed red fir and Jeffrey pine forest (Community Phase 1.4).

Forest Overstory:
Developing seedlings and saplings of Jeffrey pine, California red fir and lodgepole pine.

Forest Understory:
Forbs and grasses develop concurrently with the trees and include needlegrass and lupine.

Jeffrey pine-California red fir-lodgepole pine/needlegrass/lupine - Community Phase 1.3
As this community phase develops during primary succession Jeffrey pine, white fir, California red fir and/or western white pine overtop the older but shorter Sierra lodgepole pines, and the understory is covered with a thin layer of pine needles. A young forest develops with several canopy layers.

This community phase also represents the young forest that would develop from community 1.2 the post fire conifer regeneration community. The conifer species diversity may be higher after primary succession than secondary succession. Seedling establishment and forest structure will most likely develop quicker during secondary succession because the soil has developed better structure, accumulated organic matter, microbes, and other physical properties which enhance seedling survival and plant growth.

This community phase develops over time and benefits from low to moderate intensity fire to maintain an open forest structure. The fires kill many of the young fire-intolerant seedlings in the understory, which reduces the competition between trees and lowers the potential for a severe canopy fire. The structure, composition, age, and moisture 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.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic regime of relatively frequent surface and/or moderate severity fires, and/or partial tree mortality from a pest outbreak. This pathway leads to the mature Jeffrey pine and fir forest (Community Phase 1.1).

Community Phase Pathway 1.3b
A severe canopy fire would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.3c

If fire does not occur, then the density of the forest increases. The increased density shifts this community phase toward the closed fir and Jeffrey pine forest (Community Phase 1.5).

Jeffrey pine-California red fir-lodgepole pine/needlegrass/lupine Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Forb**				**0**	**50**		
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	0	50	0	2

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Grass/Grasslike**				**0**	**4**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	4	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Shrub**				**0**	**108**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	0	10	0	1
		goldenbush	ERICA2	*Ericameria*	0	20	0	2
		buckwheat	ERIOG	*Eriogonum*	0	8	0	5
		Lemmon's willow	SALE	*Salix lemmonii*	0	70	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Tree (understory only)**				**0**	**20**		
		white fir	ABCO	*Abies concolor*	0	5	0	2
		California red fir	ABMA	*Abies magnifica*	0	5	0	2
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	6	0	5
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	2	0	2
		western white pine	PIMO3	*Pinus monticola*	0	2	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	2	4
Forb	0	10	50
Shrub/Vine	0	47	108
Tree	0	8	20
Total:	0	67	182

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	2%
Forb	0%	9%
Shrub/ Vine	0%	3%
Tree	25%	65%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	30%	70%
Surface Fragments > 0.25" and <= 3"	20%	40%
Surface Fragments > 3"	0%	20%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	2%	15%

Forest Overstory:

Total forest canopy cover ranges from 25 to 65 percent. Jeffrey pine and white fir are dominant.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	25	40	65

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	4.0	11.0						
California red fir *Abies magnifica*	ABMA	N	3.0	8.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	5.0	13.0						
Jeffrey pine	PIJE	N	12.0	30.0						

Pinus jeffreyi				
western white pine *Pinus monticola*	PIMO3	N	1.0	3.0

Forest Understory:

Needlegrass and lupine are represented among other understory species.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
bluntlobe lupine *Lupinus obtusilobus*	LUOB	N	0	2.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	0	1.0		
goldenbush *Ericameria*	ERICA2	N	0	2.0		
buckwheat *Eriogonum*	ERIOG	N	0	5.0		
Lemmon's willow *Salix lemmonii*	SALE	N	0	2.0		

California red fir-Jeffrey pine/litter - Community Phase 1.4

Jeffrey pine and either California red for or white fir dominate over the Sierra lodgepole pines, with heavy recruitment of California red fir or white fir in the understory.

This community phase is defined by a dense canopy and high basal area of mixed conifers. Canopy cover ranges from 55 to 75 percent. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients, making them more susceptible to death. Fire hazard is high in this community phase due to the deep accumulation of litter, the standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a

If fire continues to be excluded from this system, the mature closed fir and Jeffrey pine forest develops (Community Phase 1.5).

Community Phase Pathway 1.4b

At this point, the density of ground fuels and the mid-canopy ladder fuels create conditions for a high intensity canopy fire. A severe fire would initiate forest regeneration (Community Phase

1.2).

Community Phase Pathway 1.4c
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 treatments 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 mixed conifer forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3 but with an increase to the already high fuel amounts.

California red fir-Jeffrey pine/litter - Community Phase 1.5
This community phase develops with the continued exclusion of fire. Depending upon the microclimate, seed source, snow load, elevation and other variables, California red fir or white fir will tend to dominate during this phase. They eventually shade out the associated pine species. This community is defined by a dense canopy and high basal area. Canopy cover ranges from 60 to 95 percent. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients. The understory is almost absent because of lack of sunlight on the forest floor. Fire hazard is high in this community, caused by the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b
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 treatments 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 and fir forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1 but tree mortality will increase the already high fuel amounts.

Primary succession - State 2

Debris deposits-primary succession - Community Phase 2.1
The 1915 eruptions of Lassen Peak left large swaths of debris material. This material has been subject to the slow processes of primary succession described in the ecological dynamics above.

Historic photos and research data reveal a 30 year delay in conifer establishment on the lahar and debris flow. The delay in conifer establishment could be due to several factors including:

1. The proximity to a nearby seed source.
2. Thick layers of ash may have inhibited tree establishment until the ash was washed away or weathered.
3. The trees may have been physiologically stressed to soil infertility (Kruh et al, 2000).

The dissemination of conifer seed and seedling establishment began from the periphery of the devastated area and has been moving inward. The intact forests adjacent to the debris flows provided the seeds for early colonization. As the forest on the periphery developed, more seed was produced and disseminated further into the debris flows. Heath, 1967 reports that strong winter winds come from the southwest, which would bring seed from the upper elevation forests dominated by red fir and western white pine and deposit them on the devastated area. Jeffrey pine and white fir seed would be blown away from the majority of the devastated area under this scenario. With normal wind conditions Jeffrey pine, red fir, white fir, Sierra lodgepole pine and western white disperse seed within 200 feet of the source. One report states that western white pine seed can be windblown over 2,000 feet. In addition to the wind, animals often cache the pine seeds. The presence of Sierra lodgepole pine in the early succession may be in part due to its high production of viable seeds, and the tolerance of the seedlings to open sunlight (Cope, 1993; Jenkinson, 1990; and Zouhar, 2001.).

After the 30 year delay, Sierra lodgepole pine was the initial invader, with Jeffrey pine, red fir and western white pine generally establishing later. However, Heath states that due to the complex interactions of seed dispersal, microsite characteristics, and climatic and other environmental variables, it is difficult to define a clear successional trend or even to determine the historic reference community phase.

With time, primary succession continues as conifers increase in abundance and size.

Community Phase Pathway 2.1a

Seedlings and saplings making the barren, primary conifer community phase succeeds to a more developed predominantly lodgepole pine forest. Canopy at 0 to 15% slowly develops to 15 to 35% with concurrent infill of forbs and sub-shrubs.

Lodgepole pine forest development-primary succession - Community Phase 2.2

Conifer Forest Development

This community phase slowly develops as conditions become more hospitable for tree growth. The trees that established on the barren debris deposits have produced some litter accumulation, shade, and have reached reproductive maturity. Sierra lodgepole pine is the dominant tree and is about 10 to 12 feet tall. Total canopy cover may reach up to 35 percent. The ground is mostly bare of organic matter except directly under the young lodgepole pines. White fir or California red fir seedlings are present in the shadow of the lodgepole pines. The understory is limited, with some scattered forbs on the bare soil. There may be a range in tree age due to the continual establishment of seedlings in the open areas. As time progresses, forest canopy and structure develops. When this community phase develops it eventually becomes a forest capable of spreading fire and will undergo frequent natural understory burns.

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

Transition - T2a

As forest structure develops, this forest resembles the young Jeffrey pine-fir forest (Community Phase 1.3) and follows the same community phase pathways. The forest matures in both cover and species diversity.

Lodgepole pine forest development-primary succession Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forg					**0**	**12**		
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	0	12	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**4**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	2	0	1
		sedge	CAREX	*Carex*	0	2	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**97**		
		goldenbush	ERICA2	*Ericameria*	0	12	0	1
		buckwheat	ERIOG	*Eriogonum*	0	5	0	2
		oceanspray	HODI	*Holodiscus discolor*	0	10	0	2
		Lemmon's willow	SALE	*Salix lemmonii*	0	70	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree					**8**	**26**		
		white fir	ABCO	*Abies concolor*	0	1	0	1
		California red fir	ABMA	*Abies magnifica*	0	2	0	2
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	8	17	5	10
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	2	0	2
		western white pine	PIMO3	*Pinus monticola*	0	1	0	1

Annual Production by Plant Type:

Plant Type	Annual Production (lbs/AC) Low	Representative Value	High
Grass/Grasslike	0	0	4

Forb	0	10	12
Shrub/Vine	0	52	97
Tree	8	15	26
Total:	8	77	139

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	2%
Forb	0%	4%
Shrub/ Vine	0%	4%
Tree	10%	35%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	5%	30%
Surface Fragments > 0.25" and <= 3"	20%	40%
Surface Fragments > 3"	0%	20%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	5%	30%

Forest Overstory:

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	5	15	35

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	1.0	2.0						
California red fir *Abies magnifica*	ABMA	N	1.0	2.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	3.0	29.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	1.0						
western white pine *Pinus monticola*	PIMO3	N	0	1.0						

Forest Understory:

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	1.0		
sedge *Carex*	CAREX	N	0	1.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
bluntlobe lupine *Lupinus obtusilobus*	LUOB	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
goldenbush *Ericameria*	ERICA2	N	0	1.0		
buckwheat *Eriogonum*	ERIOG	N	0	2.0		
oceanspray *Holodiscus discolor*	HODI	N	0	2.0		
Lemmon's willow *Salix lemmonii*	SALE	N	0	2.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	1.0		
California red fir *Abies magnifica*	ABMA	N	0	2.0		
incense cedar *Calocedrus decurrens*	CADE27	N	0	1.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	5.0	10.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	2.0		
western white pine *Pinus monticola*	PIMO3	N	0	1.0		
mountain hemlock *Tsuga mertensiana*	TSME	N	0	1.0		

Ecological Site Interpretations

Forest 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*	61	61	218	218	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.
Sierra lodgepole pine	*PICOM*	73	82	75	91	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	81	69	71	40	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).
western white pine	*PIMO3*	43	43	89	89	100	570	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.

Animal Community:

The wildlife habitat changes as the forest develops. The mature open forest provides the best shelter and habitat qualities. The young open stands have very little forage or shelter available for wildlife.

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).

The seeds of the conifer species associated with this site are valued for food by small mammals and birds. The young leaves and shoots are foraged by small mammals and deer. The dead down logs provide nesting cavities for small mammals, and snags are utilized by a variety of birds.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:

This ecological site provides a great opportunity to view several stages of plant succession after a major volcanic disturbance.

Wood Products:
Site productivity is highly variable on this site. Site index was higher in areas where trees were able to tap into the buried soils, which have more organic matter and nutrient development. Site index was lowest for the early pioneer trees, which are struggling to get the nutrients they need.

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

The wood of Sierra lodgepole pine is used for light framing materials, interior paneling, exterior trim, posts, railroad ties, pulp and paper (Cope, 1993).

White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production hence it is a poor source of firewood compared to other conifers (Zouhar, 2001).

Other Products:
Cones of western white pine are collected for novelty items. The tree is also planted as an ornamental (Griffin, 1992).

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).

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).

Other Information:
Alexander (1966), Haig (1932), Schumacher (1928) and Meyer (1961) were used to determine forest site productivity for lodgepole pine, western white pine, California red fir and Jeffrey pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phases 1.4 and 1.5. They are selected according to guidance listed in the site index publications.

Site index for Sierra lodgepole pine was variable on this site, depending upon access to buried soils and soil development. One site index plot, in the area where Sierra lodgepole pines are younger and still developing on unvegetated debris material, the average site index was 38. This is very low compared to the other plots on the debris material. The Sierra lodgepole pine trees are older on the other sites and may have passed the slow establishment period of primary succession, or have been able to tap into other resources.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid And Cryic Gravelly Slopes	F022BI115CA	This is a California red fir western white pine forest, portions of which were affected by debris flows.
Frigid Sandy Flood Plains	R022BI213CA	This is a riparian site associated with the small stream channels in this area.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Loam Debris Flow On Stream Terraces	F022BI105CA	This site is associated with debris flows on lower Hat Creek dominated by Sierra lodgepole pine and quaking aspen.
Frigid Extremely Gravelly Sandy Landslides	F022BI122CA	This site is associated with a rock fall area called Chaos Jumbles.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789141- Vitrandic Xerorthents, debris fan modal and ESD site location
789145
789196
789232- Vitrandic Xerofluvents modal

Similar sites at higher elevation are:
789273
789324
789337

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	4 E
Section:	24
Datum:	NAD83
Zone:	10
Northing:	4486387
Easting:	629343

General Legal Description:	The site location is about 0.75 miles north-northwest of Hat Lake, on the west side of HW 89 in the Devastated Area.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104486387629343
State:	CA
County:	Shasta
Township:	31 N
Range:	4 E
Section:	14
Datum:	NAD83
Zone:	10
Northing:	4436250
Easting:	629524
General Legal Description:	The site location is about 0.35 mile north northeast of the Hot Rock (next to Highway 89).
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104436250629524

Relationship to Other Established Classifications:

Forest Alliance = Pinus jeffreyi - Jeffrey pine forest; Association = Pinus jeffreyi-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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/18/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	9/21/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Moderately Deep Slopes

Abies magnifica - Abies concolor / *Chrysolepis sempervirens* /
(California red fir - white fir / bush chinquapin /)

Site ID: F022BI107CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Lava plateau, (2) Ground moraine
Elevation (feet): 5,980-7,600
Slope (percent): 10-65
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: Non-influencing
Mean annual precipitation (inches): 25.0-65.0
Primary precipitation: Winter months in the form of snow.
Mean annual temperature: 41 to 44 degrees F (5 to 7 degrees C)
Restrictive Layer: Indurated bedrock, dense till, or densic material is encountered 20 to 40 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra over till or in tephra over residuum from volcanic rocks
Surface Texture: (1) Very gravelly ashy loamy sand, (2) Very gravelly ashy sandy loam, (3) Ashy loamy sand
Surface Fragments <=3" (% Cover): 0-55
Surface Fragments > 3" (% Cover): 0-10
Soil Depth (inches): 20-40
Vegetation: California red fir-white fir-Jeffrey pine forest with a common understory of Bush chinquapin (Chrysolepis sempervirens).
Notes: Transition zone between the white fir-Jeffrey pine forest types at lower elevations and the red fir forest types at higher elevations.

Physiographic Features

This ecological site is situated on glaciated lava plateaus, ground moraines on lava plateaus, and on back slopes of lava plateaus. It occurs between 5,980 and 7,600 feet in elevation. Slopes range from 10 to 65 percent.

Landform: (1) Lava plateau
(2) Ground moraine

	Minimum	Maximum
Elevation (feet):	5950	7600
Slope (percent):	10	65
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	High	High
Aspect:		

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 25 to 65 inches (635 to 1,651 mm) and the mean annual temperature ranges from 41 to 44 degrees F (5 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 190 days.

There are no representative climate stations for this site. The nearest one is Manzanita Lake.

	Minimum	Maximum
Frost-free period (days):	60	90
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	25.0	65.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System Subsystem Class

Representative Soil Features

Associated with this ecological site are the Cenplat, Sunhoff, and Badgerflat soils. These moderately deep, well drained soils have very low AWC. They have formed in tephra over till or in tephra over residuum from volcanic rocks. The surface textures are ashy loamy sand, very gravelly ashy loamy sand or very gravelly ashy sandy loam. The subsurface textures are primarily loamy sands or sandy loams with extremely gravelly, cobbly or stony modifiers. A root impenetrable layer of indurated bedrock, dense till, or densic material is encountered 20 to 40 inches below the surface. Permeability is very rapid or rapid through the upper horizons and slow to very slow through the densic material and bedrock respectively.

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

Map Unit/ Component/ Component percent
100 Sunhoff 5
103 Sunhoff 3
106 Badgerflat 7
106 Badgerwash 1
106 Buttelake 2
106 Buttewash 1
106 Sunhoff 5
107 Badgerflat 40

107 Cenplat 35
107 Sunhoff 2
120 Sunhoff 15
172 Cenplat 4

Parent Materials:
Kind: Tephra, Till, Residuum
Origin: Volcanic rock

Surface Texture: (1)Ashy Loamy sand
(2)Very gravelly ashy sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	55
Surface Fragments > 3" (% Cover):	0	10
Subsurface Fragments <=3" (% Volume):	35	65
Subsurface Fragments > 3" (% Volume):	0	35

Drainage Class: Well drained To Well drained
Permeability Class: Very rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	40
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	7.0
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.8	1.5

Plant Communities

Ecological Dynamics of the Site

This site is associated with a California red fir-white fir-Jeffrey pine forest. This forest is generally dense and shady with low understory cover and diversity. Bush chinquapin (Chrysolepis sempervirens) is the most common understory component, which takes advantage of openings in the forest canopy. This forest type is found in the transition zone between the white fir-Jeffrey pine forest types at lower elevations and the red fir forest types at higher elevations.

The dominance of California red fir (Abies magnifica) in this forest type increases with elevation. At lower elevations it is a minor component with a 1 to 5 percent canopy cover that increases to 40 percent at upper elevations. California red fir is a tall, long-lived conifer with short branches and a narrow crown. It produces single needles of 0.8 to 1.4 inches long 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.

White fir (Abies concolor) is similar in appearance to California red fir but has slightly longer needles (1.2 to 2.8 inches long) and smaller cones (3 to 5 inches). White fir tends to develop shallow root systems that can graft onto other white fir roots and spread root rots. The bark of mature white fir is visibly lighter in color than that of red fir. Bark chips can confirm the difference of bark color. The internal bark color of white fir is tan while California red fir is dark reddish. With thin bark, low growing branches and shallow root systems, white fir is very susceptible to fire. Older trees are more resistant because the bark thickens and branches can self-thin, increasing the height of the canopy above the forest floor. Fire causes mortality to mature trees if the crowns burn or heat damages the thin barked trunks or shallow roots (Zouhar, 2001).

Jeffrey pine (Pinus jeffreyi) is commonly co-dominant with white fir and California red fir. Jeffrey pine produces 3 to 8 inch needles in bundles of three. The female seed cones range from 4.7 to 12 inches in length. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007) that 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. Jeffrey pine is shade intolerant and can be replaced over time by white fir or California red fir if fire is excluded from the system. Older Jeffrey pines are somewhat adapted to fire because their bark is thick enough to provide protection from moderate intensity fires. Additionally, their branches tend to thin along the lower portion of the tree trunk, leaving the crown 20 to 30 meters above the forest floor.

A study on conifer growth phenology in the Sierra Nevada describes the timing and growth period for several conifer species. The initial growth of California red fir is faster than its associated conifer species, then returns to a slower growth. Temperature is critical in initiating conifer growth after snowmelt. In the study, trees generally started 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 was unusually early, the trees did not begin annual growth until specific air temperatures were reached. It was hypothesized that heavy shrub cover delayed the start of annual growth because shade kept the soil from warming. The pines in the study began leader growth when the air temperatures reached -4 degrees C (24.8 degrees F), and the firs responded after temperatures reached 2 to 3 degrees C (35.6 to 37.4 degrees F). Pines have heavily insulated terminal buds, whereas the terminal buds of fir trees are less insulated and more susceptible to frost damage. The length of the leader growth is predetermined by growth conditions of the prior year. Primordia of fir needles and pine fascicles are developed the year before leader growth. The internode length between fir needles or pine fascicles is determinate; therefore the leader length is determined by the number of primordia developed. It appears that some conifers will not start leader growth until a specific photoperiod (a ratio of light hours to dark hours during one 24 hour period) is met, even if the snow has melted and the temperatures are warm enough. 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).

This site receives 45 inches average annual precipitation, mostly in the form of snow in winter. As the snow melts it fills macropores in the soil with water. Soil characteristics such as depth and texture determine how much water the soil can hold and how long it will remain before filtering through, evaporating away, or being lost to evapotranspiration. The soils associated with this site have very low to low water holding capacities. Under the same climatic conditions, drought would come earlier to these soils than those with higher water holding capacities. These trees have a short growing season due to early drought conditions.

Most of the forest within the present park boundary was never logged, but fire suppression has created a change in the stand structure and composition. With a natural fire regime the presence of Jeffrey pine is encouraged. Low to moderate intensity fires maintain an open forest with patches of montane shrubs and forbs in the canopy openings. In the absence of fire, firs continue to regenerate in the understory, increasing forest density and fuels. Today the forest is multilayered, dense and shady, dominated by firs. Vegetation on the forest floor is almost nonexistent.

Fire regime studies, using tree rings and fire scars, report historic median fire return intervals in white fir-red fir forests of 12, 24, and 41 years (Skinner and Chang, 1996; Bekker and Taylor, 2000; Taylor and Solem, 2001 respectively). Beaty and Taylor report that fire frequency and intensity is additionally 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 lower slope to upper slope positions. Their study also indicates a slightly later burn season in the Southern Cascades than in the Sierra Nevada. The fire scars in the Southern Cascade are primarily found at the annual tree ring boundary, indicating the trees were dormant at the time of the fire, whereas in the Sierra Nevada fires scars are often found in the late-season wood. This timing shift may be due to the timing of summer drought conditions, which begin earlier in the south. In July and August, thunderstorms are common in Lassen Volcanic National Park and the 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 report that stand-replacing fire is more common on upper slopes, while low to moderate intensity fires occur only along lower slopes. This is probably due to the tendency of fire to burn upslope, preheating the fuels as it goes (Beaty and Taylor, 2001). After a stand-replacing fire, evenly aged forests are formed. The current management practice of fire suppression has shifted forest density and composition. Fire suppression creates 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 and shade intolerant pines (Taylor 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 may 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 into more open forest types. Large outbreaks are often associated with drought years or overstocked forests. Fuel loads are frequently 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 the dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle (Dendroctonus 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).

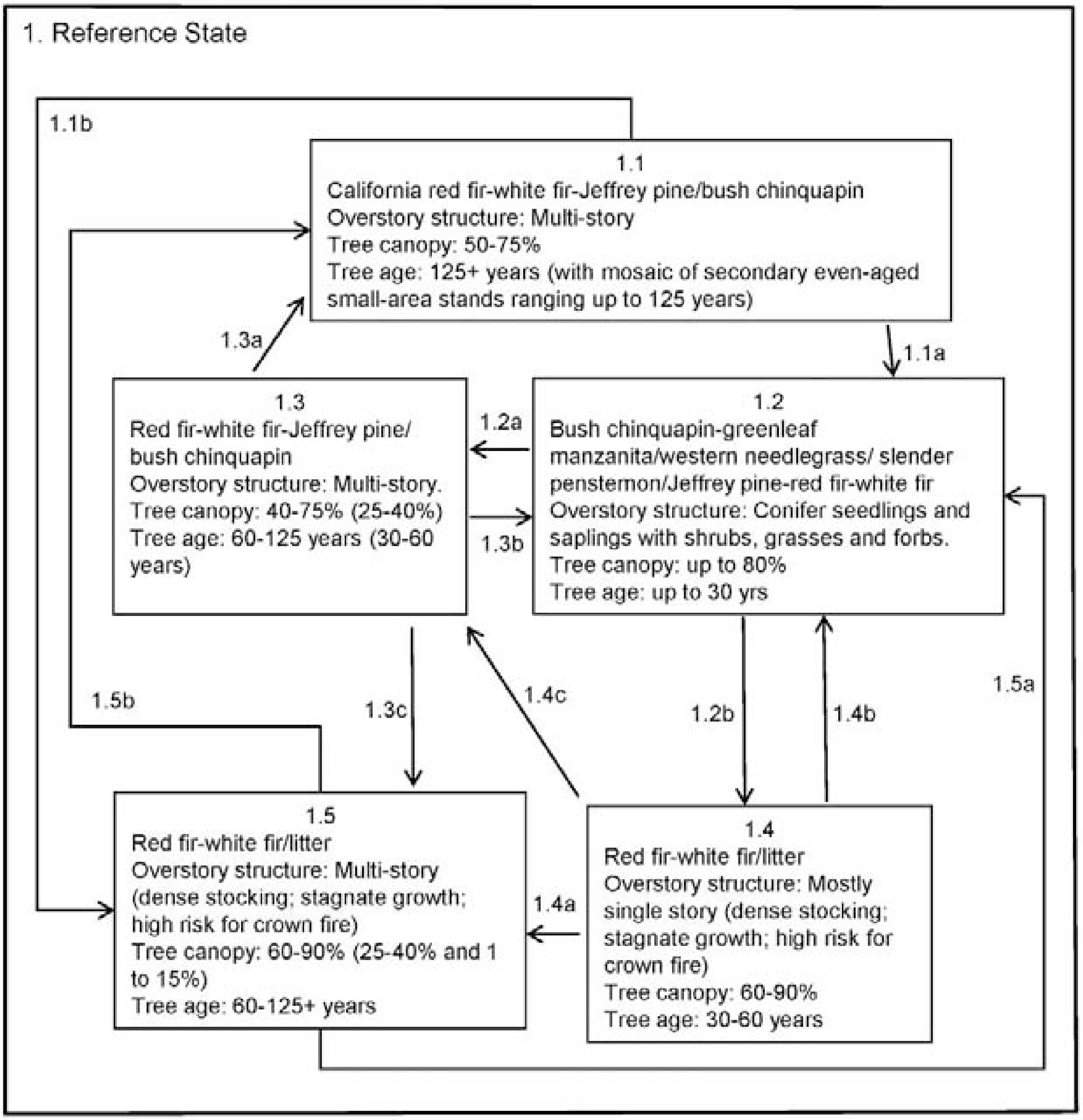
Pathogens that affect white fir are the dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), trunk rot (Echinodontium tinctorium) 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). This ecological site has evolved with natural disturbances such as fire, wind throw and disease that create canopy gaps which allow for tree regeneration.

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 (Heterobasidium 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.) (Russell, et al., 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 Diagram

State-Transition Model - Ecological Site F022BI107CA
Abies magnifica - Abies concolor /Chrysolepis sempervirens
(California red fir -white fir/bush chinquapin)



Reference - State 1

California red fir-white fir-Jeffrey pine/bush chinquapin - Community Phase 1.1

Red fir-white fir-Jeffrey pine forest

This community phase is considered to be the likely future reference or most successionally advanced community phase. It is dominated by mature white fir, California red fir and Jeffrey pine. Bush chinquapin (Chrysolepis sempervirens) is present in canopy openings.

This community phase is maintained by low and moderate intensity fires that remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires can kill overstory trees as well, leaving canopy openings that are favorable for Jeffrey pine and shrub regeneration. The moderate intensity fires therefore breakup the uniformity of the older stands with pockets of young forests intermixed.

Community Phase Pathway 1a

In the event of a severe fire there may be significant tree mortality, leaving a barren landscape with many standing dead trees. This creates community phase 1.2.

Community Phase Pathway 1b

If fire is excluded from the old growth community phase, red fir and white fir continue to regenerate in the understory, increasing tree density and shifting this community phase toward the community phase 1.5.

California red fir-white fir-Jeffrey pine/bush chinquaping Plant Species Composition:

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**10**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	10	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**30**	**785**		
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	0	400	0	10
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	30	375	1	12
		slender penstemon	PEGR4	*Penstemon gracilentus*	0	10	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**20**	**115**		
		white fir	ABCO	*Abies concolor*	10	50	1	5
		California red fir	ABMA	*Abies magnifica*	10	50	1	5
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	15	0	3

Annual Production by Plant Type:

Plant Type	Annual Production (lbs/AC) Low	Representative Value	High
Grass/Grasslike	0	5	10
Shrub/Vine	30	420	785
Tree	20	65	115
Total:	50	490	910

Forest Overstory:

The upper canopy is a mix of white fir, California red fir and Jeffrey pine. California red fir and white fir are present in the understory. The average overstory canopy cover is 60 percent, with a range of 50 to 75 percent. White fir is generally dominant, with red fir and Jeffrey pine varying in cover from 1 to 20 percent. Canopy heights range from 90 to 120 feet with diameters ranging from 25 to 35 inches at breast height. The largest and oldest trees were not measured. Basal area for this community type ranged from 120 to 180 ft2/ acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	50	60	75

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	30.0	40.0						
California red fir *Abies magnifica*	ABMA	N	10.0	20.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	10.0	15.0						

Forest Understory:

The understory is generally sparse, although there is more cover and diversity in canopy openings. Bush chinquapin (Chrysolepis sempervirens) is consistently present, with about 8 percent cover. Other associated species are greenleaf manzanita (Arctostaphylos patula), western needlegrass (Achnatherum occidentale), and slender penstemon (Penstemon gracilentus).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	2.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
greenleaf manzanita *Arctostaphylos patula*	ARPA6	N	0	10.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	1.0	12.0		
slender penstemon *Penstemon gracilentus*	PEGR4	N	0	1.0		

Bush chinquapin-greenleaf manzanita/western needlegrass/ slender penstemon/pine-firs - Community Phase 1.2

This community phase develops when the majority of the overstory trees succumb to a high intensity canopy fire. There may be a few surviving overstory trees, which become an important seed source for regeneration. Mature Jeffrey pines have thicker bark and higher tree branches than California red fir or white fir and are more likely to survive a fire and supply seed for regeneration. Because Jeffrey pine seedlings germinate well in full sun and mineral soils after fire and white fir and California red fir prefer partial shade, Jeffrey pine may have an advantage in early phases of regeneration which assures their existence and sometime prevalence in older stands.

Bush chinquapin (Chrysolepis sempervirens) can resprout from the roots, root crown or the stump after it has been top-killed by fire. It can also regenerate from seed, but there is little data about seed dormancy or storage. Greenleaf manzanita (Arctostaphylos patula) is a fire dependent shrub because its seeds remain dormant in the soil until the heat from fire scarifies the seed coat. The presence or absence of greenleaf manzanita may be an indicator of fire history. Bush chinquapin is more shade tolerant than greenleaf manzanita and could persist longer as the forest canopy encloses this site. This area does not seem to have the tendency to create dense shrub lands after a fire but recent post-fire data is lacking.

A flush of native perennial grasses and forbs is possible for the first several years after a burn.

Community Phase Pathway 1.2a

The natural pathway is to community phase 1.3, a young open red fir-white fir-Jeffrey pine forest. This pathway is followed with natural fire regime. Manual thinning with prescribed burns can emulate the natural cycle and lead to the same open community phase.

Community Phase Pathway 1.2b

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

<u>Red fir-white fir-Jeffrey pine/bush chinquapin - Community Phase 1.3</u>

This forest community phase develops with the natural fire regime, or with manual thinning and prescribed fires. Low to moderate intensity fires clear the understory and remove fuels before they reach hazardous levels, although severe high-intensity canopy fires are also possible. Since Jeffrey pine establishes early during stand regeneration it has a fair percentage of cover in the upper canopy, but it has difficulty regenerating and growing well in the understory of the canopy. Its growth and presence is dependent upon fire or other disturbances to maintain an open forest structure with canopy openings.

Community Phase Pathway 1.3a

This is the natural pathway for this community phase, which evolved with a historic fire regime of relatively frequent surface and moderate severity fires, and/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 reference community phase (Community Phase 1.1).

Community Phase Pathway 1.3b

In the event of a canopy fire this community phase would return to Community Phase 1.2, forest regeneration.

Community Phase Pathway 1.3c
If fire does not occur, forest density increases. This may favor California red fir and white fir over Jeffrey pine. The increased density shifts this community phase toward the closed red fir-white fir community phase 1.5.

Red fir-white fir/litter - Community Phase 1.4

This community phase is defined by a dense canopy and high basal area of California red fir and white fir. Canopy cover ranges from 60 to 90 percent. The trees are overcrowded and often diseased and stressed due to 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, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a
If fire continues to be excluded from this system the mature closed red fir-white fir forest community phase develops (Community Phase 1.5).

Community Phase Pathway 1.4b
At this point the density of ground fuels and ladder fuels formed in the mid-canopy create conditions for a high intensity canopy fire. A severe fire would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c
The natural event of a moderate or surface fire in this forest is unlikely due to the high fuel accumulation. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with fire over time. Manual treatments 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 an open red fir-white fir-Jeffrey pine forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3.

Red fir-white fir/litter - Community Phase 1.5


Red fir-white fir forest

The mature closed red fir-white fir forest develops with the prolonged exclusion of fire, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continues, and tree health and vigor decreases.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b
The natural event of a moderate or surface fire in this forest is unlikely due to the high fuel accumulation. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with fire over time. Manual treatments 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 red fir-white fir-Jeffrey pine forest community phase 1.1. A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1 but tree mortality will increase the already high fuel amounts.

Ecological Site Interpretations

Forest 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*	37	47	60	83	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.
California red fir	*ABMA*	42	53	142	184	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.
Jeffrey pine	*PIJE*	56	56	43	43	57	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:

Red fir-white fir-Jeffrey pine forests provide browse, cover and nesting sites for a variety of wildlife species. Mature open forests, closed dense forests, young forests and shrub lands provide different habitats and forage for wildlife. The type and quality of the wildlife habitat varies with the community type. Douglas squirrels cut and cache fir cones before the cones are fully mature. Cavity-nesting birds utilize holes in snags and dying trees for their nests while ground-nesting birds and animals find homes in the fallen trees. Deer and bear browse the needles of these conifers in winter and the new growth in the spring. Porcupines eat the bark of fir and can kill saplings. Rodents feed on the white fir cambial tissue. Birds forage for insects in the foliage of mature conifers

This forest type intergrades between the lower elevation white fir and Jeffrey pine forests and the upper elevation red fir forests. It is difficult to find specific data about animal use in this mixed forest.

There are about 33 species of mammals commonly present in the white fir forest type in California and, of these, 7 are generally associated with mature forests. About 123 species of birds are found in the white fir forest type of California and southern Oregon, about 50 of which are associated primarily with mature forests. Many of these birds use mature white fir trees and snags for foraging, roosting, nesting and/or breeding. Included are bald eagle, California spotted owl, brown creeper, pileated woodpecker, white-headed woodpecker and, when near lakes or streams, osprey. Reptiles in white fir forests are represented by 17 species, mostly at lower elevations, 8 of which are associated with mature forests (Zouhar, 2001).

Animals that use California red fir forests include martin, fisher, wolverine, black bear, squirrels, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, mountain beaver, and pocket gopher (Cope, 1993).

American black bears and 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, deer mice, yellow-pine chipmunks, and lodgepole chipmunks (Gucker, 2007).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area is suitable for hiking and backpacking trails. Trails may be used primarily for passing through since dense forests and slopes do not easily accommodate campsites.

Wood Products:
White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production, hence it provides poor firewood compared to other conifers (Zouhar, 2001).

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber (Gucker, 2007).

The wood from California red fir is straight-grained and light. California red fir wood 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, and high-quality wrapping paper, and is preferred for pulping (Cope, 1993).

Site index and CMAI (culmination of mean annual increment) in the Forest Site Productivity section above are in units of feet and cubic feet/acre/year, respectively.

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:

Additional information

Common white fir pathogens:

White fir dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris) is a parasitic plant common in the survey area as evident by witches brooms, top kill, stem cankers and swellings. The vegetative shoots of the dwarf mistletoe are often present from spring to fall. A fungus (Cytospora abietis) kills the branches that are infected with dwarf mistletoe. The reduced vigor makes the tree more susceptible to bark beetle and other diseases. The mistletoe cankers, by creating cracks in the bark, create an entry point for other diseases such as heart rots (Burns and

Honkala, 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.). This disease can damage tree growth by reducing crown development. Mortality is less common in mature trees than in younger regeneration trees. Secondary infection is possible from heart rots entering through openings in the infected areas (Burns and Honkala, 1990).

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 the 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 and Honkala, 1990).

The fir engraver beetle (Scolytus ventralis) can cause extensive damage to white fir forests. 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 fire damage.

Additional information on Jeffrey pine pathogens:

Infections from western dwarf mistletoe (Arceuthobium campylopodium) cause witches brooms, reduced growth and tree mortality. Sticky seeds are spread in fall and infest nearby and understory trees. In years of severe drought dwarf mistletoe has induced 60 to 80 percent of the Jeffery pine mortality (Burns and Honkala, 1990).

Jeffrey pine bark beetles (Dendroctonus jeffreyi) are native beetles that can only reproduce in Jeffrey pine. They are a natural cycle in maintaining forest health. They generally attack older weaker trees, but in times of drought or other disturbances such as lightning or fire, epidemic levels can break out and cause extensive damage to the forest. These beetles infest the lower stem and bole of the trees, usually after pine engraver (Ips pini) infestation in the upper portion of the tree. The beetles slowly destroy the cambium, inhibiting the flow of nutrients. A sign of infestation is the changing color of the pine needles from green to yellow or reddish brown, beginning from the top down (Hagle et al., 2003; Smith, 1971).

Forest Pathogens that affect Red fir:
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 also 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 (Russell, 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.

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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 get to epidemic levels when the trees are stressed due to drought, annosus root rot, dwarf mistletoe, or fire damage. (Russell, et al., 1990).

Site index documentation:

Schumacher (1928), Schumacher (1926) and Meyer (1961) were used to determine forest site productivity for red fir, white fir and Jeffrey pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phase 1.3. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Low Precip Frigid Sandy Tephra Gentle Slopes	F022BI100CA	This is a Jeffrey pine forest found on lower slopes and flats.
Frigid And Cryic Gravelly Slopes	F022BI115CA	This is a red fir-western white pine forest found at higher elevations.
Low Precip Frigid Sandy Moraine Slopes	F022BI119CA	This is a Jeffrey pine-white fir forest found on lower slopes.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes	F022BI109CA	This is a red fir-Jeffrey pine forest found at higher elevations on cinder cones and shield volcanoes.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789107- Site location
789362

Type Locality:

State:	CA
County:	Lassen
Township:	31 N
Range:	6 E
Section:	11
Datum:	NAD83
Zone:	10
Northing:	4491392
Easting:	645930
General Legal Description:	The type locality is above Butte Lake and north of Sunrise Peak.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104491392645930

Relationship to Other Established Classifications:

Forest Alliance = Abies magnifica-Abies concolor – Red fir-white fir forest; Association = Abies magnifica-Abies concolor-Pinus jeffreyi. (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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/18/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	10/15/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Moist Sandy Lake Or Stream Terraces

Pinus contorta var. murrayana / / Veratrum californicum var. californicum - Elymus glaucus
(Sierra lodgepole pine / / California false hellebore - blue wildrye)

Site ID: F022BI108CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Lake terrace, (2) Stream terrace
Elevation (feet): 5,960-6,900
Slope (percent): 0-8
Water Table Depth (inches): 0-60
Flooding-Frequency: Rare to frequent
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 35.0-65.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41-44 degrees F (5-7 degrees C)
Restrictive Layer: Duripan or petroferric contact at 40 inches to greater than 60 inches
Temperature Regime: Frigid
Moisture Regime: Aquic
Parent Materials: Alluvium from volcanic rocks
Surface Texture: (1) Gravelly medial sandy loam
Surface Fragments <=3" (% Cover): 0-5
Surface Fragments > 3" (% Cover): 0-0
Soil Depth (inches): 40-60+
Vegetation: Sierra lodgepole pine (Pinus contorta var. murrayana) is dominant with approximately 40 percent canopy cover. The lush understory has a variety of species, and dominants vary by microclimate. Common plants are blue wildrye (Elymus glaucus), bluejoint (Calamagrostis Canadensis), tufted hairgrass (Deschampsia cespitosa), meadow barley (Hordeum brachyantherum), bigleaf lupine (Lupinus polyphyllus), common yarrow (Achillea millefolium), arrowleaf ragwort (Senecio triangularis), longstalk clover (Trifolium longipes), and

California false hellebore (Veratrum californicum var. californicum).
Notes: This is a moist Sierra lodgepole pine site found on stream or lake terraces. It is often adjacent to a meadow community.

Physiographic Features

The majority of this site is found between 5,960 and 6,900 feet, but it has been associated with minor components which are mapped between 5,500 and 8,000 feet in elevation. Slopes are generally between 0 to 8 percent.

This site has a seasonal water table that may be at the surface to around 60 inches.

Landform: (1) Lake terrace
(2) Stream terrace

	Minimum	Maximum
Elevation (feet):	5500	8000
Slope (percent):	0	8
Water Table Depth (inches):	0	60
Flooding:		
Frequency:	Rare	Frequent
Duration:	Brief	Long
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation in the winter months in the form of snow. The mean annual precipitation is ranges from 35 to 65 inches (889 to 1,651 mm) and the mean annual temperature is about 41 degrees F (5 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.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	35.0	65.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This ecological site is often found adjacent to stream channels and along lake margins.

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the Typic Endoaquands soil component, which consists of deep and very deep, poorly drained soils that formed in alluvium from volcanic rocks. There are a couple inches of organic pine needles and muck over an A horizon. The A and B horizons have gravelly medial sandy loam textures with 12 to 15 percent clay and 20 to 25 percent gravel. The C horizons have coarse sandy loam and loamy coarse sand textures with 1 to 2 percent clay, 50 to 60 percent gravel, and 10 percent cobbles. These soils on average have low AWC in the upper 60 inches of soil. There are masses of oxidized iron around rock fragments below 29 inches, and a duripan or petroferric contact at 40 inches to greater than 60 inches. The iron concentrations indicate prolonged saturation, due to a water table perched above the duripan or petroferric layer.

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

DMU Component Percent
103 Typic Endoaquands 2
104 Typic Endoaquands 2
105 Typic Endoaquands 2
117 Typic Endoaquands 5
130 Typic Endoaquands 15
134 Aquepts 3

139 Typic Endoaquands 20
142 Aquepts 3
145 Aquepts 2
148 Typic Endoaquands 15
163 Typic Endoaquands 2
171 Typic Endoaquands 5
172 Typic Endoaquands 1
173 Typic Endoaquands 8

Parent Materials:
Kind: Alluvium
Origin: Volcanic rock

Surface Texture: (1)Gravelly Sandy loam
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	5
Surface Fragments > 3" (% Cover):	0	0
Subsurface Fragments <=3" (% Volume):	25	70
Subsurface Fragments > 3" (% Volume):	0	15

Drainage Class: Poorly drained
Permeability Class: Rapid To Moderate

	Minimum	Maximum
Depth (inches):	40	80
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.71	7.33

Plant Communities

Ecological Dynamics of the Site

This is a moist Sierra lodgepole pine site found on stream or lake terraces. It is often adjacent to a meadow community. Sierra lodgepole pine (Pinus contorta var. murrayana) is dominant with approximately 40 percent canopy cover. The lush understory has a variety of species, and dominants vary by microclimate. Common plants are blue wildrye (Elymus glaucus), bluejoint (Calamagrostis Canadensis), tufted hairgrass (Deschampsia cespitosa), meadow barley

(Hordeum brachyantherum), bigleaf lupine (Lupinus polyphyllus), common yarrow (Achillea millefolium), arrowleaf ragwort (Senecio triangularis), longstalk clover (Trifolium longipes), and California false hellebore (Veratrum californicum var. californicum).

Sierra lodgepole pine is more tolerant of wet soil conditions than other conifers in the area, so it dominates in these wet meadow margins. White fir (Abies concolor) or California red fir (Abies magnifica) are occasionally found in these forests, but they will not replace lodgepole pine due to the wetness. Sierra lodgepole pine can be long-lived, and some trees on this site are almost 200 years old. Sierra lodgepole pine does not usually gain much in girth, with older trees averaging 16 to 21 inch diameters. Its thin bark and shallow roots make it susceptible to fire. It grows tall and narrow with short branches and 1.2 to 2.4 inch needles in fascicles of two. Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds.

This ecological site is on alluvial stream terraces with water tables at the surface during snow melt, then dropping throughout the season. There is a root restrictive layer below 40 inches, which may perch water for a short period. The roots of Sierra lodgepole pine are generally shallow, enabling them to grow on this site. Sierra lodgepole pine produces a taproot, but it may atrophy or grow horizontally in cases of high water table or a root restrictive layer.

Several sampled trees are older than 150 years, which indicates that lodgepole pine was present at some of these sites prior to the encroachment period documented by Taylor (Taylor, 1990). A younger stratum of trees sampled meets the profile of Taylor's encroachment period. Taylor identified a period between 1905 and 1955 when most of the lodgepole pine became established within the meadows of Lassen Volcanic National Park. The study was unable to identify a single cause for encroachment but selected a combination of factors, such as the cessation of grazing and the practice of fire suppression. In Yosemite National Park, pulses of lodgepole pine encroachment were related to multiple years of warmer than normal summers with lower than normal precipitation. Taylor found that this did not apply to this area, and wetter than normal conditions prevailed during periods of encroachment. More research is needed to determine if (or how much) this ecological site has encroached into meadow habitat due to human caused triggers.

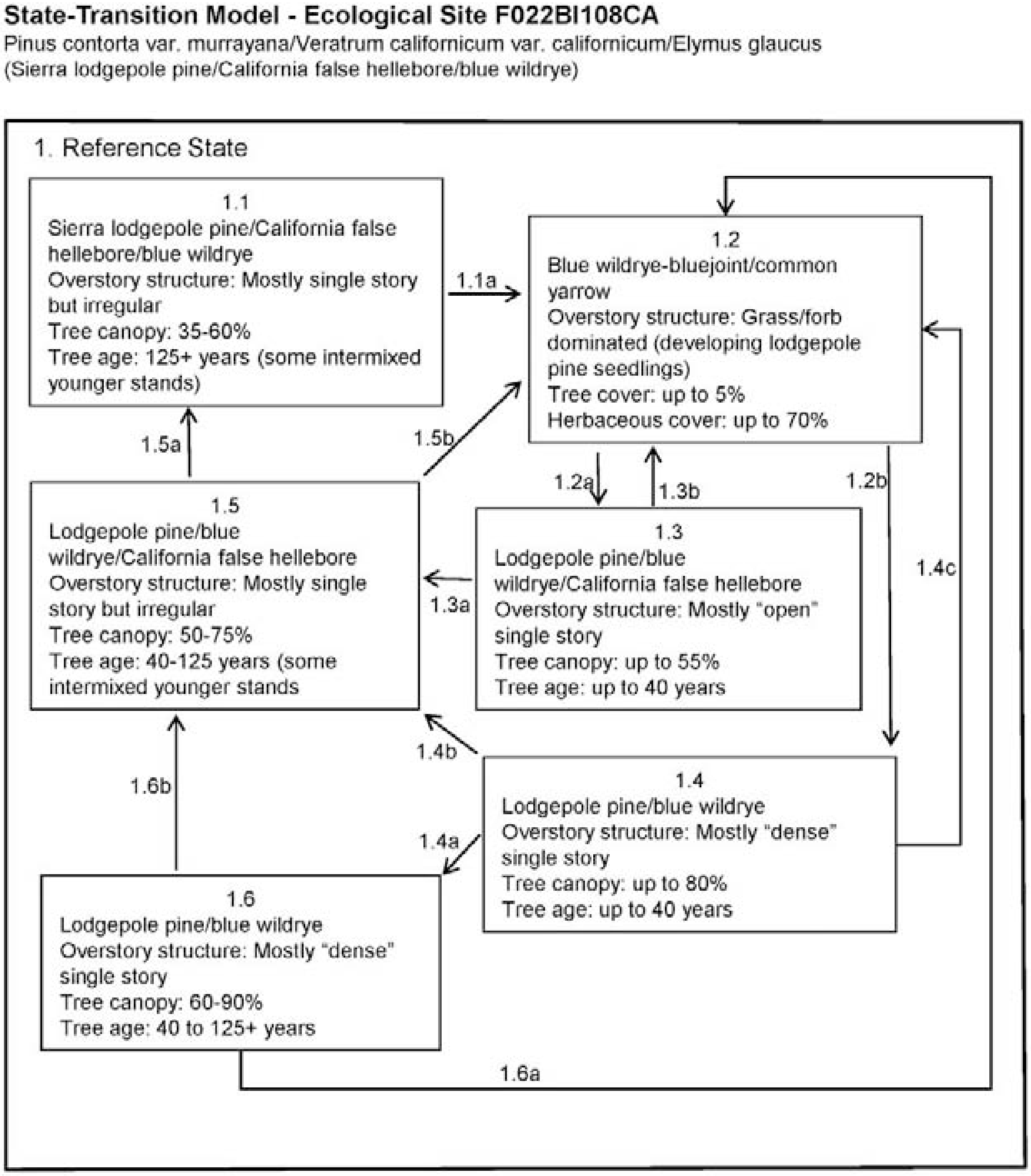
The cessation of grazing has an immediate affect on conifer survival because herbivores browse on young seedlings. Secondary to seedling survival is the removal of competing vegetation and the creation of open patches of bare soil that is ideal for lodgepole pine establishment. In meadow systems with a stream, grazing may have caused bank instability causing channel confinement and incision. A deeper water table could result from an altered channel, which would create a drier meadow more suitable for conifer encroachment. On a longer time scale, many of these meadows are on the fringes of relict glacial lakes that are slowly filling with organic matter and sediments. Please refer to the meadow ecological sites for more information on hydrologic dynamics (R022BI217CA and R022BI206CA). A high mortality fire or mountain pine beetle infestation could result in up to 30 percent more water being released into the watershed since the trees are not using the water. This could raise the water table in the meadow, making it less desirable for lodgepole pine.

Sierra lodgepole pine has a complex disturbance regime which includes cyclic beetle infestations and fire. Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates of the lodgepole pine (Taylor and Solem, 1995). Sierra lodgepole pine regenerates prolifically after fire and evenly aged stands are formed. As the canopy closes the moderately shade intolerant pines go through an extended period of self-thinning. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly. Low intensity fires can cause damage to live trees, however, and fire damaged trees are more susceptible for the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine regeneration. Over time these gaps break up the uniformity of the evenly aged stand that formed after the last large fire event. Old growth lodgepole pine that has not experience severe fire has an irregular forest structure and is able to regenerate in canopy gaps created by disturbances.

Other pathogens that affect Sierra lodgepole pine include insects such as the pine engraver (Ips pini), lodgepole terminal weevil (Pissodes terminalis), Warren's collar weevil (Hylobius warreni), weevil (Magdalis gentiles), pine needle scale (Chionaspis pinifoliae), black pineleaf scale (Nuculaspis californica), spruce spider mite (Oligonychus ununguis), lodgepole sawfly (Neodiprion burkei), lodgepole needle miner (Coleotechnites milleri), sugar pine tortrix (Choristoneura lambertiana), pine tube moth (Argyrotaenia pinatubana), and the pandora moth (Coloradia pandora). The pine engraver commonly develops in windthrows and logging slash, especially slash that is shaded and cannot dry quickly. Prompt slash disposal is an effective control measure. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that can affect large areas of lodgepole pine (Lotan and Critchfield, 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 Diagram



Reference - State 1

Sierra lodgepole pine/California false hellebore/blue wildrye - Community Phase 1.1

Sierra lodgepole pine forest

This mature Sierra lodgepole pine forest develops with continual small scale disturbances which create gaps in the canopy. It is considered the most successionally advanced community phase. These gaps (single tree fall to .25 acre in size) provide suitable sites for Sierra lodgepole pine regeneration, and over time, create uneven forest structure and composition. Several age classes of Sierra lodgepole pine are present.

Community Phase Pathway 1.1a

A high tree mortality fire leads to the grass and forb community phase 1.2.

Sierra lodgepole pine/California false hellebore/blue wildrye Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**19**	**340**		
		common yarrow	ACMI2	*Achillea millefolium*	10	80	1	10
		bigleaf lupine	LUPO2	*Lupinus polyphyllus*	5	50	1	5
		monkeyflower	MIMUL	*Mimulus*	0	5	0	1
		sweetcicely	OSBE	*Osmorhiza berteroi*	0	15	0	2
		longstalk clover	TRLO	*Trifolium longipes*	4	40	1	10
		California false hellebore	VECAC2	*Veratrum californicum var. californicum*	20	150	1	8

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**30**	**1161**		
		alpine bentgrass	AGHU	*Agrostis humilis*	0	10	0	5
		bluejoint	CACA4	*Calamagrostis canadensis*	0	630	0	20
		sedge	CAREX	*Carex*	0	15	0	5
		blue wildrye	ELGL	*Elymus glaucus*	30	420	2	30
		meadow barley	HOBR2	*Hordeum brachyantherum*	0	70	0	5
		muhly	MUHLE	*Muhlenbergia*	0	6	0	3
		alpine timothy	PHAL2	*Phleum alpinum*	0	10	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**220**		
		whitestem gooseberry	RIIN2	*Ribes inerme*	0	20	0	2
		arrowleaf ragwort	SETR	*Senecio triangularis*	0	200	0	12

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**2**	**8**		

Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	2	8	1	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	30	522	1161
Forb	19	191	340
Shrub/Vine	0	45	220
Tree	2	5	8
Total:	51	763	1729

Forest Overstory:

The forest overstory has 35 to 60 percent cover from almost exclusively Sierra lodgepole pine. White fir and California red fir are often in the adjacent drier forests but seldom within this wet site. The upper canopy height ranges from 80 to 100 feet. Basal area is between 100 and 160 ft/acre. Several age classes are present, with gaps of young seedlings and saplings. Diameter at breast height for the overstory trees ranges from 15 to 19 inches.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	40	60

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	35.0	60.0						

Forest Understory:

There is high cover and production of hydrophytic vegetation in the understory. Grasses are mixed and include alpine bentgrass (Agrostis humilis), bluejoint (Calamagrostis Canadensis), blue wildrye (Elymus glaucus), alpine timothy (Phleum alpinum), muhly (Muhlenbergia spp.) and meadow barley (Hordeum brachyantherum). A variety of sedges (Carex spp.) may be present in small amounts. Other plants on this site are common yarrow (Achillea millefolium), tinker's penny (Hypericum anagalloides), bigleaf lupine (Lupinus polyphyllus), monkeyflower (Mimulus spp.), sweetcicely (Osmorhiza berteroi), whitestem gooseberry (Ribes inerme), arrowleaf ragwort (Senecio triangularis), longstalk clover (Trifolium longipes), and California false hellebore (Veratrum californicum var. californicum). Total understory production is around 800 to 1,000 pounds per acre.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
alpine bentgrass *Agrostis humilis*	AGHU	N	0	4.0		
bluejoint *Calamagrostis canadensis*	CACA4	N	0	20.0		
sedge *Carex*	CAREX	N	0	5.0		
blue wildrye *Elymus glaucus*	ELGL	N	2.0	30.0		
meadow barley *Hordeum brachyantherum*	HOBR2	N	0	5.0		
bigleaf lupine *Lupinus polyphyllus*	LUPO2	N	1.0	5.0		
muhly *Muhlenbergia*	MUHLE	N	0	3.0		
alpine timothy *Phleum alpinum*	PHAL2	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
common yarrow *Achillea millefolium*	ACMI2	N	1.0	10.0		
monkeyflower *Mimulus*	MIMUL	N	0	1.0		
sweetcicely *Osmorhiza berteroi*	OSBE	N	0	2.0		
longstalk clover *Trifolium longipes*	TRLO	N	1.0	10.0		
California false hellebore *Veratrum californicum var. californicum*	VECAC2	N	1.0	8.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
whitestem gooseberry *Ribes inerme*	RIIN2	N	0	2.0		
arrowleaf ragwort *Senecio triangularis*	SETR	N	0	12.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	1.0	5.0		

Blue wildrye-bluejoint/common yarrow - Community Phase 1.2

This post-fire meadow community phase may persist for 1 to 2 years. With an absence of conifers and a subsequent increase in watershed release, the site could become wetter and this community phase may persist longer. Data is lacking for this post-fire community, but most of the understory species listed above would return quickly after fire. Some species such as common yarrow (Achillea millefolium) and blue wildrye (Elymus glaucus) proliferate after disturbance. Rhizomatous species such as common yarrow and bluejoint (Calamagrostis Canadensis) can resprout from undamaged rhizomes after fire. Other species may be top-killed and resprout from tubers or root caudices. All species can regenerate from on or off-site seed sources.

Sierra lodgepole pine will germinate from wind blown seed. It may take a few years for the young seedlings to establish due to competition from the grasses and forbs.

Community Phase Pathway 1.2a

With time and the establishment and growth of the Sierra lodgepole pine seedlings, Community Phase 1.3 develops.

Community Phase Pathway 1.2b

In some cases, the establishment of seedlings is extremely dense, and Community Phase 1.4 develops.

Lodgepole pine/blue wildrye/California false hellebore - Community Phase 1.3

This Sierra lodgepole pine regeneration community phase is defined by the density of the seedling establishment. This site generally has less than 500 stems per acre, and develops into a relatively open forest. The seedlings develop into pole sized trees, with up to 55 percent canopy cover. The understory cover and diversity remains high.

Community Phase Pathway 1.3a

With continued growth and small scale natural disturbances a multi-aged Sierra lodgepole pine forest (Community Phase 1.5) develops.

Community Phase Pathway 1.3b

Fire is unlikely at this point, but should it occur, the grass and forb community phase (Community Phase 1.2) will exist for a short period.

Lodgepole pine/blue wildrye - Community Phase 1.4

This regeneration community phase is defined by dense seedling establishment. More research is needed to determine the cause of dense versus open seedling recruitment, and appropriate indicators to define the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. There are many variables which influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid October. These seeds can be stored in the soil for several years, but tend to regenerate from wind dispersed seeds deposited after the fire. Therefore, the season of burn and timing in relation to seed crop cycles may affect seedling density. Smaller fires may have higher seedling density, due to the proximity of an available seed source. Fires leave bare soil and disturbed duff with open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. Seasonal precipitation patterns and air temperatures, during the season and germination, influence the survival of seedlings.

As the seedlings develop they form dense thickets. The trees thin out their lower branches as they grow tall and thin. They self thin to some extent, but most trees persist even with limited sunlight on their canopy. Growth becomes stagnant, due to competition for light, water and nutrients. After a certain point in development Sierra lodgepole pine may not respond to competitive release from thinning, disease, or fire.

Community Phase Pathway 1.4a
With time and growth in the absence of disturbance, the stand remains dense and evenly aged (Dense lodgepole pine forest, Community Phase 1.6).

Community Phase Pathway 1.4b
Although dense, over time natural small scale disturbances such as fire, beetle infestations, or wind-throw, can shift this community phase towards an open Sierra lodgepole pine forest (Community Phase 1.5).

Community Phase Pathway 1.4c
This pathway is triggered by a high mortality fire, which initiates a grass and forb community phase (Community Phase 1.2).

Lodgepole pine/blue wildrye/California false hellebore - Community Phase 1.5
This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. Shallow roots, which make lodgepole pine susceptible to wind throw, can produce canopy gaps, but mountain pine beetle infestations are the most significant disturbances to create openings. After a pest infestation, patches of the stand die, leaving gaps for lodgepole pine regeneration. Low intensity fire is often fatal to mature lodgepole pine, so even a low severity fire can be a stand replacing event. It would be uncommon for a fire event to create small gaps or openings, however low intensity smoldering fires have been documented that spread through downed trees after a mountain pine beetle infestation. Trees damaged by fire are more susceptible to mountain pine beetle attack to the next cycle of mountain pine beetles. In all likelihood fire would not ignite easily in the moist understory of this site or in the nearby meadow until the end of summer.

Community Phase Pathway 1.5a
With time and growth and small scale disturbances, this forest continues to develop into an open Sierra lodgepole pine forest (community phase 1.1) with a multi-aged, complex forest structure.

Community Phase Pathway 1.5b
This pathway is triggered by a high mortality fire, which initiates a grass and forb community community (Community Phase 1.2).

Lodgepole pine/blue wildrye - Community Phase 1.6
This forest develops in the absence of canopy disturbance. It remains evenly aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the

understory branches die back. The self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees will enable the pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

Community Phase Pathway 1,6a
This pathway is triggered by a high mortality fire, which initiates a grass and forb community phase (Community Phase 1.2).

Community Phase Pathway 1.6b
This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low-mortality fires, or wind throw. The forest becomes a more open Sierra lodgepole pine forest (Community Phase 1.5) with several age classes, with continued small scale disturbances and aging can eventually develop into Community Phase 1.1.

Ecological Site Interpretations

Forest 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
Sierra lodgepole pine	*PICOM*	90	90	104	104	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.

Animal Community:
Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. These forests have high productivity in the understory and abundant forage for wildlife. They are often adjacent to water bodies and open meadows that encourage an increase in wildlife activity. Thirty-one mammals and almost fifty bird species have been documented to use Sierra lodgepole pine forests. Snags and downed logs are important for cavity-nesting birds and mammals. Some animals forage on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This site is usually adjacent to scenic meadows, lakes and streams and provides access to these areas. Care should be taken to avoid compaction or diversion of water flow since this area is

seasonally wet.

Wood Products:
Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light and straight grained with consistent texture (Cope 1993).

Other Products:

Other Information:

Site index documentation:

Alexander (1966) was used to determine forest site productivity for Sierra lodgepole pine. 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.

Lodgepole pine appropriate for site index measurement typically occurs in community phases 1.5, and older stands of 1.3. They are selected according to guidance listed in the site index publication.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Loam Moraines Or Lake Terraces	F022BI112CA	This is a red fir forest on drier slopes.
Frigid Coarse Glaciolacustrine Gentle Slopes	F022BI117CA	This is a drier lodgepole pine site, which is replaced by red fir over time.
Cryic Lacustrine Flat	R022BI206CA	The lodgepole pine surrounds this cryic meadow at upper elevations.
Frigid Lacustrine Flat	R022BI217CA	The lodgepole pine surrounds this frigid meadow site at lower elevations.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This is a moist white fir-lodgepole pine forest.
Frigid Flat Outwash Terraces	F022BI123CA	This is a lodgepole pine forest with a grassy understory, which is eventually replaced by white fir.
Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	F022BI125CA	This is a lodgepole pine forest found in cold air drainages and drier flats.

Cold Frigid Tephra Over Moraine Slopes	F022BI126CA	This is a lodgepole pine forest with a grassy understory, which is eventually replaced by Jeffrey pine and ponderosa pine.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789236- site location
789307
789309

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	5 E
Section:	32
Datum:	NAD83
Zone:	11
Northing:	4485342
Easting:	631225
General Legal Description:	The type location is about 0.78 miles east of Hat Lake, below Dersch Meadow in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83114485342631225

Relationship to Other Established Classifications:

Forest Alliance = Pinus contorta ssp. murrayana – Lodgepole pine forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/21/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	10/19/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes

Abies magnifica - Pinus jeffreyi / / Arctostaphylos nevadensis - Achnatherum occidentale
(California red fir - Jeffrey pine / / pinemat manzanita - western needlegrass)

Site ID: F022BI109CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Cinder cone, (2) Shield volcano
Elevation (feet): 6,240-8,200
Slope (percent): 10-60
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 27.0-57.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 and 44 degrees F (5 to 6.6 degrees C)
Restrictive Layer: Lithic bedrock
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra from cinder cone volcanoes or in tephra over residuum from andesite
Surface Texture: (1) Very gravelly ashy coarse sand, (2) Ashy coarse sand
Surface Fragments <=3" (% Cover): 18-40
Surface Fragments > 3" (% Cover): 0-25
Soil Depth (inches): 40-60+
Vegetation: California red fir-Jeffrey pine (Abies magnifica-Pinus jeffreyi respectively) forest with pinemat manzanita (Arctostaphylos nevadensis) in the canopy openings. Western white pine (Pinus monticola) replaces Jeffrey pine at the upper elevations of this site.
Notes: This ecological site is located on cinder cone volcanoes or on the side slopes of shield volcanoes.

Physiographic Features

This ecological site is located on cinder cone volcanoes or on the side slopes of shield volcanoes. It is mapped from 6,240 to 8,200 feet in elevation but the majority of the site is found between 6,700 and 8,000 feet. Slopes range from 10 to 60 percent.

Landform:	(1) Cinder cone
	(2) Shield volcano

	Minimum	Maximum
Elevation (feet):	6240	8200
Slope (percent):	10	60
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Low
Aspect:	South East West	

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 between 27 and 57 inches (686 mm to 1,448 mm) and the mean annual temperature ranges between 41 and 44 degrees F (5 to 6.6 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 60 to 190 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	60	190

Mean annual precipitation (inches): 27.0 57.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is not influenced by water features.

Wetland Description: System Subsystem Class

Representative Soil Features

This site is associated with the Ashbutte and Prospectpeak soil components. These soils are deep to very deep, and well drained to somewhat excessively drained. They formed in tephra from cinder cone volcanoes or in tephra over residuum from andesite. They have very low AWC. The surface textures are very gravelly ashy coarse sand and ashy coarse sand. They have coarse subsurface textures with extremely gravelly or stony modifiers. The Prospectpeak soils have a lithic contact between 40 to greater than 60 inches. Permeability is very rapid for the Ashbutte soils. The permeability of the Prospectpeak soils is very rapid to rapid through the upper horizons and very slow through bedrock.

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

Maunit Component Percent
102 Ashbutte 65
102 Prospectpeak 2
109 Prospectpeak 85
110 Prospectpeak 2

Parent Materials:

Kind: Tephra, Residuum
Origin: Volcanic rock

Surface Texture: (1)Very gravelly ashy coarse sand
(2)Ashy Coarse sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	18	40
Surface Fragments > 3" (% Cover):	0	25
Subsurface Fragments <=3" (% Volume):	20	80
Subsurface Fragments > 3" (% Volume):	0	60

Drainage Class: Well drained To Somewhat excessively drained
Permeability Class: Very rapid To Very slow

	Minimum	Maximum
Depth (inches):	40	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.03	3.72

Plant Communities

Ecological Dynamics of the Site

This site is represented by a California red fir-Jeffrey pine (Abies magnifica-Pinus jeffreyi respectively) forest with pinemat manzanita (Arctostaphylos nevadensis) in the canopy openings. Western white pine (Pinus monticola) replaces Jeffrey pine at the upper elevations of this site. In its natural condition this forest has relatively low canopy cover from large old growth California red fir and Jeffrey pine. The understory cover is moderate with a mix of shrubs, forbs and grasses.

The dominance of California red fir (Abies magnifica) in this forest type increases with elevation and northern aspects. California red fir is a tall, long-lived conifer with short branches and a narrow crown. It produces single 0.8 to 1.4 inch needles that are distributed along 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 the trees mature the bark thickens and fire resistance increases.

Jeffrey pine (Pinus jeffreyi) is commonly co-dominant with California red fir in this ecological site. Jeffrey pine produces 3 to 8 inch needles in bundles of three. The female seed cones range from 4.7 to 12 inches in length. Trees produce deep taproots and extensive lateral roots (Gucker, 2007) that 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. They are shade intolerant and can be replaced over time by white fir or California red fir if fire is excluded from the system. Older Jeffrey pines are somewhat adapted to fire because their bark is thick enough to provide protection from moderate intensity fires. Additionally, their branches tend to thin along the lower portion of the tree trunk, leaving the crown 20 to 30 meters above the forest floor.

A study on conifer growth phenology in the Sierra Nevada describes the timing and growth period for several conifer species. The initial growth of California red fir is faster than its associated conifer species, then returns to a slower growth. Temperature is critical in initiating conifer growth after snowmelt. In the study, trees generally started 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 was unusually early, the trees did not begin annual growth until specific air temperatures were reached. It was hypothesized that heavy shrub cover delayed the start of annual growth because shade kept the soil from warming as fast as needed. The pines in the study began leader growth when the air temperatures reached -4 degrees C (24.8 degrees F), and the firs responded after temperatures reached 2 to 3 degrees C (35.6 to 37.4 degrees F). Pines have heavily insulated terminal buds, whereas the terminal buds of fir trees are less insulated and more susceptible to frost damage. The length of the leader growth is predetermined by growth conditions of the prior year. Primordia of fir needles and pine fascicles are developed the year before leader growth. The internode length between fir needles or pine fascicles is determinate, the leader length is determined by the number of primordia developed. It appears that some conifers will not start leader growth until a specific photoperiod (a ratio of light hours to dark hours during one 24 hour period) is met, even if the snow has melted and the temperatures are warm enough. 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, the growing season can be prolonged. Conifer growth ceases with the onset of drought conditions and the decline of water potentials (Royce and Barbour, 2001). This study shows that precipitation and soil and air temperatures are critical for annual growth, with each species having specific tolerance zones. This site is within the tolerance range of California red fir and Jeffrey pine. Western white pine finds appropriate conditions for growth at the upper elevations of this site, and white fir is adapted at the lower elevations.

This site receives 42 inches average annual precipitation, mostly in the form of snow in winter. As the snow melts it fills macropores in the soil with water. Soil characteristics such as depth and texture determine how much water the soil can hold and how long it will remain before filtering through, evaporating away, or being lost to evapotranspiration. The soils associated with this site have very low to low water holding capacities. Under the same climatic conditions, drought would come earlier to these soils than those with higher water holding capacities. As this site experiences early drought conditions, these trees have a short growing season.

In the year 2000 Alan Taylor published a report on the historic fire regimes of several forest types in relation to aspect on Prospect Peak. A large portion of this ecological site is located on the south and south-eastern side of Prospect Peak between the Jeffrey pine-white fir forests at the lower elevations and the red fir-western white pine forests at the upper elevations. In Taylor’s report fire regimes were determined by dating wood cross sections from fire scarred trees or by examining radial growth changes in tree cores. Between the years of 1546 and 1903, the point fire return interval for Jeffrey pine-white fir forests ranged from 15.5 to 38 years, with a mean of 29.8. The point fire return interval for red fir-western white pine forests between the years of 1685 and 1937 ranged from 26 to 109, with a mean of 70 (Taylor, 2000). Fire return intervals were shorter on the eastern slopes than on the southern and western slopes. Data was not analyzed for the northern slopes, which extend beyond the park boundary. Some of the variation in the fire return interval was attributed to the un-vegetated areas of Fantastic Lava Beds, Painted Dunes and Cinder Cone, which lie to the south. These formations do not provide fuel sources and act as a fire barrier. This red fir-Jeffrey pine ecological site probably has a fire return interval between the means listed above (30 to 70 years) or shorter, if on an eastern aspect. In a separate study, Beaty and Taylor report that fire return intervals are longer on north facing slopes than on south facing slopes. This report also states that 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). Fire size on Prospect Peak between the years of 1627 and 1904 ranged from 39 to 1537 ha, with a mean of 457 ha. The larger fires generally occurred in the Jeffrey pine forests (Taylor, 2000).

Taylor reports a significant drop in fire frequency and a corresponding increase in understory fuels and canopy cover after 1905. This change developed more quickly in the lower Jeffrey pine-white fir forests than in the upper elevation red fir-western white pine forests. Natural fire regimes reflect the time it takes for forests to naturally develop fuels sufficient to carry fire. At the upper elevations in a red fir dominated forest, fuel accumulation is slower, more compact, and the fuels remain moist for longer during the summer, thereby reducing the risk of fire. Red fir seedlings develop slower than white fir seedlings due to physiographic characteristics and climatic variables, so ladder fuels take longer to develop in red fir forests. If a natural fire regime is 70 years (as for red fir-western white pine forests) then the impact of missing 1 fire cycle in 100 years will be less significant than a forest with a 30 year fire regime that has missed 3 fire cycles. If fire cycles continue to be passed, stand density and fuel loads will increase to levels that put forests at risk of disease and severe canopy fire. The suppression of fire cycles can also create a change in species composition by allowing fire intolerant and shade tolerant firs to increase in cover and density, eventually out-competing fire tolerant and shade intolerant pines (Taylor and Solem, 2001).

Most of the forest within the present park boundary was never logged, but fire suppression has created a change in the stand structure and composition. With a natural fire regime an open forest and the presence of Jeffrey pine or western white pine is encouraged. Low to moderate intensity fires maintain an open forest, with patches of montane shrubs and forbs in the canopy openings. In the absence of fire, California red fir continues to regenerate in the understory, increasing forest density and fuels.

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 may 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 into more open forest types. Large outbreaks are often associated with drought years or overstocked forests. Fuel loads are frequently high after outbreaks, creating ideal conditions for high intensity fires.

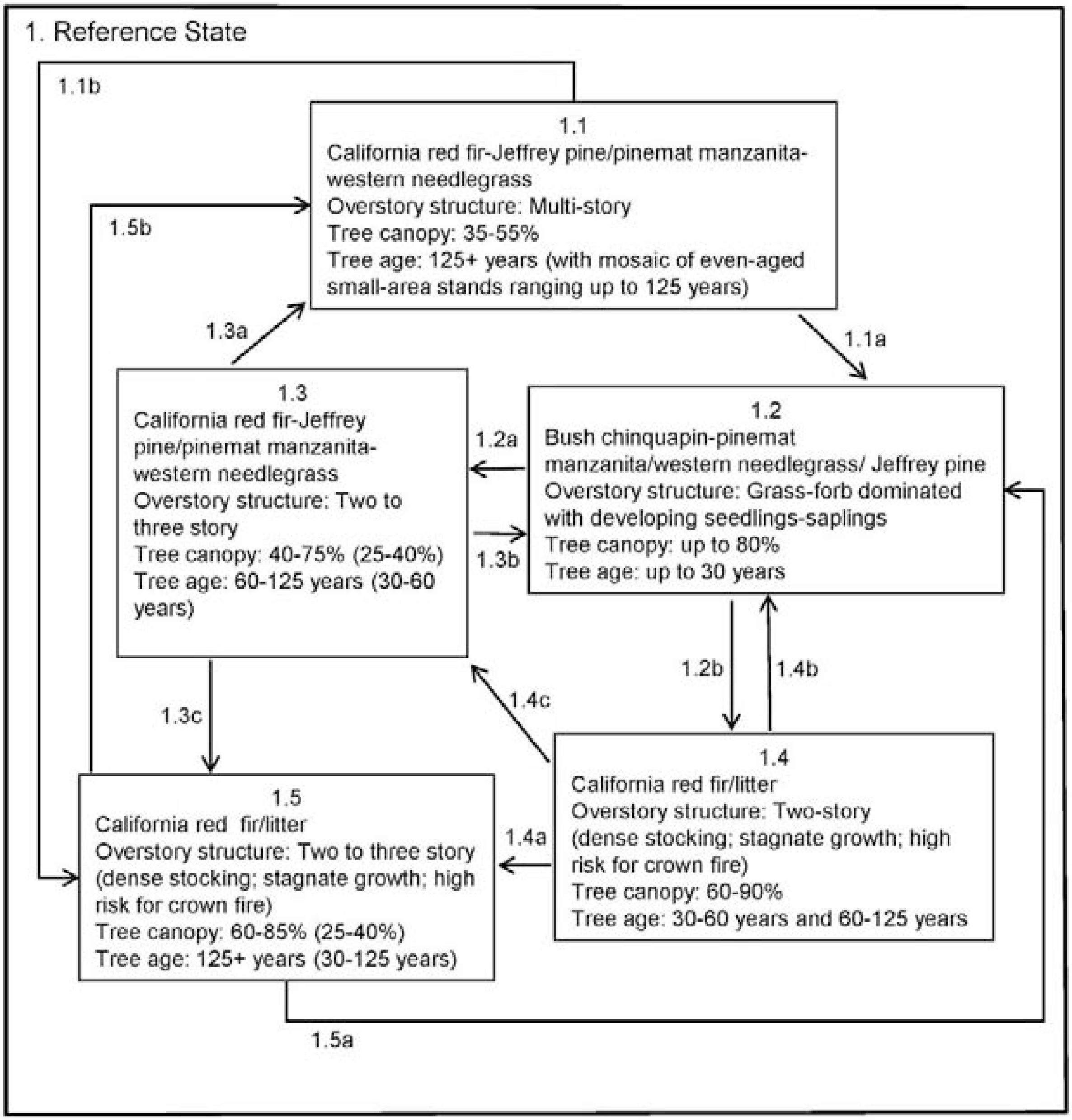
Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. Pathogens that affect Jeffrey pine in this area are the dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle (Dendroctonus 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).

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 (Heterobasidium 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).

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 Diagram

State-Transition Model - Ecological Site F022BI109CA
Abies magnifica-Pinus jeffreyi/Arctostaphylos nevadensis-Achnatherum occidentale
(California red fir-Jeffrey pine/pinemat manzanita-western needlegrass)



Reference - State 1

California red fir-Jeffrey pine/pinemat manzanita-western needlegrass - Community Phase 1.1


Red fir-Jeffrey pine forest

This community phase is the interpretive plant community phase. It is difficult to find a site representative of the historic conditions because the density of understory fir has increased since the practice of fire suppression. Had there been a natural fire regime this community phase would likely represent a more open forest. This forest is presently dominated by mature California red fir and Jeffrey pine. Bush chinquapin (Chrysolepis sempervirens) and pinemat manzanita (Arctostaphylos patula) are present in canopy openings. Western white pine begins to replace Jeffrey pine at the upper elevations, and white fir replaces a portion of the red fir at the lower elevations.

This community phase is maintained by low and moderate intensity fires that remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires can kill some of the overstory trees as well, leaving canopy openings that are favorable for Jeffrey pine and shrub regeneration. Moderate intensity fires therefore breakup the uniformity of the older stands with pockets of young forests intermixed.

Community Phase Pathway 1.1a

In the event of a severe fire there may be significant tree mortality, leaving a relatively short duration scorched landscape with many standing dead trees. The community phase eventually infills mainly with shrubs and some trees (Community Phase 1.2).

Community Phase Pathway 1.1b

If fire is excluded from the old growth community phase, red fir will continue to regenerate in the understory, increasing tree density and shifting this community phase toward the closed red fir-Jeffrey pine forest(Community Phase 1.5).

California red fir-Jeffrey pine/pinemat manzanita-western needlegrass Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**5**		
		rockcress	ARABI2	*Arabis*	0	5	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**10**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	10	0	3

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**5**	**145**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	5	65	1	15
		little prince's pine	CHME	*Chimaphila menziesii*	0	5	0	1

		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	0	45	0	10
		mountain monardella	MOOD	*Monardella odoratissima*	0	20	0	10
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	5	0	1
		Sierra gooseberry	RIRO	*Ribes roezlii*	0	5	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**10**	**50**		
		California red fir	ABMA	*Abies magnifica*	10	30	1	3
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	20	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	5	10
Forb	0	0	5
Shrub/Vine	5	100	145
Tree	10	30	50
Total:	15	135	210

Structure and Cover:

Ground Cover

Vegetative Cover	**Minimum**	**Maximum**
Grass / Grasslike	0%	3%
Forb	0%	8%
Shrub/ Vine	1%	25%
Tree	35%	55%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	40%	80%
Surface Fragments > 0.25" and <= 3"	15%	40%
Surface Fragments > 3"	0%	25%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	2%	10%

Forest Overstory:
This is an open forest dominated by California red fir. The canopy cover of red fir ranges from 18 to 40 percent. Jeffrey pine cover ranges from 1 to 18 percent. Combined canopy cover ranges from 35 to 55 percent. The main canopy trees are between 90 to 110 feet tall. Basal area ranges from 135 to 270 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	45	55

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	18.0	40.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	1.0	18.0						

Forest Understory:
Since the forest canopy is fairly open, pinemat manzanita (Arctostaphylos nevadensis) and bush chinquapin (Chrysolepis sempervirens) are present with fair cover. Other common species are western needlegrass (Achnatherum occidentale), rockcress (Arabis spp.), little prince's pine (Chimaphila menziesii), mountain monardella (Monardella odoratissima), white vein shinleaf (Pyrola picta), and Sierra gooseberry (Ribes roezlii).

There is 1 to 3 percent cover from red fir and Jeffrey pine saplings.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	3.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
rockcress *Arabis*	ARABI2	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	1.0	15.0		
little prince's pine	CHME	N	0	1.0		

Chimaphila menziesii				
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	0	10.0
mountain monardella *Monardella odoratissima*	MOOD	N	0	4.0
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	1.0
Sierra gooseberry *Ribes roezlii*	RIRO	N	0	1.0

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	1.0	3.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	2.0		

Bush chinquapin-pinemat manzanita/western needlegrass/Jeffrey pine - Community Phase 1.2

This community phase develops when the majority of the overstory trees succumb to a high intensity canopy fire. There may be a few surviving overstory trees, which become an important seed source for regeneration. The mature Jeffrey pines have thicker bark and higher tree branches than California red fir and are more likely to survive a fire and supply seed for regeneration. Because Jeffrey pine seedlings germinate well in full sun and mineral soils after fire and California red fir prefers partial shade, Jeffrey pine has an advantage in this early phase of regeneration which assures their existence and prevalence in older stands.

Bush chinquapin (Chrysolepis sempervirens) can resprout from the roots, root crown, or the stump after it has been top-killed by fire. It can also regenerate from seed, but there is little data about seed dormancy or storage.

A flush of native perennial grasses and forbs is possible for the first several years after a burn. Pinemat manzanita does not sprout after fire but re-establishes from seed.

Community Phase Pathway 1.2a

The natural pathway is to Community Phase 1.3, a young open red fir-white fir-Jeffrey pine forest. This pathway is followed with natural fire regime. Manual thinning with prescribed burns can imitate the natural cycle and lead to the same open community phase.

Community Phase Pathway 1.2b

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

California red fir-Jeffrey pine/pinemat manzanita-western needlegrass - Community Phase 1.3

This forest community phase develops with natural fire regimes, or with manual thinning and prescribed fires. Low to moderate intensity fires clear the understory and remove fuels before they reach hazardous levels, although severe high-intensity canopy fires are also possible. Since

Jeffrey pine establishes early during stand regeneration, it has a fair percentage of cover in the upper canopy but has difficulty regenerating or growing well in the canopy understory. Its growth and presence is dependent upon fire or other disturbances to maintain an open forest structure with canopy openings.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of relatively frequent surface and moderate severity fires, and/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 reference community phase 1.1.

Community Phase Pathway 1.3b
In the event of a canopy fire this community would return to Community Phase 1.2, forest regeneration.

Community Phase Pathway 1.3c
If fire does not occur, forest density increases. This may favor California red fir over Jeffrey pine. The increased density shifts this community phase toward the closed California red fir forest (Community Phase 1.5).

California red fir/litter - Community Phase 1.4
This community phase is defined by a dense canopy and a high basal area of California red fir developing in the understory, although there may be some Jeffrey pine in the understory as well. The upper canopy is dominated by California red fir and Jeffrey pine. Canopy cover ranges from 60 to 90 percent. The trees are becoming overcrowded with indications of disease and stress due to competition for water and nutrients. This stress makes the trees more susceptible to death from infestation and drought. Fire hazard is high in this community, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a
If fire continues to be excluded from this system the mature closed red fir-Jeffrey pine forest develops (Community Phase 1.5).

Community Phase Pathway 1.4b
At this point the density of ground fuels and ladder fuels formed in the mid-canopy create conditions for a high intensity canopy fire. A severe fire would initiate conifer regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c
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. Prescribed burns or manual treatments to thin out the white fir and other fuels in the understory could be implemented to shift this forest back to its natural state of an open red fir-Jeffrey pine forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community

Phase 1.3.

California red fir/litter - Community Phase 1.5

The mature closed red fir-Jeffrey pine forest develops with the continued exclusion of fire and a subsequential increase in tree density in the understory layers. Competition for water and sunlight continues, and tree health and vigor decreases. Disease and mortality from diverse causes is common, leaving numerous snags and thick layers of down wood and debris. California red fir is heavily dominant in both the overstory and understory canopy layers. The understory vegetation is almost non-existent due to the lack of sunlight and deep accumulation of litter on the forest floor.

Community Phase Pathway 1.5a

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

Community Phase Pathway 1.5b

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. Prescribed burns or manual treatments to thin out the understory trees and other fuels could be implemented to shift this forest back to its natural state of an open red fir-Jeffrey pine forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1, but tree mortality will increase the already high fuel amounts.

Ecological Site Interpretations

Forest 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*	37	50	126	171	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.
Jeffrey pine	*PIJE*	75	78	62	66	45	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:

Red fir-Jeffrey pine forests provide browse, cover and nesting sites for a variety of wildlife species. The type and quality of the wildlife habitat varies with the community type. Mature open forests, closed dense forests, young forests and shrub lands each provide different habitats and forage for wildlife. Douglas squirrels cut and cache fir cones before the cones are fully mature. Cavity-nesting birds utilize holes in snags and dying trees for their nests, while ground nesting birds and animals find homes in the fallen trees. Deer and bear browse the leaves of these conifers in winter and the new growth in the spring. Porcupines eat the bark of fir and can kill saplings. Birds forage for insects in the foliage of mature conifers

Animals that use California red fir forests include: martin, fisher, wolverine, black bear, squirrels, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, mountain beaver, and pocket gopher (Cope, 1993).

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, deer mice, and yellow-pine chipmunks.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area is suitable for hiking trails.

Wood Products:
Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber (Gucker, 2007).

The wood from California red fir is straight-grained and light. California red fir wood 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).

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:
Jeffrey pine pathogens:

Infections from western dwarf mistletoe (Arceuthobium campylopodium) cause witches brooms, reduced growth and tree mortality. Sticky seeds are spread in fall and infest nearby and understory trees. In years of severe drought dwarf mistletoe has induced 60 to 80 percent of the Jeffery pine mortality (Burns et al., 1990).

Jeffrey pine bark beetles (Dendroctonus jeffreyi) are native beetles that can only reproduce in Jeffrey pine. They are a natural cycle in maintaining forest health. They generally attack older weaker trees, but in times of drought or other disturbances such as lightning or fire, epidemic levels can break out and cause extensive damage to the forest. These beetles infest the lower stem and bole of the trees, usually after pine engraver (Ips pini) infestations in the upper portion of the tree. The beetles slowly destroy the cambium, inhibiting the flow of nutrients. A sign of infestation is the changing color of the pine needles from green to yellow or reddish brown, beginning from the top down (Hagle et al., 2003; Smith, 1971).

Forest Pathogens that affect Red fir:

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) spreads from infected roots to healthy roots and 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 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 bring about extensive damage to red fir forests with outbreaks causing mortality to several acres of trees. Epidemic levels of damage can be reached when the trees are stressed from drought, annosus root rot, dwarf mistletoe, or fire (Burns, et al., 1990).

Site index documentation:

Schumacher (1928) and Meyer (1961) were used to determine forest site productivity for red fir and Jeffrey pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phases 1.3.

They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Very Deep Cinder Cone Or Shield Volcano Slopes	F022BI114CA	This site has similar vegetation but is more open because it associated with volcanic rubble.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Moderately Deep Slopes	F022BI107CA	This site is a red fir-white fir-Jeffrey pine forest.
Frigid And Cryic Gravelly Slopes	F022BI115CA	This is a red fir-western white pine forest.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789112- site location
789121
789201
789119- closed red fir forest

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	6 E
Section:	8
Datum:	NAD27
Zone:	10
Northing:	4491713
Easting:	641717
General Legal Description:	The type location is about 1 mile north-northwest of Cinder Cone on the eastern slope of Prospect Peak.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	

Universal Transverse Mercator (UTM) system: NAD27104491713641717

Relationship to Other Established Classifications:
Forest Alliance = Abies magnifica - Red fir forest; Associations = Abies magnifica/Arctostaphylos nevadensis. (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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/16/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Humic Loamy Gentle Slopes

Abies concolor - *Calocedrus decurrens* / *Ceanothus cordulatus* / *Achnatherum*
(white fir - incense cedar / whitethorn ceanothus / needlegrass)

Site ID: F022BI110CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Glacial-valley walls, (2) Strath terrace, (3) Outwash terrace
Elevation (feet): 5,256-7,410
Slope (percent): 2-80, but generally 2-40
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 43.0-91.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41-43 degrees F (5- 6 degrees C)
Restrictive Layer: Dense till, duripan or bedrock
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Colluvium, outwash, glacial till, or in alluvium over residuum from volcanic rocks
Surface Texture: (1) Extremely gravelly medial fine sandy loam, (2) Gravelly ashy sandy loam, (3) Gravelly medial sandy loam
Surface Fragments <=3" (% Cover): 29-85
Surface Fragments > 3" (% Cover): 0-10
Soil Depth (inches): 20-60+
Vegetation: Large mature white fir (Abies concolor), Jeffrey pine (Pinus jeffreyi), incense cedar, (Calocedrus decurrens) and sugar pine (Pinus lambertiana). The reference community phase is similar to the historic community phase but has become denser since the practice of fire suppression. The understory contains a sparse cover of forbs, graminoids and shrubs.

Notes: This white fir-mixed conifer community phase is found at the lowest elevations in the southeast corner of Lassen Volcanic National Park.

Physiographic Features

This site is found on back slopes of glacial-valley walls, colluvial aprons and landslides, strath terraces, outwash terraces, stream terraces and moraines. This site is generally found between 5,200 and 6,500 feet in elevation but is mapped higher in some areas. This site is on slopes that range from 2 to 40 percent, but is associated with map units with up to 80 percent slopes.

Landform: (1) Glacial-valley walls
(2) Strath terrace
(3) Outwash terrace

	Minimum	Maximum
Elevation (feet):	5256	7410
Slope (percent):	2	40
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	High
Aspect:	South East West	

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 between 43 to 91 inches (1,092 to 2,300 mm) and the mean annual temperature is about 42 degrees F (5.5 degrees C). The frost free (>32 degrees F) season is 70 to 90 days. The freeze free (>28 degrees F) season is 85 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	60	90

Freeze-free period (days):	70	200
Mean annual precipitation (inches):	43.0	91.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the following soil components: Kingsiron; Juniperlake, bouldery; Humic Haploxerands, strath terrace; Humic Haploxerands, colluvium; Humic Haploxerands, stream terrace and Humic Haploxerands, outwash terrace. These soils are moderately deep to very deep, well drained, with very low to low AWC. They formed in colluvium, outwash, glacial till, alluvium or in alluvium over residuum from volcanic rocks. The surface textures are gravelly medial sandy loam, extremely gravelly medial fine sandy loam, or gravelly ashy sandy loam, with coarse subsurface textures. Permeability is generally rapid to very rapid through these soils unless dense till or bedrock is encountered then permeability is slow to moderate or very slow respectively.

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

Map unit, Component, Percent
126 Kingsiron, 45
127 Humic Haploxerands, strath terrace, 65
127 Humic Haploxerands, colluvium, 5
129 Humic Haploxerands, colluvium, 80
129 Kingsiron, 10
129 Humic Haploxerands, strath terrace, 2
160 Humic Haploxerands, stream terrace, 35
164 Humic Haploxerands, strath terrace, 1

166 Humic Haploxerands, outwash terrace, 40
166 Juniperlake, 4
166 Humic Haploxerands, strath terrace, 3
176 Juniperlake, 85
176 Humic Haploxerands, outwash terrace, 3

Parent Materials:
Kind: Colluvium, Outwash, Till
Origin: Volcanic rock
Surface Texture: (1) Extremely gravelly medial fine sandy loam
(2) Gravelly ashy sandy loam
(3) Gravelly medial sandy loam
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	29	85
Surface Fragments > 3" (% Cover):	0	10
Subsurface Fragments <=3" (% Volume):	30	85
Subsurface Fragments > 3" (% Volume):	0	40

Drainage Class: Well drained To Well drained
Permeability Class: Very rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.0	6.8
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.7	3.2

Plant Communities

Ecological Dynamics of the Site

The reference community phase is composed of large mature white fir (Abies concolor), Jeffrey pine (Pinus jeffreyi), incense cedar, (Calocedrus decurrens) and sugar pine (Pinus lambertiana). The reference community phase is similar to the historic community phase but has become denser since the practice of fire suppression. The understory contains a sparse cover of forbs, graminoids and shrubs. This white fir-mixed conifer community phase is found at the lowest elevations in the southeast corner of Lassen Volcanic National Park.

White fir is the most abundant tree in these forests. White fir produces single needles that are 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 that can graft to other white fir roots and spread root rots (Zouhar, 2001).

Jeffrey pine is commonly co-dominant with white fir. Jeffrey pine produces 3 to 8 inch needles in bundles of three. The female seed cones range from 4.7 to 12 inches in length. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007) that 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. Jeffrey pine is shade intolerant and can be replaced over time by white fir if fire is excluded from the system. Older Jeffrey pines are somewhat adapted to fire because their bark is thick enough to provide protection from moderate intensity fires. Additionally, their branches tend to thin along the lower portion of the tree trunk, leaving the crown 65 to 100 feet above the forest floor.

Incense cedar is a common component in these forests but is never dominant. It produces scale-like leaves that are overlapped and arranged in flattened branches. The cones are small and oblong, ranging from 0.8 to 1.5 inches in length, and hang from the end of the branches (Habeck, 2008). The cones open to 3 parts, somewhat resembling an upside down tulip. Incense cedar is a slower growing species than white fir or Jeffrey pine, but it is shade tolerant and can become dense in the understory in the absence of fire. Young incense cedar is fire intolerant because of its very flammable leaves and fibrous bark. Young trees are usually killed by fire but the thicker bark on older trees provides for more protection (Habeck, 2008). Incense cedar seedlings are slow to develop a deep taproot in the first year and reach about half the length of those comparable for Jeffrey pines, initially permitting the Jeffrey pine to out-compete the incense cedar. After the first year however, incense cedar root lengths are equivalent to Jeffrey pine and other species and eventually develop an extensive spreading root system (Powers and Oliver, 1990).

Sugar pine is not often a dominant tree in these forests, but it is very noticeable because it is frequently the largest in diameter and occasionally an emergent tree above the upper canopy. It has broad sweeping branches with 12 inch long cones dangling from the outer ends. The pine needles are in clusters of 5 and are about 3 inches long. Sugar pine germinates best on mineral soil in sunlight, and seedlings quickly develop a deep tap root. Sugar pine seedlings grow slowly, but growth rates increase after the seedling stage. Sugar pine becomes more shade intolerant with age.

Several factors combine to create a habitat suitable for white fir and Jeffrey pine growth. A study on conifer phenology in the Southern Sierra Nevada describes the environmental factors that affect the initiation and seasonal growth of several species. Jeffrey Pine and white fir are included within this study. Temperature is critical in initiating conifer growth after snowmelt. In the study, trees generally started 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 was unusually early, the trees did not begin annual growth until specific air temperatures were reached. It was hypothesized that heavy shrub cover delayed the start of annual growth because the shade kept the soil from warming. The pines in the study began leader growth when the air temperatures reached -4 degrees C (24.8 degrees F), and the firs responded after temperatures reached 2 to 3 degrees C (35.6 to 37.4

degrees F). Pines have heavily insulated terminal buds, whereas the terminal buds of fir trees are less insulated and more susceptible to frost damage. The length of the leader growth is predetermined by growth conditions of the prior year. Primordia of fir needles and pine fascicles are developed the year before leader growth. The internode length between fir needles or pine fascicles is determinate. Therefore leader length is determined by the number of primordia developed. It appears that some conifers will not start leader growth until a specific photoperiod (a ratio of light hours to dark hours during one 24 hour period) is met, even if the snow has melted and the temperatures are warm enough. 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).

This site receives 55 inches average annual precipitation, mostly in the form of snow in winter. As the snow melts it fills macropores in the soil with water. Soil characteristics such as depth and texture determine how much water the soil can hold and how long it will remain before filtering through, evaporating away, or being lost to evapotranspiration. The soils associated with this site have very low to low water holding capacities. Under the same climatic conditions, drought would come earlier to these soils than those with higher water holding capacities. The trees on this site have a short growing season due to the duration of snow and early drought conditions.

Most of the forest within the present park boundary was never logged, but fire suppression has created a change in the stand structure and composition. Historically, with a natural fire regime, this forest would most likely be dominated by large Jeffrey pine and sugar pine in the overstory with a lesser component of white fir and incense cedar. Low to moderate intensity fires would maintain an open forest with patches of montane shrubs, forbs and grasses in the canopy openings. In the absence of fire, white fir would continue to regenerate in the understory, increasing forest density and fuels. Today the forest is multilayered, dense and shady, dominated by white fir. Vegetation on the forest floor is almost nonexistent.

Fire regime studies, using tree rings and fire scars, report historic median fire return intervals in Jeffrey pine-white fir forests of 14, 18.8, and 70 years (Bekker and Taylor; Skinner and Chang; Taylor and Solem respectively). Beaty and Taylor report that fire frequency and intensity is additionally associated with slope position, aspect, and climatic fluctuations. Fire return intervals are longer for north facing slopes than for south facing slopes, and fire intensity increases from lower slopes to upper slope positions. Their study also indicates a slightly later burn season in the Southern Cascades than in the Sierra Nevada. The fire scars in the Southern Cascade are primarily found at the annual tree ring boundary, signifying that the trees were dormant at the time of the fire, whereas in the Sierra Nevada fires, scars are often found in the late-season wood. This timing shift may be due to the timing of summer drought conditions, which begin earlier in the south. In July and August, thunderstorms are common in Lassen Volcanic National Park and the 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). Beaty and Taylor report that 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 (Beaty and Taylor, 2001). After a stand replacing fire, evenly aged forests are formed. The current management practice of fire suppression has shifted forest density and composition. Fire suppression creates 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 and 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. Although small infestations may affect relatively few trees, large outbreaks may kill the dominant trees over large areas of forest, creating large canopy openings and stand regeneration. Most of these pathogens and infestations are natural cycles of regulation and can push the closed forest types to more open forests. Fuel loads are often high after outbreaks, creating ideal conditions for high intensity fires.

Pathogens that affect white fir are the dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melampsorella 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).

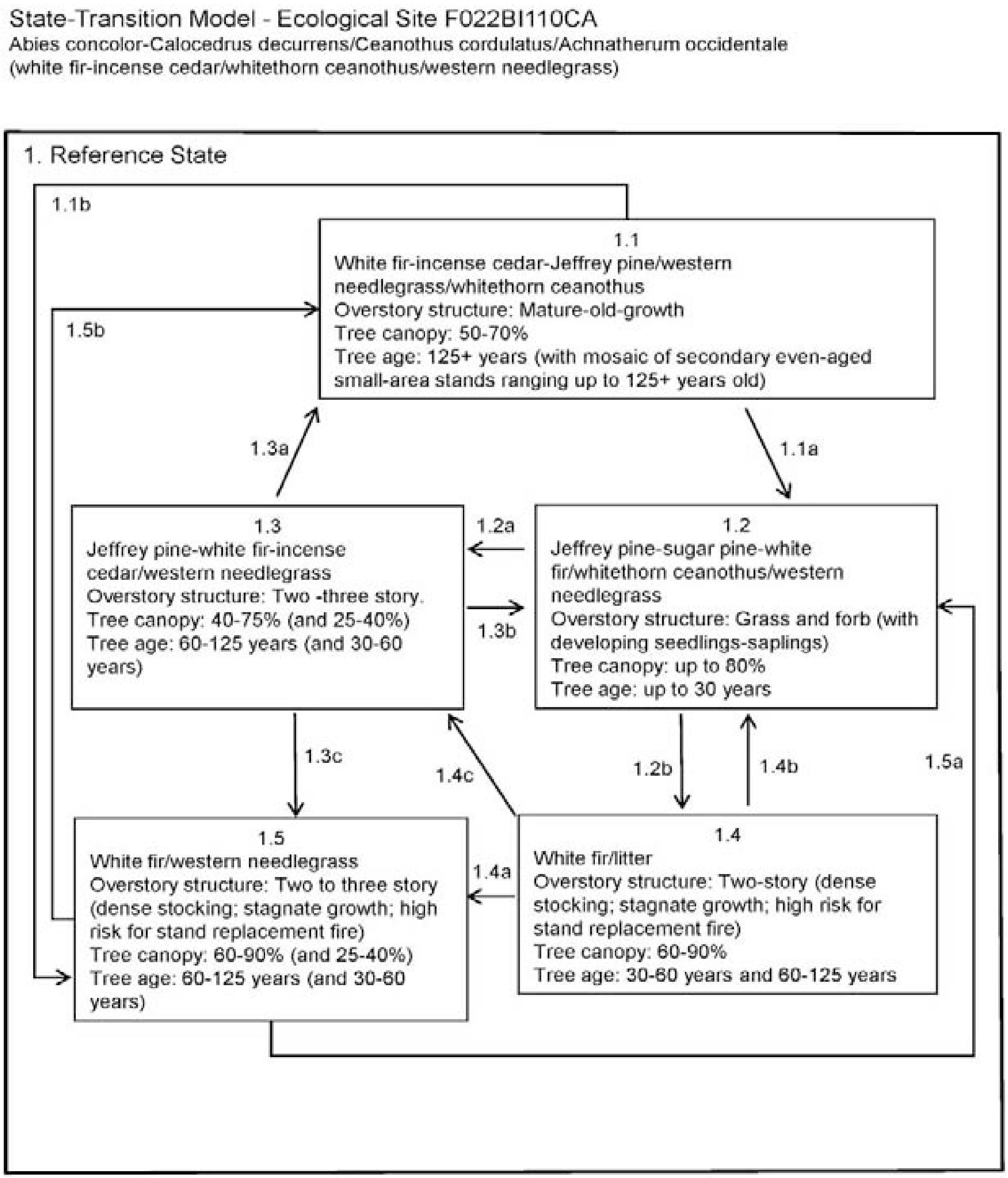
Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. Pathogens that affect Jeffrey pine in this area are the dwarf mistletoe (Arceuthobium campylopodum), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle, (Dendroctonus 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).

The most destructive pathogen for incense cedar is pocket dry rot (Tyromyces amarus). Trees are generally infected when the mycelium is able to enter in areas where the bark has been removed by fire, mechanical injury, or other processes. Root diseases are to blame for the majority of incense cedar mortalities. The major root diseases are annosus root disease (Heterobasidium annosum), Armillaria root disease (Armillaria sp.), and laminated root rot (Phellinus weirii) (Powers and Oliver, 1990).

The major pathogens that affect sugar pine (Pinus lambertiana) are white pine blister rust (Cronartium ribicola) and bark beetles (Dendroctonus ponderosae and Ips species). White pine blister rust is an introduced fungus that causes cankers that girdle and eventually kill the infected tree. This fungus is a serious threat to all 5 needle pines but especially sugar pine. White pine blister rust kills old, young, and seedling trees. It can severely inhibit regeneration in infested areas, almost eliminating sugar pine from those areas. The mountain pine beetle (Dendroctonus ponderosae) can cause widespread mortality as well. Please see the section titled Other Information for further details about the tree pathogens mentioned above.

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 Diagram



Reference - State 1

White fir-incense cedar-Jeffrey pine/western needlegrass/whitethorn ceanothus - Community Phase 1.1

White fir- mixed conifer forest

This is the reference community phase for this ecological site, comprising a multi-tiered forest of white fir, Jeffrey pine, sugar pine, and incense cedar. This community phase develops 150 to 300 years after a major disturbance event such as fire. The trees are large with wide reaching canopies. White fir and Jeffrey pine dominate, with several large sugar pines and incense cedars.

This forest develops with frequent low intensity fires or occasional small high severity fires that either remove understory trees or create small openings in the forest for gap regeneration. This community phase needs a continued disturbance from low intensity fires to maintain the open understory and reduce competition between the trees for water, nutrients, and sunlight.

It is difficult to find a representative site for this community phase because most of the area has missed several fire rotations, resulting in high cover of white fir in the understory. The photo for this community phase is from the type location, which does have several large Jeffrey pine, white fir and sugar pines in the overstory, but the dense understory of white fir is visible. This photo accurately represents a forest on a pathway to the closed white fir forest (Community Phase 1.5).

Community Phase Pathway 1.1a

The primary threat to a white fir–mixed conifer forest is a severe canopy fire. In the event of a severe canopy fire this community phase would return to the regeneration community phase (Community Phase 1.2).

Community Phase Pathway 1.1b

If fire is excluded from the old growth community phase, tree density continues to increase and shifts the community phase toward the closed white fir forest (Community Phase 1.5).

White fir-incense cedar-Jeffrey pine/western needlegrass/whitethorn ceanothus Plant Species Composition:

Forb

					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
0 -Forb					**0**	**11**		
		spreading groundsmoke	GADI2	*Gayophytum diffusum*	0	1	0	1
		white hawkweed	HIAL2	*Hieracium albiflorum*	0	10	0	6

Grass/Grasslike

					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
0 -Grass/Grasslike					**2**	**83**		
		needlegrass	ACHNA	*Achnatherum*	2	48	1	30
		California brome	BRCA5	*Bromus carinatus*	0	20	0	5
		Orcutt's brome	BROR2	*Bromus orcuttianus*	0	2	0	1
		Brainerd's sedge	CABR7	*Carex brainerdii*	0	2	0	1
		Ross' sedge	CARO5	*Carex rossii*	0	5	0	4
		squirreltail	ELEL5	*Elymus elymoides*	0	6	0	3

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
0 -Shrub					**0**	**368**		
		whitethorn ceanothus	CECO	*Ceanothus cordulatus*	0	100	0	20
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	18	0	12
		huckleberry oak	QUVA	*Quercus vacciniifolia*	0	150	0	15
		Sierra gooseberry	RIRO	*Ribes roezlii*	0	100	0	10

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
0 -Tree (understory only)					**1**	**25**		
		white fir	ABCO	*Abies concolor*	1	10	1	5
		incense cedar	CADE27	*Calocedrus decurrens*	0	3	0	3
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	6	0	3
		sugar pine	PILA	*Pinus lambertiana*	0	6	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	2	31	83
Forb	0	5	11
Shrub/Vine	0	31	368
Tree	1	16	25
Total:	3	83	487

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	1%	40%
Forb	0%	19%
Shrub/ Vine	0%	35%
Tree	50%	75%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**

Litter	50%	80%
Surface Fragments > 0.25" and <= 3"	30%	80%
Surface Fragments > 3"	0%	10%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	0%	2%

Forest Overstory:

Canopy cover ranges from 50 to 70 percent. The structure in this old growth mixed conifer forest is complex, including scattered or clumped trees larger than 30 inches dbh and exceeding 120 feet in height. White fir and Jeffrey pine co-dominate, with a significant portion of sugar pine in the upper canopy. The dominant trees on this site may be 300 to 500 years old. There are two to three understory layers dominated by white fir and incense cedar.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	50	55	70

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	26.0	40.0						
incense cedar *Calocedrus decurrens*	CADE27	N	4.0	10.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	9.0	15.0						
sugar pine *Pinus lambertiana*	PILA	N	11.0	15.0						

Forest Understory:

The understory is relatively sparse, having an average of 10 percent cover. Grasses generally dominate with a few forbs and shrubs. Common plants include: needlegrass (Achnatherum spp.), California brome (Bromus carinatus), Orcutt's brome (Bromus orcuttianus), Brainerd's sedge (Carex brainerdii), Ross' sedge (Carex rossii), whitethorn ceanothus (Ceanothus cordulatus), squirreltail (Elymus elymoides), naked buckwheat (Eriogonum nudum), spreading groundsmoke (Gayophytum diffusum) and Sierra gooseberry (Ribes roezlii).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
needlegrass *Achnatherum*	ACHNA	N	1.0	30.0		
California brome	BRCA5	N	0	5.0		

Bromus carinatus				
Orcutt's brome *Bromus orcuttianus*	BROR2	N	0	1.0
Brainerd's sedge *Carex brainerdii*	CABR7	N	0	1.0
Ross' sedge *Carex rossii*	CARO5	N	0	4.0
squirreltail *Elymus elymoides*	ELEL5	N	0	3.0

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
spreading groundsmoke *Gayophytum diffusum*	GADI2	N	0	1.0		
white hawkweed *Hieracium albiflorum*	HIAL2	N	0	6.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
whitethorn ceanothus *Ceanothus cordulatus*	CECO	N	0	20.0		
naked buckwheat *Eriogonum nudum*	ERNU3	N	0	12.0		
huckleberry oak *Quercus vacciniifolia*	QUVA	N	0	15.0		
Sierra gooseberry *Ribes roezlii*	RIRO	N	0	10.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	1.0	5.0		
incense cedar *Calocedrus decurrens*	CADE27	N	0	3.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	3.0		
sugar pine *Pinus lambertiana*	PILA	N	0	3.0		

Jeffrey pine-sugar pine-white fir/whitethorn ceanothus/western needlegrass - Community Phase 1.2

White fir- mixed conifer regeneration community

This community phase develops when the majority of the overstory trees succumb to a high intensity canopy fire. There may be a few surviving overstory trees, which become an important seed source for regeneration. The mature Jeffrey pine and sugar pines have thicker bark and higher tree branches than white fir and incense cedar and are more likely to survive a fire and supply seed for regeneration. Because Jeffrey pine and sugar pine seedlings germinate well in full sun and mineral soils after fire and white fir and incense cedar prefer partial shade, the pines have an advantage in this early phase of regeneration which assures their existence and prevalence in older stands.

Whitethorn ceanothus (Ceanothus cordulatus) is the dominate shrub in this area, and is dependent upon fire for regeneration. It produces abundant seeds which accumulate over the years near the source. The seeds generally remain dormant until fire scarifies the seed coat. Fire scarification followed by a period of cold scarification creates maximum germination rates. It also resprouts from the lignotuber after fire. (Reeves, 2006).

Cover from native cool season bunch grasses may be up to 30 percent after a fire. Western needlegrass (Achnatherum occidentale), Columbia needlegrass (Achnatherum nelsonii), squirreltail (Elymus elymoides), California brome (Bromus carinatus), and Orcutt's brome (Bromus orcuttianus) were documented in this area. These grasses are somewhat resistant to fire, because they are generally only top-killed and can regenerate from the root crown after fire.

They also regenerate from on or off-site seed.

The photo for this community phase is from a prescribed fire that caused mortality in the overstory trees. There is a high cover of grasses after this burn.

Community Phase Pathway 1.2a
1.2a. The natural pathway is to community phase 1.3, the Young Open White Fir-Mixed Conifer Forest. This pathway is followed with natural fire regime. Reports vary on the natural fire return interval; this pathway assumes a relatively frequent surface fire interval of 4 to 12 years. Manual thinning with prescribed burns can imitate the natural cycle and lead to the same open community.

Community Phase Pathway 1.2b
An alternate pathway is created when fire is excluded from the system and leads to the Young Closed White Fir-Mixed Conifer Forest (Community Phase 1.4).

Forest Overstory:
The overstory trees can be completely absent, or a few surviving trees may provide up to 10 percent canopy cover.

Forest Understory:
The understory is dominated by grasses for a short duration, and the cover of whitethorn ceanothus increases over the first 5 years. Initially young Jeffrey pine and sugar pine seedlings are abundant. There may be a high mortality rate but enough survive to develop a new forest. White fir and incense cedar establish secondarily, in the shade of the young pines. Grass cover may be high including: western needlegrass (Achnatherum occidentale), Columbia needlegrass (Achnatherum nelsonii), California brome (Bromus carinatus), Orcutt's brome (Bromus orcuttianus), and squirreltail (Elymus elymoides).

Jeffrey pine-white fir-incense cedar/western needlegrass - Community Phase 1.3
This forest community phase develops with the natural fire regime, or with manual thinning and prescribed fires. Low to moderate intensity fires clear the understory and remove fuels before they reach hazardous levels, although severe high-intensity canopy fires are also possible. If Jeffrey pine and sugar pine establish during stand initiation they have a fair percentage of cover in the upper canopy. Jeffrey pine and sugar pine have difficulty regenerating and growing well in the understory of the canopy. Their growth and presence is dependent upon fire or other disturbances to maintain an open forest structure with canopy openings.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of relatively frequent surface and moderate severity fires, and/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 reference community phase (Community Phase 1.1).

Community Phase Pathway 1.3b
In the event of a canopy fire this community phase would return to Community Phase 1.2, stand initiation.

Community Phase Pathway 1.3c
If fire does not occur, forest density increases. This may favor white fir and incense cedar over Jeffrey pine and sugar pine. The increased density shifts this community phase toward the closed white fir forest(Community Phase 1.5).

White fir/litter - Community Phase 1.4

Young closed white fir forest

This community phase is defined by a dense canopy and high basal area of white fir. Canopy cover ranges from 65 to 85 percent. The trees are overcrowded and often diseased and stressed due to 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 phase, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a

If fire continues to be excluded from this system the mature closed white fir–mixed conifer forest develops (Community Phase 1.5).

Community Phase Pathway 1.4b

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

Community Phase Pathway 1.4c

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 treatments 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 an open white fir-mixed conifer forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3.

White fir/western needlegrass - Community Phase 1.5


Mature closed white fir forest

The mature closed white fir forest develops with the continued exclusion of fire, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continue, and tree health and vigor decreases.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate stand regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b
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 treatments 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 white fir-mixed conifer forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1, but tree mortality will increase the already high fuel amounts.

Ecological Site Interpretations

Forest 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*	50	98	91	234	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.
Jeffrey pine	*PIJE*	98	117	99	135	40	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:
White fir forests provide browse, cover and nesting sites for a variety of wildlife species. The type and quality of the wildlife habitat varies with the community type. Mature open forests, closed dense white fir forests, young forests and shrub lands provide different habitats and forage for wildlife. Deer and bear can heavily browse young white fir shoots. Porcupines eat the bark of white fir and can kill saplings. Rodents feed on the cambial tissue. Young seedlings and seeds are eaten by animals as well. Douglas squirrels cut and cache white fir cones before the cones are fully mature.

There are about 33 species of mammals commonly present in the white fir forest type in California and, of these, 7 are generally associated with mature forests. About 123 species of birds are found in the white fir forest type of California and southern Oregon, about 50 of which are associated primarily with mature forests. Many of these birds use mature white fir trees and snags for foraging, roosting, nesting and/or breeding. Included are bald eagle, California spotted owl, brown creeper, pileated woodpecker, white-headed woodpecker, and, when near lakes or streams, osprey. Reptiles in white fir forests are represented by 17 species, mostly at lower elevations, 8 of which are associated with mature forests (Zouhar, 2001).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
These areas are suitable for hiking trails and campsites in the flatter areas.

Wood Products:
White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production, hence it provides poor firewood compared to other conifers (Zouhar, 2001).

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber (Gucker, 2007).

Incense cedar wood is resistant to decay, making it very desirable for exterior use. This wood is used as mud sills, window sashes, sheathing under stucco or brick veneer construction, greenhouse benches, fencing, poles and trellises. It is also widely used for exterior and interior siding. Much of the top quality incense cedar is used in the manufacture of pencils (Habeck, 2008).

Other Products:
Jeffrey pine seeds are edible. Jeffrey pine sap was used by Native Americans to treat pulmonary disorders and, later, heptane was distilled from the sap and sold to treat pulmonary problems and tuberculosis. Jeffrey pine heptane was also used to develop the octane scale used to rate petroleum used in automobiles (Gucker, 2007).

Other Information:
Additional information on the common white fir pathogens:

White fir dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris) is a parasitic plant common in the survey area as evident by witches brooms, top kill, stem cankers and swellings. The vegetative shoots of the dwarf mistletoe are often present from spring to fall. A fungus (Cytospora abietis) kills the branches that are infected with dwarf mistletoe. The reduced vigor makes the tree more susceptible to bark beetle and other diseases. The mistletoe cankers, by creating cracks in the bark, create an entry point for other diseases such as heart rots (Burns and Honkala, 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.). This disease can damage tree growth by reducing crown development. Mortality is less common in mature trees than in younger regeneration trees. Secondary infection is possible from heart rots entering through openings in the infected areas (Burns and Honkala, 1990).

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 the 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 and Honkala, 1990).

The fir engraver beetle (Scolytus ventralis) can cause extensive damage to white fir forests. 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 fire damage.

Additional information on Jeffrey pine pathogens:

Infections from western dwarf mistletoe (Arceuthobium campylopodium) cause witches brooms, reduced growth and tree mortality. Sticky seeds are spread in fall and infest nearby and understory trees. In years of severe drought dwarf mistletoe has induced 60 to 80 percent of the Jeffery pine mortality (Burns and Honkala, 1990).

Jeffrey pine bark beetles (Dendroctonus jeffreyi) are native beetles that can only reproduce in Jeffrey pine. They are a natural cycle in maintaining forest health. They generally attack older weaker trees, but in times of drought or other disturbances such as lightning or fire, epidemic levels can break out and cause extensive damage to the forest. These beetles infest the lower stem and bole of the trees, usually after pine engraver (Ips pini) infestation in the upper portion of the tree. The beetles slowly destroy the cambium, inhibiting the flow of nutrients. A sign of infestation is the changing color of the pine needles from green to yellow or reddish brown, beginning from the top down (Hagle et al., 2003; Smith, 1971).

Additional information about the mountain pine beetle, which can affect sugar pine, as well as other pines:

The mountain pine beetle (Dendroctonus ponderosae) creates pitch tubes on the bark at the point of entry. Boring dust is evident at the base of the tree. These beetles feed on the phloem layer in the inner bark of the tree, eventually girdling the tree. A blue stain fungus is inoculated into the tree by the beetles and reduces the flow of water. These beetles generally infest trees that are weakened by drought or other stresses and usually kill the tree. The engraver beetles (Ips spp.) are a secondary bark beetle, coming in after the mountain pine beetle. They eat the inner bark of the tree and inoculate the blue stain fungus as mentioned above, but the trees have a lower mortality rate. These beetles can be distinguished by their feeding patterns in the wood, and by the shape of the adults.

SITE INDEX DOCUMENTATION:

Schumacher (1926) was used to determine forest site productivity for white 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 site index for white fir was quite variable. 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. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This is a white fir-Sierra lodgepole pine forest found in slightly wetter conditions.
Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes	F022BI121CA	This is an open Jeffrey pine forest with a shrubby understory found on ridges and shoulders.
Frigid Loamy Flood Plains	R022BI210CA	This is a riparian complex associated with Hot Springs Creek.
Spring Complex	R022BI211CA	This site is associated with springs, generally dominated by alder.
Frigid Gravelly Flood Plains	R022BI215CA	This is a riparian complex associated with Kings Creek.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Tephra Over Slopes And Flats	F022BI103CA	This is a white fir-Jeffrey pine forest found on the west side of the park, with dense shrub phase.
Low Precip Frigid Sandy Moraine Slopes	F022BI119CA	This is a white fir-Jeffrey pine forest, which tends towards Jeffrey pine due to lower precipitation.

State Correlation:
This site has been correlated with the following states:

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

Community 1.1
789247- type location

Community 1.1 to 1.5 transition
789169
789287
789303

Community 1.2
789310

Community 1.4
789351

Community 1.5
789289
789311

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	5 E
Section:	23
Datum:	NAD83
Zone:	10
Northing:	4478291
Easting:	635986
General Legal Description:	The site location is approx. 0.4 miles east of Drakesbad Guest Ranch, on the south facing slope.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104478291635986

Relationship to Other Established Classifications:

Forest Alliance = Abies concolor – White fir forest; Association = Abies concolor-Calocedrus decurrens-Pinus jeffreyi. (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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/16/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes

Tsuga mertensiana - Abies magnifica / / Lupinus obtusilobus - Eriogonum marifolium
(mountain hemlock - California red fir / / bluntlobe lupine - marumleaf buckwheat)

Site ID: F022BI111CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Mountain slope, (2) Moraine, (3) Lava flow
Elevation (feet): 6,470-8,300
Slope (percent): 1-80, but generally 2-30
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, East, West
Mean annual precipitation (inches): 37.0-111.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 38 to 43 degrees F (3.3 to 6 degrees C)
Restrictive Layer: Densic layer or lithic contact
Temperature Regime: Cryic
Moisture Regime: Xeric
Parent Materials: Tephra over, or mixed, with till from volcanic rocks
Surface Texture: (1) Gravelly ashy sandy loam, (2) Ashy Sandy loam
Surface Fragments <=3" (% Cover): 17-40
Surface Fragments > 3" (% Cover): 0-50
Soil Depth (inches): 20-60+
Vegetation: The subalpine forest is dominated by California red fir (Abies magnifica) and mountain hemlock (Tsuga mertensiana).
Notes: This ecological site is found on glaciated mountain slopes and lava flows, moraines, or on linear to concave positions on pyroclastic cones.

Physiographic Features

This ecological site is found on glaciated mountain slopes and lava flows, moraines, or on linear to concave positions on pyroclastic cones. The range in elevation is from 6,470 to 8,300 feet. Slopes range from 1 to 80 percent however slopes of 2 to 30 percent are more common.

Landform: (1) Mountain slope
(2) Moraine
(3) Lava flow

	Minimum	Maximum
Elevation (feet):	6470	8300
Slope (percent):	1	80
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very low	High
Aspect:	North East West	

Climatic Features

This ecological site receives most of its annual precipitation during the winter months in the form of snow. The mean annual precipitation ranges from 67 to 111 inches (1,702 to 2,819 mm). Prism models indicate precipitation drops to 37 inches (940 mm) on the upper cinder cones on the eastern side of the Park. The mean annual temperature ranges from 38 to 43 degrees F (3.3 to 6 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 60 to 185 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	60	185
Mean annual precipitation (inches):	37.0	111.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description:	System	Subsystem	Class

Representative Soil Features

This ecological site is associated with the Shadowlake soil component, the Terracelake soil component and the Xeric Vitricryands, ash over cinders soil component.

The Shadowlake soils are deep, well drained soils that formed in tephra over, or mixed, with till from volcanic rocks. The surface texture is a gravelly ashy sandy loam. Subsurface textures are similar, but gravel content increases significantly with depth. The lower portion of the profile contains greater than 35 percent rock fragments. A densic layer is present at depths of 40 to 60 inches. These soils are classified as Ashy-skeletal, glassy Xeric Vitricryands. Permeability is rapid to moderately rapid in the upper horizons and very slow through the densic layer. AWC (available water capacity) is very low to low in the upper 60 inches of soil.

The Terracelake soils are moderately deep, well drained soils that formed in tephra over, or mixed, with colluvium and residuum from volcanic rock. The surface texture is a gravelly ashy sandy loam. Subsurface textures are similar, but gravel content increases significantly with depth. Just above the bedrock there is an extremely stony ashy sandy loam textured horizon. Depth to dacite bedrock varies from 20 to 40 inches. There is greater than 35 percent rock fragments throughout most of this soil profile. These soils are classified as Ashy-skeletal, amorphic Xeric Vitricryands. Permeability is rapid to moderately rapid in the upper horizons but impermeable through the bedrock. AWC is very low to moderate in the upper 60 inches of soil.

The Xeric Vitricryands, ash over cinders soils are very deep, well drained soils that formed in ash over colluvium from volcanic rocks. The surface texture is ashy sandy loam. Subsurface textures are similar, but gravel content increases significantly with depth. Below 45 inches the soil has 98 percent rock fragments with a gravel texture. Permeability is rapid to moderately rapid in the upper horizons and very rapid through the lower gravel horizon. AWC is very low to low.

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

Map Unit Component /Percent
115 Shadowlake /85
115 Terracelake /10
122 Xeric Vitricryands, ash over cinders /30
136 Terracelake /45
144 Shadowlake / 2
175 Shadowlake /75

Parent Materials:
Kind: Tephra, Till
Origin: Volcanic rock
Surface Texture: (1)Gravelly ashy sandy loam
(2)Ashy Sandy loam
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	17	40
Surface Fragments > 3" (% Cover):	0	50
Subsurface Fragments <=3" (% Volume):	34	61
Subsurface Fragments > 3" (% Volume):	0	55

Drainage Class: Well drained To Well drained
Permeability Class: Rapid To Impermeable

	Minimum	Maximum
Depth (inches):	20	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.28	5.37

Plant Communities

Ecological Dynamics of the Site

This site is associated with moderately deep to very deep soils with greater than 35 percent rock fragments in most of the soil profile. The rock fragments are mostly gravels. The soils are well drained and have very low to moderate water holding capacity. Despite the droughty nature of the soil, this site receives relatively high precipitation and is cool, losing less water to evaporation. This area receives 67 to 111 inches of precipitation, mostly during the winter in the form of snow. The deep snow pack melts gradually and can persist into the early summer months. The soils remain moist due to cool summer air temperatures that are enhanced by high elevations, northern aspects, canopy shade, and cool air drainages coming down the mountain. As snow melts from this site, it continues to receive snow melt from even cooler sites upslope. This site is often found on wind-sheltered slopes and valleys which accumulate rather than divert wind blown snow and water melt-off. The frost-free growing season ranges from 2 to 3 months. The growing season begins approximately 2 weeks after snow melt and lasts until drought conditions set in. The length of the growing season is critical for seedling establishment and annual growth. Conifer species have a variety of variables that need to be met to initiate seasonal growth. Perhaps the most critical factor is a minimum soil and air temperature during the growing season. Conifer species found at lower elevations require warmer temperatures and longer frost free conditions for sustainable growth (Royce and Barbour, 2001).

This is a subalpine forest is dominated by California red fir (Abies magnifica) and mountain hemlock (Tsuga mertensiana). California red fir is a tall, long-lived conifer with short branches and a narrow crown. It produces single 0.8 to 1.4-inch 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 is adapted to 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. It is shade tolerant and continues to reproduce under the forest canopy, therefore increasing in dominance in the absence of fire.

Mountain hemlock is a slow-growing native conifer. On this site it grows as a tall tree, with branches on the upper portion of the stem. In open areas the branches are low on the stem and, if touching the soil, may root by layering. It produces single needles, which tightly overlap the twig surfaces. The needles generally curve upward. Trees have a shallow wide-spreading root system. Mountain hemlock is shade tolerant and will reproduce in the understory. (Tesky, 1992). Reestablishment of mountain hemlock after a fire or other disturbance is often slow and, in some areas, it never regains its tree-like stature (Arno and Hammerly, 1984).

Western white pine is also a long-lived conifer with a narrow crown. It has 2 to 4-inch needles in bundles of 5. It produces a deep tap root and extensive lateral roots. Most of the lateral roots are within the upper 2 feet of soil. Young trees have thin bark and are very susceptible to fire due to damage to the cambial tissue. Mature trees develop thicker bark and have higher branches, making them less prone to mortality from fire (Griffith, 1992). Western white pine bark, when damaged by fire, can allow infestations of pathogens that can eventually kill the trees. It is shade intolerant and dependent upon canopy disturbances for regeneration and long-term survival.

Sierra lodgepole pine can be long-lived. Trees nearby were 180 to 200 years old and reached heights of 100 to 120 feet. Sierra lodgepole pine does not usually gain much in girth with time and older trees on this site averaged 20 to 24-inch diameters. Trees grow tall and narrow with short branches and 1.2 to 2.4-inch needles in fascicles of two. Its thin bark and shallow roots make it susceptible to fire. Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow, which enable it to grow on this site. Sierra lodgepole pine produces a taproot that may atrophy or grow horizontally in cases of high water tables or root restrictive layers. It is shade intolerant and regenerates prolifically after fire or other canopy disturbances (Cope, 1993). Disturbance is needed to maintain Sierra lodgepole pine on this site.

Forest communities of this site have evolved with fire over the centuries. They are relatively slow growing and accumulate fuels slowly."Therefore fire spreads across this site less frequently than lower elevation conifer forests. Fire ecology for this subalpine forest type is poorly studied. The point fire return interval for the red fir-western white pine forest on Prospect Peak ranges from 26 to 109 years, with a mean of 70 (Taylor, 2000). In the Caribou Wilderness the mean is 66 years (Taylor and Solem, 2001). In the Thousand Lakes Wilderness the point fire return interval ranges from 9 to 91 years, with a mean of 20 for red fir-mountain hemlock forests (Bekker and Taylor, 2001). Fire return intervals may be between 400 to 800 years in a pure mountain hemlock forest (Tesky, 1992). 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 upper slopes, while low to moderate intensity fires occur only along 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). This forest is fairly continuous and can become dense with heavy fuel accumulations. Severe fires are likely at certain stages of development. Since the fire frequency at this site is probably more common at the lower elevations than the upper elevations, where mountain hemlock becomes more prevalent than California red fir, the natural fire return interval may range from 20 years to longer than 100 years.

Evidence of fire suppression is evident in this forest type. Shade tolerant California red fir and mountain hemlock seedlings and saplings are common in the understory. Some areas are further along than others in understory development. As the canopy cover increases, the shade intolerant western white pine and Sierra lodgepole pine decline.

Tree pathogens and insect infestations can have significant impacts on the composition and structure of 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 represent natural cycles of regulation that can push closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests. Fuel loads are frequently high after outbreaks, creating ideal conditions for high intensity fires.

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). Other diseases that can affect red fir are the heart rots, including yellow cap fungus (Pholiota limonella), Indian paint fungus (Echinodontium tinctorium), cone maggots (Earomyia spp.), several chalcids (Megastigmus spp.), and cone moths (Barbara spp. and Eucosma spp.) (Burns and Honkala, 1990).

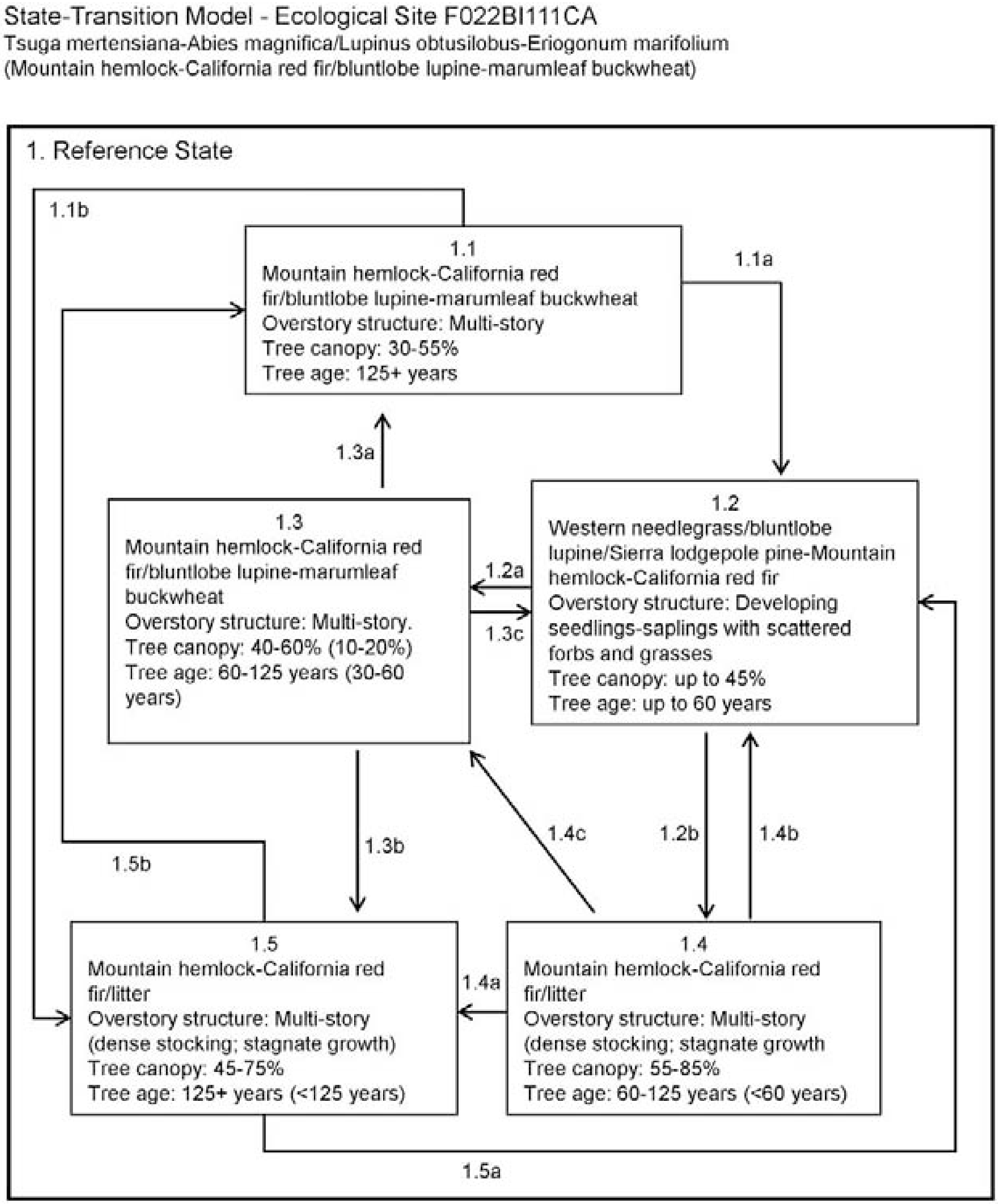
Several pathogens affect mountain hemlock, but epidemics are rare. The major pathogens that affect mountain hemlock are laminated root rot (Phellinus weirii), such heart rots as Indian paint fungus (Echinodontium tinctorum), a number of needle diseases, snow mold (Herpotrichia nigra), and dwarf-mistletoe (Arceuthobium tsugense) (Tesky, 1992).

The mountain pine beetle (Dendroctonus ponderosae) is the most serious pest for Sierra lodgepole pine and outbreaks can kill acres forests. Pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), weevil (Magdalis gentiles), lodgepole terminal weevil (Pissodes terminalis), Warren's collar weevil (Hylobius warreni), pine needle scale (Chionaspis pinifoliae), black pineleaf scale (Nuculaspis californica), spruce spider mite (Oligonychus ununguis), lodgepole sawfly (Neodiprion burkei), lodgepole needle miner (Coleotechnites milleri), sugar pine tortrix (Choristoneura lambertiana), pine tube moth (Argyrotaenia pinatubana), and pandora moth (Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips also can build-up in windthrows. Fungal diseases that affect lodgepole pine productivity include stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 1990).

The major pathogen affecting western white pine is the white pine blister rust (Cronartium ribicola). It is a non-native disease that was introduced from Europe and Asia in the 1920s. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are the needle cast fungi (Lophodermella arcuata and L. nitens) and (Bifusella linearis). Wood decay is caused by red rot (Phellinus pini), red-brown butt rot (Phaeolus schweinitzii), annosus root disease (Heterobasidion annosum), and honey mushroom (Armillaria spp.). Significant insect pests include mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Taylor and Halpern, 1991).

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 Diagram



Reference - State 1

Mountain hemlock-California red fir/bluntlobe lupine-marumleaf buckwheat - Community Phase 1.1

Mountain hemlock-red fir forest

This is an upper elevation mixed conifer forest. California red fir (Abies magnifica), western white pine (Pinus monticola), Sierra lodgepole pine (Pinus contorta var. murrayana) and mountain hemlock (Tsuga mertensiana) all coexist, providing 30 to 55 percent canopy cover. The understory contains scattered grasses and dryland sedges, with pinemat manzanita (Arctostaphylos nevadensis) and bluntlobe lupine (Lupinus obtusilobus) in open areas.

This community phase has developed with occasional low to moderate intensity fire or other canopy disturbances, such as disease. Understory burns cause high mortality to understory trees and some of the overstory trees, reducing forest density and cover. Localized mortality from forest pathogens also opens the forest canopy. Canopy openings create opportunities for the shade intolerant western white pine and Sierra lodgepole pine to regenerate within the forest, creating a more diverse and multi-aged forest.

Community Phase Pathway 1.1a
Wind throw, stand-replacing fire, or tree die off from disease on areas greater than 0.25 acre creates suitable conditions for forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b

If fire is excluded from this community, tree density continues to increase in the understory and shifts the community toward the closed mountain hemlock-red fir forest (Community Phase 1.5).

Mountain hemlock-California red fir/bluntlobe lupine-marumleaf buckwheat Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**105**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	2	0	2
		Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0	3	0	3
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	0	98	0	14
		Davis' knotweed	PODA	*Polygonum davisiae*	0	2	0	2

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**5**	**47**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	5	25	2	10
		sedge	CAREX	*Carex*	0	15	0	5
		squirreltail	ELEL5	*Elymus elymoides*	0	7	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**1**	**84**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	0	80	0	20
		marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	1	4	1	4

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**45**		
		California red fir	ABMA	*Abies magnifica*	0	15	0	5
		Sierra lodgepole pine	PICOM	*Pinus contorta var.*	0	4	0	2

		murrayana				
western white pine	PIMO3	Pinus monticola	0	6	0	3
mountain hemlock	TSME	Tsuga mertensiana	0	20	0	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	5	22	47
Forb	0	28	105
Shrub/Vine	1	23	84
Tree	0	22	45
Total:	6	95	281

Forest Overstory:

This forest is dominated by California red fir with mountain hemlock second in importance. Western white pine and Sierra lodgepole pine are also common. The upper tree canopy is 100 to 120 feet tall, providing 30 to 55 percent cover. Dbh (diameter at breast height) is greater than 30 inches for some of the larger red fir trees. Basal areas range from 150 to approximately 200 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	30	45	55

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	15.0	30.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	3.0	9.0						
western white pine *Pinus monticola*	PIMO3	N	2.0	4.0						
mountain hemlock *Tsuga mertensiana*	TSME	N	10.0	12.0						

Forest Understory:

The understory exhibits a high cover of litter and duff with a low to moderate cover of grasses and forbs. Pinemat manzanita (Arctostaphylos nevadensis) is present in canopy openings. Bluntlobe lupine (Lupinus obtusilobus) has high cover in some areas. Other common plants are western needlegrass (Achnatherum occidental), pioneer rockcress (Arabis platysperma), sedge (Carex spp.), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), squirreltail (Elymus elymoides), marumleaf buckwheat (Eriogonum marifolium), and Davis' knotweed (Polygonum davisiae).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	2.0	10.0		
sedge *Carex*	CAREX	N	0	5.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	2.0		
Mt. Hood pussypaws *Cistanthe umbellata var. umbellata*	CIUMU	N	0	3.0		
bluntlobe lupine *Lupinus obtusilobus*	LUOB	N	0	14.0		
Davis' knotweed *Polygonum davisiae*	PODA	N	0	2.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	0	20.0		
marumleaf buckwheat *Eriogonum marifolium*	ERMA4	N	1.0	4.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	0	5.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0		
western white pine *Pinus monticola*	PIMO3	N	0	3.0		
mountain hemlock *Tsuga mertensiana*	TSME	N	0	5.0		

Western needlegrass/bluntlobe lupine/Sierra lodgepole pine-Mountain hemlock-California red fir - Community Phase 1.2

This community phase develops after a stand-replacing fire or in small gaps created by a canopy disturbance. Fire intensity and size, and the season of burn and timing in relation to cone crops affect the composition and structure of conifer regeneration. Large high intensity fires, which remove most of the overstory canopy, may favor Sierra lodgepole pine and western white pine regeneration as these seedlings establish better in open sunlight. Smaller fires, which provide shade from surviving trees, and other small gap-creating disturbances such as windthrow or mortality from pest infestation may have all tree species successfully regenerating including California red fir and mountain hemlock. In addition to shade, smaller fires may establish conifer seedlings earlier and at higher densities than larger fires because of the close proximity to a seed source. Seed availability after a fire is related to cone production cycles. The conifers associated with this site have cone crop cycles ranging from 1 to 6 years. Seedling establishment may be delayed a few years, due to crop cycles and climatic variables.

California red fir produces mature cones in 2 to 6-year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or in light litter, in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. Winged red fir seeds are wind dispersed at 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993).

Mountain hemlock seedlings are adapted to partial shade. Seeds are winged and wind dispersed. Mountain hemlock produces cones in 3-year intervals with almost no cone production between intervals. For the seeds to establish, a good seed crop is needed with favorable temperature and moisture conditions. Mountain hemlock establishes well during years of lower than normal April snowpack depths, which provides a longer snow-free growing season (Taylor, 1995). Adequate summer moisture is also important. Growth of the seedlings is very slow at first. In a study of mountain hemlock recruitment in Lassen Volcanic Park, 30 cm tall seedlings were 29 years old (Taylor, 1995).

Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid-October. Although seeds can be stored in the soil for several years, seedlings tend to regenerate from wind dispersed seeds after fire.

Western white pine produces good seed crops every 3 to 4 years. The seeds of western white pine can be dispersed over 2,000 feet by wind. Seeds can remain viable in litter for up to 4 years, but viability decreases quickly after that period of time (Griffith, 1992). Birds, squirrels and other rodents will cache some of these seeds in the soil, which can germinate in bunches if not consumed.

Pinemat manzanita is killed by fire. It does not resprout from the root crown but re-establishes itself from seed. It colonizes disturbed sites and continues to grow well under an open canopy as long as there is sufficient sunlight (Howard, 1993). Other forbs and grasses germinate from on-site stored seed or wind dispersed seed from adjacent areas. Some of the understory species may resprout after low to moderate intensity fires.

Community Phase Pathway 1.2a
With time, growth and canopy disturbances, the mountain hemlock-red fir forest develops (Community Phase 1.3).

Community Phase Pathway 1.2b
An alternate pathway is created when fire and other disturbances are absent from the system, which leads to a closed moutain hemlock-red fir forest (Community Phase 1.4).

<u>Mountain hemlock-California red fir/bluntlobe lupine-marumleaf buckwheat - Community Phase 1.3</u>
This community phase develops with small scale disturbances or low intensity fires. Fire removes understory trees, reducing density. Windthrow and localized disease create canopy openings that enable shade intolerant species to regenerate and persist in this forest.

The trees reach reproductive maturity in this phase. California red fir begins producing cones at 35 to 40 years, mountain hemlock at 20 years, western white pine at 10 years, and Sierra lodgepole pine as early as 4 to 8 years (Cope, 1993, Griffith, 1992, and Tesky, 1992).

California red fir and mountain hemlock will slowly continue to regenerate under the forest canopy, while Sierra lodgepole pine and western white pine will utilize the canopy openings.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of small low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to an open subalpine mountain hemlock-red fir forest (Community Phase 1.1).

Community Phase Pathway 1.3b
In the absence of fire or other canopy disturbance, forest density increases. The increased density shifts this community phase toward the closed mountain hemlock-red fir forest (Community Phase 1.5).

Community Phase Pathway 1.3c
In the event of a canopy fire, this community phase would return to Community Phase 1.2, forest regeneration.

Mountain hemlock-California red fir/litter - Community Phase 1.4

Closed mountain hemlock-red fir forest

The development of this community phase within this ecological site is relatively common. Trees may be pole-sized and evenly aged at first but will develop into a mature forest over time. Density increases as California red fir and mountain hemlock continue to establish, creating multiple canopy layers. This forest is defined by a dense canopy and high basal area of California red fir, Sierra lodgepole pine, and mountain hemlock. Canopy cover ranges from 55 to 85 percent. The overstory trees may be up to 125 years old. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients. This stress makes the trees more susceptible to death from infestation and drought. Crown fire hazard increases in this community, a result of the deep accumulation of litter, standing dead and downed trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a

If fire continues to be excluded from this system, the mature closed mountain hemlock-red fir forest develops (Community Phase 1.5).

Community Phase Pathway 1.4b

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

Community Phase Pathway 1.4c

The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with fire over time. Manual treatments to thin trees and other fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to its natural state of a more open mountain hemlock-red fir forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3.

Mountain hemlock-California red fir/litter - Community Phase 1.5

Closed mountain hemlock-red fir forest

The mature closed mountain hemlock-red fir forest develops with the continued exclusion of fire and other canopy disturbances, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continue, and tree health and vigor decreases. The overstory trees are over 125 years old.

Sierra lodgepole pine and western white pine decline over time, due to their inability to regenerate under the dense forest canopy.

Community Phase Pathway 1.5a

At this point, a severe fire is likely and would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b

The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it had developed with fire and other disturbances over time. Manual treatments to thin the understory trees and other fuels, and/or prescribed burns, could be implemented to shift this forest back to its natural state of a more open mountain hemlock-red fir forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1.

Forest Overstory:

California red fir and mountain hemlock dominate this dense forest. There is heavy recruitment of red fir and mountain hemlock in the understory. There may be 3 to 4 canopy layers. Basal areas range from 200 to 460 ft2 / acre.

Forest Understory:

There is sparse cover of grasses and forbs in the understory. The cover of litter and woody debris is high.

Ecological Site Interpretations

Forest 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*	40	42	135	142	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.
Sierra lodgepole pine	*PICOM*	60	60	49	49	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.
mountain hemlock	*TSME*	67	85	72	110	65	990	100TA	Barnes, George H. 1962. Yield of even-aged stands of western hemlock. USDA, Forest Service. Pacific Northwest Forest and Range Experiment Station Technical Bulletin 1273.

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 new growth of the conifers 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). Some birds consume mountain hemlock seeds. In some areas the understory provides decent forage (Tesky, 1992).

The fruit of pinemat manzanita is eaten by black bear, deer, coyote, and various birds and rodents. After fire, young foliage is browsed by deer, but older foliage is not desirable.

Grasses provide forage for deer and small rodents.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area is suitable for trails and provides scenic views.

Wood Products:
The wood from California red fir is straight-grained and light. California red fir is soft, but it is 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 and high-quality wrapping paper; it is the preferred wood 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).

Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light, straight-grained and of consistent texture (Cope 1993).

If harvested, mountain hemlock is usually sold with western hemlock. The wood is moderately strong and used as small lumber, pulp, interior finish, cabinetry, crates, flooring and ceilings (Tesky, 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:
Additional information on forest pathogens:

Red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) is a parasitic plant commonly found in the survey area, as evident by witches brooms, top kill, stem cankers 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. The fungus (Cytospora abietis) kills those branches that are infected with dwarf mistletoe. Dwarf mistletoe will weaken trees by generating cankers that create entry points for diseases such as heart rots (Burns and Honkala, 1990) and other pathogens.

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). Fir broom rust can damage tree growth by reducing crown development. Mortality is less common in mature trees than in the 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 windthrow. Annosus root rot can also be spread aerially, 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. 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 and Honkala, 1990).

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

White pine blister rust (Cronartium ribicola) causes cankers on 5-needled pines and eventually kills 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 those portions above. Leaves on the upper portions turn red and fall (Hagle et al., 2003). Pruning cankers off infected stems has been shown to be beneficial.

SITE INDEX DOCUMENTATION:

Schumacher (1928) and Barnes (1962) were used to determine forest site productivity for red fir and mountain hemlock respectively. Barnes site curves and yield estimates for western hemlock were used to roughly approximate forest site productivity for mountain hemlock. 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.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Cryic Coarse Loamy Colluvial Slopes	F022BI104CA	This is a mountain hemlock forest found at higher elevations and sheltered north slopes.
Cirque Floor	R022BI205CA	This is a lupine dominated rangeland site found in cirque floors.
Cryic Lacustrine Flat	R022BI206CA	This cryic meadow site is found in alluvial flats among the forest.
Alpine Slopes	R022BI207CA	This sparsely vegetated alpine range site is found at higher elevations.
Cryic Pyroclastic Cones	R022BI208CA	This rangeland site is found on the shoulders of cinder cones in the eastern side of the Park.
Spring Complex	R022BI211CA	This site is associated with springs and seeps and is dominated by alders, forbs, and sedges.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid And Cryic Gravelly Slopes	F022BI115CA	This red fir-western white pine site merges with this site at lower elevations.

State Correlation:
This site has been correlated with the following states:

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

789150
789199
789262-site location
789274
789300
789327
789338
789372
789373
789375
789396

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	5 E
Section:	8
Datum:	NAD83
Zone:	10
Northing:	4482229
Easting:	630656
General Legal Description:	The type location is about 0.5 miles east of Shadow Lake in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104482229630656

Relationship to Other Established Classifications:

Forest Alliance = Tsuga mertensiana – Mountain hemlock forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra E Moseley	2/16/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/16/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Sandy Loam Moraines Or Lake Terraces

Abies magnifica - Pinus contorta var. murrayana / / *Penstemon gracilentus - Lupinus arbustus*
(California red fir - Sierra lodgepole pine / / slender penstemon - longspur lupine)

Site ID: F022BI112CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Moraine, (2) Lake terrace
Elevation (feet): 5,500-8,200
Slope (percent): 1-40
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 35.0-109.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 38 and 43 degrees F (3.3 to 6.1 degrees C)
Restrictive Layer: Dense till at 40 to 60 inches; silica cemented duripan at 20 to greater than 60 inches below the surface
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Lake terrace; tephra and glacial till from andesite and basalt; lake sediments from volcanic rocks
Surface Texture: (1) Gravelly medial sandy loam, (2) Medial sandy loam
Surface Fragments <=3" (% Cover): 18-40
Surface Fragments > 3" (% Cover): 0-35
Soil Depth (inches): 20-80
Vegetation: Heavily dominated by California red fir (Abies magnifica) with Sierra lodgepole pine ((Pinus contorta var. murrayana) and western white pine (Pinus monticola) commonly present. White fir (Abies concolor) is present at the lower elevations. Sierra lodgepole pine is a post fire pioneer species on this site.

Notes: This ecological site is found on moraines and dry lake terraces.

Physiographic Features

This ecological site is found on moraines and dry lake terraces between 5,500 and 8,200 feet in elevation. Slopes range from 1 to 40 percent.

Landform: (1) Moraine
(2) Lake terrace

	Minimum	Maximum
Elevation (feet):	5500	8200
Slope (percent):	1	40
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Medium
Aspect:	No Influence on this site	

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 35 to 109 inches (889 to 2,769 mm) with an average of 49 inches (1245 mm). The mean annual temperature is between 38 and 43 degrees F (3.3 to 6.1 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.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	35.0	109.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the Juniperlake and Humic Haploxerands-lake terrace soil components. These soils are moderately deep to very deep (1.6 to greater than 5 feet deep) over a root restrictive layer. They are skeletal soils, meaning they have a high percentage of rock fragments. These soils are well drained with moderately rapid to rapid permeability in the upper layers, and very slow to slow permeability through the root restrictive layer.

The Juniperlake soils are deep and formed in tephra and glacial till from andesite and basalt. They are classified as Medial-skeletal, amorphic, frigid Humic Haploxerands. There is a thin O horizon over two A horizons (from 1 to 10 inches) which have a gravelly medial sandy loam texture. The AB horizon (10 to 21 inches) and the Bw1 horizon (21 to 30 inches) have very cobbly medial sandy loam textures with 20 percent cobbles. The Bw2 horizon (30 to 47 inches) has a very gravelly medial sandy loam texture with 31 percent gravel and 20 percent cobbles. A root restrictive layer that formed from dense till occurs between 40 to 60 inches below the surface. The available water capacity in the upper 60 inches of soil is 0.52 to 5.35 inches (very low to moderate) with an RV of 3.2 inches (low).

The Humic Haploxerands-lake terrace soils formed in lake sediments from volcanic rocks. They are also classified as Medial-skeletal, amorphic, frigid Humic Haploxerands. They have a negligible O horizon over 3 A horizons. The A1 horizon (from 0 to 3 inches) has a medial sandy loam texture. The A2 and A3 horizons (3 to 11 and 11 to 18 inches respectively) have very bouldery medial fine sandy loam and extremely bouldery medial fine sandy loam textures, with

14 to 15 percent gravel, 5 to 10 percent cobbles, 5 to 10 percent stones, and 30 percent boulders. A Bw horizon (from 18 to 26 inches) has a very cobbly medial fine sandy loam texture with 30 percent gravel, 15 percent cobbles, and 5 percent stones. A root restrictive, silica cemented duripan occurs between 20 to greater than 60 inches below the surface. The available water capacity in the upper 60 inches of soil is 0.26 to 4.55 (very low to low) with an RV of 1.4 inches (low).

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

Map Unit Component, Comp %
103 Juniperlake, 10
104 Juniperlake, 20
105 Juniperlake, 85
105 Humic Haploxerands-lake terrace, 4
107 Juniperlake, 3
148 Humic Haploxerands-lake terrace, 70
148 Juniperlake, 5

Parent Materials:
Kind: Till, Lacustrine deposits
Origin: Volcanic rock

Surface Texture: (1)Gravelly medial sandy loam
(2)Medial sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	18	40
Surface Fragments > 3" (% Cover):	0	35
Subsurface Fragments <=3" (% Volume):	18	65
Subsurface Fragments > 3" (% Volume):	5	40

Drainage Class: Well drained To Well drained
Permeability Class: Rapid To Slow

	Minimum	Maximum
Depth (inches):	20	80
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	6.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.26	5.35

Plant Communities

Ecological Dynamics of the Site

This forest is heavily dominated by California red fir (Abies magnifica) with Sierra lodgepole pine ((Pinus contorta var. murrayana) and western white pine (Pinus monticola) commonly present. White fir (Abies concolor) is present at the lower elevations. Sierra lodgepole pine is a post fire pioneer species on this site. It also has fair cover in flat areas that accumulate water, and in cold air drainages. This forest has the potential to grow very dense in the absence of fire or other natural disturbances.

The understory tends to be sparse, but in some areas the cover of longspur lupine (Lupinus arbustus), slender penstemon (Penstemon gracilentus), and mountain monardella (Monardella odoratissima) is over 40 percent. Other common species are western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides), pinemat manzanita (Arctostaphylos nevadensis), California brome (Bromus carinatus), buckwheats (Eriogonum spp.) and Mt. Hood pussypaws (Cistanthe umbellata var. umbellata).

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 needles that are 0.8 to 1.4 inches long, which 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.

Western white pine is also a long lived conifer with a narrow crown. It has 2 to 4 inch long needles in bundles of 5. It produces a deep tap root and extensive lateral roots. Most of the lateral roots are within the upper 2 feet of soil. Young trees have thin bark and are very susceptible to fire due to damage to the cambial tissue. Mature trees develop thicker bark and have high branches, making them less prone to mortality from fire (Griffith, 1992). Western white pine bark, when damaged by fire, can allow infestations of pathogens that can eventually kill the trees.

Sierra lodgepole pine does not grow as tall and is not generally as long lived as California red fir and western white pine. It can be a pioneer species on this site after fire, which is eventually replaced by California red fir and western white pine in the absence of disturbance. Sierra lodgepole pine has a complex disturbance regime which includes cyclic beetle infestations and fire. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest which can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993).

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, which gradually declines through the summer (Royce and Barbour, 2001).

This forest has evolved with fire for centuries. Although it has the potential for dense growth and fuel accumulation, growth and fuel production is slower than for lower elevation forests. Also, fuels remain moist for later in the season than at lower elevations, so the fire season is shorter. These properties create longer fire return intervals at upper elevation sites. The point fire return interval for the red fir-western white pine forests 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). Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates of the lodgepole pine (Taylor and Solem, 1995). Prior to the practice of fire suppression Sierra lodgepole pine forest may have been more extensive, since there may not have been enough time between fires for the forest to develop into the later successional stages. This forest is probably comparable to the Prospect Peak and Caribou Wilderness red fir western white pine forests, and may have a similar fire regime with a mean fire return interval between 66 to 70 years. 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).

This forest type exhibits evidence of fire suppression. Even in the most open forests young seedlings and saplings are filling in the understory and shading out the understory. Some areas are further along in understory development with several canopy layers being dominated by California red fir. As the canopy cover increases, the shade intolerant Sierra lodgepole pine and western white pine decline in the understory. The overstory canopy is unhealthy and dying in some areas due to forest pathogens.

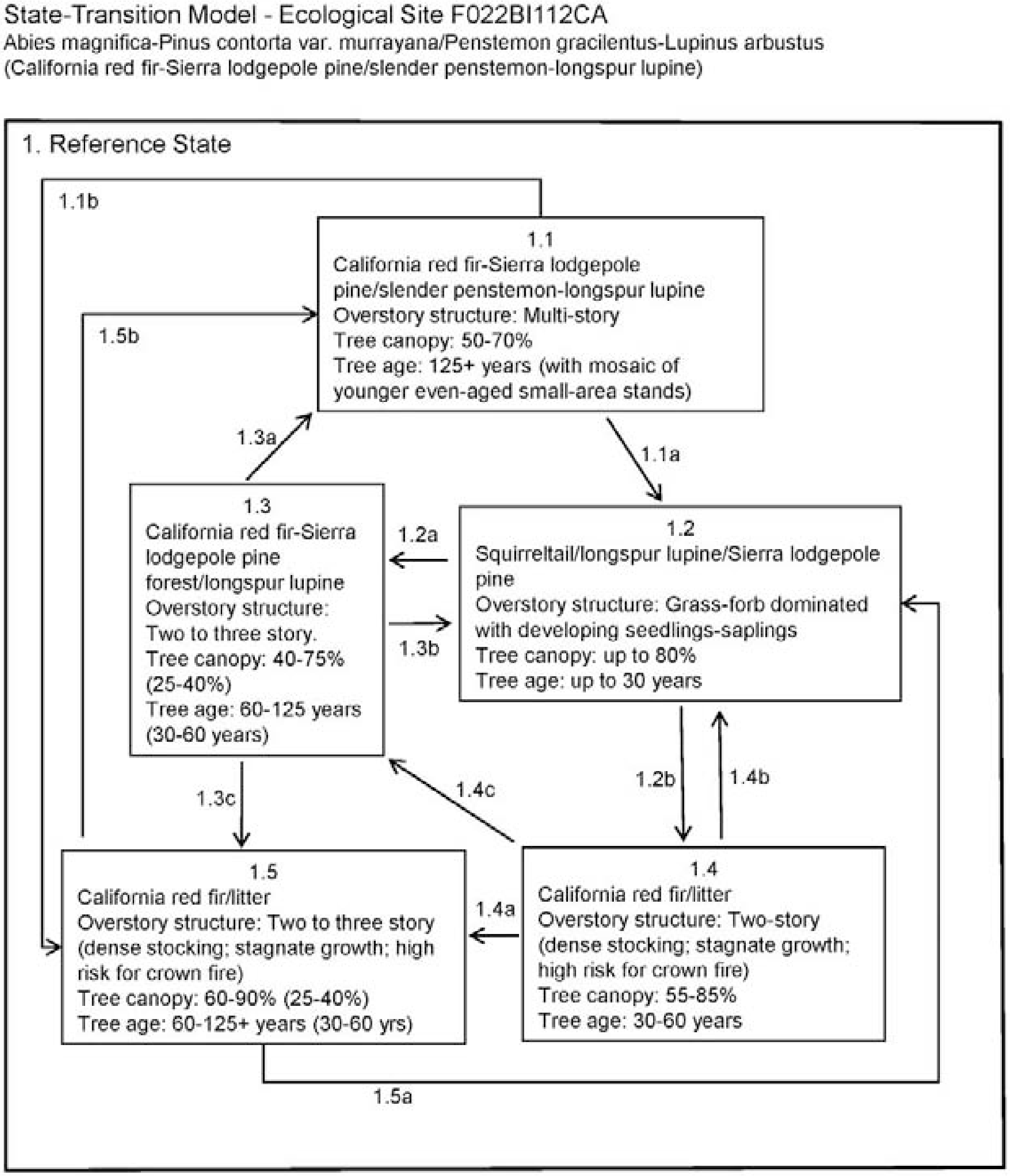
This forest is susceptible to several pathogens that can break out to epidemic levels and cause extensive stand mortality. Native pathogens are a natural component of the ecosystem and, at times, have important functions within the forest cycle. If trees are overstressed due to drought or competition for sunlight they become more vulnerable to pests and disease. Pathogens often infest the weak trees and spread in overcrowded conditions. The surviving trees may benefit from the death of the overstocked trees, and canopy gaps provide an opportunity for regeneration of the same species or other 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 major pathogen affecting western white pine is the 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 and eventually kills 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 and causing leaves to turn red and fall (Hagle et al., 2003). Pruning cankers from infected stems has shown to be beneficial. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are needle cast fungi (Lophodermella arcuata, Lophodermium nitens, and Bifusella linearis) and butt-rot fungi (Phellinus pini, Phaeolus schweinitzii, Heterobasidion annosum, and Armillaria spp.). Insects that can cause damage include the mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Graham, 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 Diagram



Reference - State 1

California red fir-Sierra lodgepole pine/slender penstemon-longspur lupine - Community Phase 1.1

California red fir forest

The mature open California red fir forest is the reference community phase for this ecological site, which has evolved with natural disturbances such as fire and disease. Low intensity understory burns remove some of the understory vegetation and young trees. Wind throw, disease and other disturbances create canopy openings and break up the uniformity and density of the stand. California red fir or Sierra lodgepole pine or shrubs may regenerate in these openings. It is difficult to find this forest in this phase since tree density has increased in most areas due to lack of fire. A natural fire regime reflects the time it takes for a forest to naturally develop fuels sufficient to carry fire. At the upper elevations in red fir dominated forests, fuel accumulation is slow and relatively compact, reducing flammability. Red fir seedlings develop slowly due to physiographic characteristics and climatic variables, so ladder fuels take decades to develop. The natural fire return interval may be 20 to 70 years for this site. Taylor reports a significant drop in fire after 1905 on Prospect Peak, just over 100 years ago (Taylor, 2000).

The photo of the community was taken from the site location, but California red fir was very unhealthy here. Many of the overstory trees are dying or dead, and living ones have swollen trunks and witches brooms. Mistletoe is visible throughout the stand. California red fir is regenerating in the understory, but this may be in response to the open canopy left from dying trees as much as fire suppression.

Community Phase Pathway 1.1a
Wind-throw, fire, or tree die off from disease creates openings in the forest that present suitable conditions for California red fir regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b
If fire is excluded from the old growth community phase, tree density continues to increase in the understory and shifts the community toward the closed California red fir forest (Community Phase 1.5).

California red fir-Sierra lodgepole pine/slender penstemon-longspur lupine Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**40**	**152**		
		Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0	2	0	1
		longspur lupine	LUAR6	*Lupinus arbustus*	40	110	15	40
		slender penstemon	PEGR4	*Penstemon gracilentus*	0	40	0	8

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**24**		
		needlegrass	ACHNA	*Achnatherum*	0	20	0	10
		California brome	BRCA5	*Bromus carinatus*	0	4	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**4**	**60**		

		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	4	30	2	15
		mountain monardella	MOOD	*Monardella odoratissima*	0	30	0	15

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**19**		
		white fir	ABCO	*Abies concolor*	0	5	0	2
		California red fir	ABMA	*Abies magnifica*	0	5	0	5
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	4	0	2
		western white pine	PIMO3	*Pinus monticola*	0	5	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	12	24
Forb	40	96	152
Shrub/Vine	4	30	60
Tree	0	9	19
Total:	44	147	255

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	12%
Forb	15%	50%
Shrub/ Vine	2%	15%
Tree	50%	70%
Non-Vascular Plants	0%	1%
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	50%	80%
Surface Fragments > 0.25" and <= 3"	15%	40%
Surface Fragments > 3"	0%	35%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	6%	10%

Forest Overstory:

California red fir dominates this forest with up to a quarter of the canopy composed of western white pine. Sierra lodgepole pine is often present but in low proportions. At the lowest elevations white fir is present. Total canopy cover averages ranges from 50 to 70 percent and basal area is approximately 200-ft2/acre. The upper canopy is roughly 110 feet above the forest floor with one to two understory canopies dominated by red fir. Overstory trees are over 100 years old and have a 20 to 30 d.b.h. (diameter at breast height).

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	50	60	70

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	1.0	5.0						
California red fir *Abies magnifica*	ABMA	N	40.0	50.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	1.0	5.0						
western white pine *Pinus monticola*	PIMO3	N	8.0	20.0						

Forest Understory:

The understory is dominated by forbs with some grasses and pinemat manzanita (Arctostaphylos nevadensis). Understory cover increases with an open overstory canopy. Common plants are needlegrasses (Achnatherum spp.), California brome (Bromus carinatus), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), longspur lupine (Lupinus arbustus), mountain monardella (Monardella odoratissima) and slender penstemon (Penstemon gracilentus).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
needlegrass *Achnatherum*	ACHNA	N	0	10.0		
California brome *Bromus carinatus*	BRCA5	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Mt. Hood pussypaws *Cistanthe umbellata var. umbellata*	CIUMU	N	0	1.0		

longspur lupine *Lupinus arbustus*	LUAR6	N	15.0	40.0
slender penstemon *Penstemon gracilentus*	PEGR4	N	0	8.0

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	2.0	15.0		
mountain monardella *Monardella odoratissima*	MOOD	N	0	15.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	2.0		
California red fir *Abies magnifica*	ABMA	N	0	5.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0		
western white pine *Pinus monticola*	PIMO3	N	0	3.0		

Squirreltail/longspur lupine/Sierra lodgepole pine - Community Phase 1.2

California red fir, western white pine and Sierra lodgepole pine will germinate from wind or animal dispersed seed after a fire. Sierra lodgepole pine is often the pioneer conifer species on this site after fire because it tends to produce high volumes of viable seeds, which germinate well in full sun and on mineral soil. Sierra lodgepole pine can be a nurse tree for California red fir. California red fir seedling establishment may be delayed for 3 to 4 years after a fire. This may be due to the mortality of the seedlings during the first few years or be related to the timing of cone production, which occurs in 2 to 6 year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or in light litter, in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. The winged red fir seeds are wind dispersed 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993). Seeds of western white pine can be dispersed over 2,000 feet by wind. The seeds can remain viable in litter for up to 4 years, but viability decreases quickly (Griffith, 1992). Birds, squirrels and other rodents will cache some of these seeds in the soil, where they will germinate in bunches if not consumed. Sierra lodgepole pine is often dominant post-fire due to high production of viable seeds and the tolerance of the seedlings to open sunlight. It is eventually overtopped and shaded out by California red fir. It may persist into the young forest community phases (1.4 and 1.3) and in moist flats.

The severity and size of a fire influences the structure of regeneration. California red fir seems to regenerate better after a low to moderate intensity fire, or in high intensity fires of smaller size. This is most likely due to proximity to a seed source and the benefits from partial shade (Chappell and Agee 1996).

Pinemat manzanita is killed by fire. It does not re-sprout from the root crown but re-establishes itself from seed. It colonizes disturbed sites and continues to grow well under an open canopy as long as there is sufficient sunlight (Howard, 1993). Other forbs and grasses germinate from on-site stored seed or wind dispersed seed from adjacent areas. Some understory species may re-sprout after low to moderate intensity fires.

Community Phase Pathway 1.2a
The natural pathway is to Community Phase 1.3, the young California red fir-Sierra lodgepole pine forest. This pathway is followed in time and growth with small low to moderate intensity surface fires.

Community Phase Pathway 1.2b
An alternate pathway is created when fire is excluded from the system and leads to the young closed California red fir forest (Community Phase 1.4).

California red fir-Sierra lodgepole pine forest/longspur lupine - Community Phase 1.3
Sierra lodgepole pine generally has a shorter life span than California red fir and is eventually replaced in time. It is also shorter in stature at maturity than mature California red fir, and does not survive well in the understory. Small gap disturbances allow Sierra lodgepole pine to persist to some degree within the forest. This community phase benefits from an occasional lightening induced surface fire, which reduces the understory canopy.

This community phase experiences rapid growth in conifer height and canopy cover. California red fir reaches seed bearing age at 35 to 40 years, but western white pine can bear seed at 10 years (Cope, 1993, and Griffith, 1992). Therefore California red fir needs a longer fire free interval to develop new seed crops.

This community phase begins with pole-sized trees and lasts until the trees are about 125 years old. California red fir will slowly continue to regenerate under the forest canopy during this time.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of small low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to a mature open California red fir-Sierra lodgepole pine forest (Community Phase 1.1).

Community Phase Pathway 1.3b
In the event of a canopy fire this community phase would return to Community Phase 1.2, Sierra lodgepole pine regeneration.

Community Phase Pathway 1.3c
If fire does not occur, forest density increases. The increased density shifts this community phase toward the closed California red fir forest (Community Phase 1.5).

California red fir/litter - Community Phase 1.4

The development of this community phase is relatively common within this ecological site since young even-aged dense stands generally form after fire and a period of forest regeneration. The trees may be pole-sized and even aged at first, developing into a mature forest over time. Density increases as California red fir continues to establish in the understory, creating multiple canopy layers. When this forest develops it is defined by a dense canopy and high basal area of Sierra lodgepole pine and California red fir and, to a lesser degree western white pine. Canopy cover ranges from 55 to 80 percent. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients, making the trees more susceptible to death from infection and drought. Fire hazard increases in this community, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a
If fire continues to be excluded from this system the mature closed California red fir forest develops (Community Phase 1.5).

Community Phase Pathway 1.4b
At this point the density of ground fuels and ladder fuels formed in the mid-canopy create conditions for a high intensity canopy fire. A severe fire would initiate Sierra lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c
This pathway is triggered by a high mortality fire, which initiates dense Sierra lodgepole pine regeneration (Community Phase 1.3) provided ample cones and seed are present under optimum seed germination conditions.

California red fir/litter - Community Phase 1.5
The mature closed California red fir forest develops with the continued exclusion of fire, allowing tree density to increase to unhealthy levels. This community phase often develops through pathway 1.1b, from increased understory growth under the mature open canopy. Competition for water and sunlight continues, and tree health and vigor decreases.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate Sierra lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b
The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it had developed with fire over time. Manual treatments to thin understory trees and other fuels, and/or prescribed burns, could be implemented to shift this forest back to its natural state of an open California red fir-Sierra lodgepole pine forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1 but tree mortality will increase the already high fuel amount.

Ecological Site Interpretations

Forest 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*	57	57	117	117	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.
California red fir	*ABMA*	46	52	157	180	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.
Sierra lodgepole pine	*PICOM*	94	99	111	119	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.
western white pine	*PIMO3*	38	42	81	87	100	570	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.

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 new growth of conifers 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.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:

This site is suitable for trails and has excellent views.

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 and 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 also 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. Epidemic levels can be reached when trees are stressed due to drought, annosus root rot, dwarf mistletoe, or from fire damage. (Burns, et al., 1990).

SITE INDEX DOCUMENTATION:

Schumacher (1928), Schumacher (1926), Alexander (1966) and Haig (1932) were used to determine forest site productivity for red fir, white fir, lodgepole pine and western white pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phases 1.3 and 1.4. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Bouldery Glacially Scoured Ridges Or Headlands	F022BI102CA	This is an open California red fir forest found in moderate deep soils with bedrock contact.
Frigid Moist Sandy Lake Or Stream Terraces	F022BI108CA	This is a moist lodgepole pine forest found on lake and stream terraces.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Moderately Deep Slopes	F022BI107CA	This is red fir-white fir forest at lower elevations.
Frigid Landslide Undulating Slopes	F022BI118CA	This is a dense red fir forest found on landslides with fine textured soils.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789147
789148 (lab 148)- site location
789166
789249
789251
789284

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	6 E
Section:	22
Datum:	NAD83
Zone:	10
Northing:	4478508
Easting:	645060
General Legal Description:	The type location is about 2,600 feet south southeast from the new Juniper Lake ranger station in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104478508645060

Relationship to Other Established Classifications:

Forest Alliance = Abies magnifica - Red fir forest; Association = Abies magnifica-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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/22/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Very Deep Loamy Slopes

Abies magnifica / / *Monardella odoratissima* - *Phlox diffusa*
(California red fir / / mountain monardella - spreading phlox)

Site ID: F022BI113CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: Mountain slope
Elevation (feet): 5,680-8,570
Slope (percent): 10-80, but generally 10-50
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 63.0-119.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 38 and 42 degrees F (3.3 to 5.5 degrees C)
Restrictive Layer: Paralithic contact occurs below 60 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra and colluvium over residuum from hydrothermally altered rocks
Surface Texture: Ashy Loam
Surface Fragments <=3" (% Cover): 8-40
Surface Fragments > 3" (% Cover): 0-1
Soil Depth (inches): 60
Vegetation: Heavily dominated by California red fir (Abies magnifica) with an occasional western white pine (Pinus monticola) and mountain hemlock (Tsuga mertensiana). White fir (Abies concolor) is found at the lower elevations with California red fir. Associated understory species include spreading phlox (Phlox diffusa), mountain monardella (Monardella odoratissima), ragwort (Senecio spp.), bluntlobe lupine (Lupinus obtusilobus), woolly mule-ears (Wyethia mollis), dusky onion (Allium campanulatum), and pinemat manzanita (Arctostaphylos

nevadensis).
Notes: This ecological site occurs on mountain slopes in the hydrothermally altered areas of Brokeoff Volcano.

Physiographic Features

This ecological site occurs on mountain slopes in the hydrothermally altered areas of Brokeoff Volcano. This site is found between 5,680 and 8,570 feet in elevation. Slopes range from 10 to 80 percent, but are generally between 10 to 50 percent.

Landform: (1) Mountain slope

	Minimum	Maximum
Elevation (feet):	5680	8500
Slope (percent):	10	80
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	South East West	

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 63 to 119 inches (1,600 to 3,023 mm) and the mean annual temperature is between 38 and 42 degrees F (3.3 to 5.5 degrees C). The frost free (>32 degree 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.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	63.0	119.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

The Diamondpeak soil series is associated with this site. Diamondpeak soils are very deep and well drained. They formed in tephra and colluvium over residuum from hydrothermally altered rocks. Acidic steam and water of various temperatures and pH have altered the mineralogy of the rock to produce soils with a significantly higher amount of clay and a lower pH than those soils in the rest of the Park. The pH was sampled in the field at 4.7 at depths from 0 to 3 inches, and 5.0 to 5.1 in the lower horizons. These soils are strongly acidic 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.

The Diamondpeak soils are classified as Fine-loamy, isotic, frigid Typic Dystroxerepts. The surface texture in the A horizon from 0 to 3 inches is an ashy loam. The subsurface textures are (with increasing depth) very paragravelly clay loam, very paragravelly sandy clay loam, and extremely paragravelly loam. Paragravel content increases with depth from 50 to 75 percent. The A horizon has 25 percent clay, with 39 percent clay in the horizon below. Percent clay gradually decreases with depth, with 18 percent clay at 60 inches. Paralithic contact occurs below 60 inches. Permeability ranges from rapid to moderately slow throughout the profile.

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

Map Unit Component, Component %
119 Diamondpeak, 30

Parent Materials:
Kind: Tephra, Colluvium, Residuum
Origin: Hydrothermally altered rock
Surface Texture: (1)Ashy loam
Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	8	40
Surface Fragments > 3" (% Cover):	0	1
Subsurface Fragments <=3" (% Volume):	4	75
Subsurface Fragments > 3" (% Volume):	0	1

Drainage Class: Well drained To Well drained
Permeability Class: Rapid To Moderately slow

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	6.0
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	9.52	11.04

Plant Communities

Ecological Dynamics of the Site

This forest is heavily dominated by California red fir (Abies magnifica) with an occasional western white pine (Pinus monticola) and mountain hemlock (Tsuga mertensiana). White fir (Abies concolor) is found at the lower elevations with California red fir. The overstory tree canopy ranges from 10 to 50 percent. The forest is patchy and unevenly aged. Associated understory species include spreading phlox (Phlox diffusa), mountain monardella (Monardella odoratissima), ragwort (Senecio spp.), bluntlobe lupine (Lupinus obtusilobus), woolly mule-ears (Wyethia mollis), dusky onion (Allium campanulatum), and pinemat manzanita (Arctostaphylos nevadensis).

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. They react with oxygen and other elements to form the variety of chemicals that can be found in the steam deposits.

California red fir has a high site index potential on this soil but in most areas still remains an uneven aged open forest. Trees may have difficulty establishing at first but once established, will grow well. Low pH, potential Al and Mn toxicity, open sun and low litter accumulation may all combine to contribute to poor seedling establishment. Understory composition and production may be influenced by the chemical characteristics of the soil as well. Pinemat manzanita (Arctostaphylos nevadensis) is common in open red fir forest nearby, but is not extensive in this area.

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 needles 0.8 to 1.4 inches in length 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.

Western white pine is occasionally present. Western white pine is also a long lived conifer with narrow crowns. It has 2 to 4 inch long needles in bundles of 5. It produces a deep tap root and extensive lateral roots. Most of the lateral roots are within the upper 2 feet of soil. Young trees have thin bark and are very susceptible to fire due to damage to the cambial tissue. Mature trees develop thicker bark and have high branches, making them less prone to mortality from fire (Griffith, 1992). Western white pine bark, when damaged by fire, can allow infestation of pathogens that can eventually kill the tree.

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, which gradually declines through the summer (Royce and Barbour, 2001).

This forest type has evolved with fire over the centuries. It is relatively open, slow growing, and accumulates fuels slowly. Therefore fire spreads across this site less frequently then for lower elevation conifer forests. 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). The stand densities and fuel characteristics of the forests in these studies are not specific enough to directly compare to fire return intervals for this site, but it seems likely that this ecological site is more open than the red fir-white fir forests on Prospect Peak or in Thousand Lakes Wilderness, so the fire return interval may lean toward the longer interval of 70 years or more. 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).

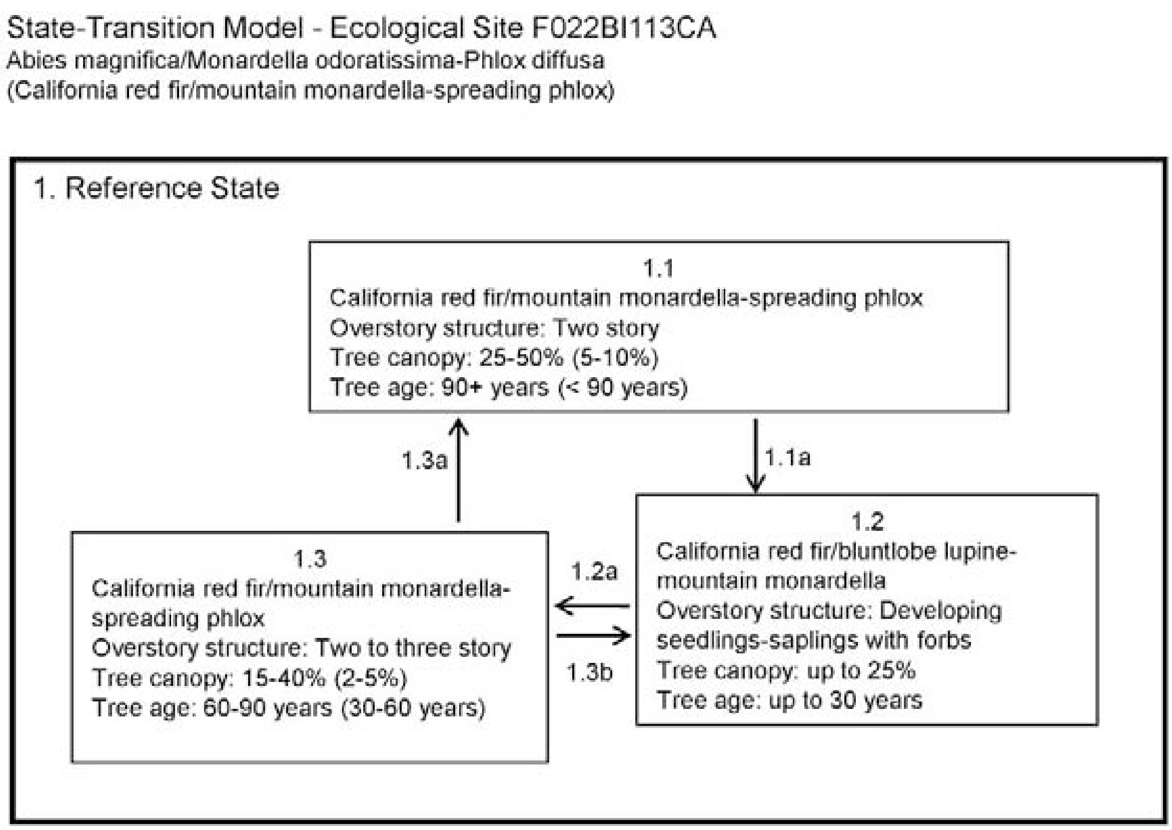
This forest is susceptible to several pathogens that can break out to epidemic levels and cause extensive stand mortality. Native pathogens are a natural component of the ecosystem and, at times, have important functions within the forest cycle. If trees are overstressed due to drought or competition for sunlight they become more vulnerable to pests and disease. Pathogens often infest the weak trees and spread in overcrowded conditions. The surviving trees may benefit from the death of the overstocked trees, and canopy gaps provide an opportunity for regeneration of the same or other 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 major pathogen affecting western white pine is the 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 upper portions above and causing leaves to turn red and fall (Hagle et al., 2003). Pruning cankers from infected stems has shown to be beneficial. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are needle cast fungi (Lophodermella arcuata, Lophodermium nitens, and Bifusella linearis) and butt-rot fungi (Phellinus pini, Phaeolus schweinitzii, Heterobasidion annosum and Armillaria spp.). Insects that can cause damage include the mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Graham., 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 Diagram



Reference - State 1

California red fir/mountain monardella-spreading phlox - Community Phase 1.1


Open California red fir forest

The mature open California red fir forest is the reference community phase for this ecological site. It is similar to its historic condition with only minor changes in understory density, due to the lack of fire. A natural fire regime reflects the time it takes for a forest to naturally develop fuels sufficient to carry fire. At the upper elevation red fir dominated forests, fuel accumulation is slow and relatively compact, reducing flammability. Red fir seedlings develop slowly due to physiographic characteristics and climatic variables, so ladder fuels take decades to develop. The natural fire return interval may be more than 100 years for this site. Taylor reports a significant drop in fire after 1905, just over 100 years ago (Taylor, 2000). Therefore this area is theoretically due for a fire, according to the historic fire cycle, but it is not long overdue and impacts from fire suppression are minimal.

Community Phase Pathway 1.1a
Wind throw, fire, and/or tree die-off from disease create openings in the forest that present suitable conditions for California red fir regeneration (Community Phase 1.2).

California red fir/mountain monardella-spreading phlox Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**7**	**60**		
		dusky onion	ALCA2	*Allium campanulatum*	2	20	1	10
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	5	35	2	10
		woolly mule-ears	WYMO	*Wyethia mollis*	0	5	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**5**	**37**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	0	20	0	2
		mountain monardella	MOOD	*Monardella odoratissima*	5	15	2	5
		spreading phlox	PHDI3	*Phlox diffusa*	0	2	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**15**		
		California red fir	ABMA	*Abies magnifica*	0	15	0	2

Annual Production by Plant Type:

Plant Type	Annual Production (lbs/AC) Low	Representative Value	High
Forb	7	24	60
Shrub/Vine	5	20	37
Tree	0	8	15
Total:	12	52	112

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	0%
Forb	5%	25%
Shrub/ Vine	0%	2%
Tree	25%	50%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	30%	80%
Surface Fragments > 0.25" and <= 3"	8%	45%
Surface Fragments > 3"	0%	5%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	0%	10%

Forest Overstory:

California red fir heavily dominates this forest with a few other conifers, including western white pine and mountain hemlock. There are several canopy layers as trees slowly recruit into the understory. The height of the upper tree canopies range from 100 to 130 feet and trees are 90 to greater than 200 years old. The dbh (diameter at breast height) of the mature trees ranges from 30 to 45 inches. Below the oldest trees is another canopy 60 to 80 feet tall, with 55 to 70 year old trees. Dbh ranges from 15 to 22 inches. Basal area ranges from 200 to 280 ft2/ acre. Tree canopy cover ranges from 25 to 50 percent.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	25	37	50

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	23.0	45.0						
western white pine *Pinus monticola*	PIMO3	N	1.0	2.0						
mountain hemlock *Tsuga mertensiana*	TSME	N	0	3.0						

Forest Understory:

The understory is generally sparse, but increases in some areas where tree canopy is low and conditions are suitable for growth. There is a 10 percent cover from dusky onion (Allium campanulatum) at this site, which is unusually high. Other common plants are pinemat manzanita (Arctostaphylos nevadensis), bluntlobe lupine (Lupinus obtusilobus), mountain monardella (Monardella odoratissima), spreading phlox (Phlox diffusa) and woolly mule-ears (Wyethia mollis).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
dusky onion *Allium campanulatum*	ALCA2	N	1.0	10.0		
bluntlobe lupine *Lupinus obtusilobus*	LUOB	N	2.0	10.0		
woolly mule-ears *Wyethia mollis*	WYMO	N	0	1.0		

Understory - Plant Type: Fern/fern ally

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
spreading phlox *Phlox diffusa*	PHDI3	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	0	2.0		
mountain monardella *Monardella odoratissima*	MOOD	N	2.0	5.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	0	2.0		

California red fir/bluntlobe lupine-mountain monardella - Community Phase 1.2

This community phase develops after a stand replacing fire or in small gaps created by a canopy disturbance. California red fir will germinate from wind or animal dispersed seed after a fire. California red fir seedling establishment may be delayed for 3 to 4 years after a fire. This may be due to the mortality of the seedlings during the first few years or be related to the timing of cone production, which occurs in 2 to 6 year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or in light litter, in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. The winged red fir seeds are wind dispersed 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993) or longer on this site. Birds, squirrels and other rodents will cache some of these seeds in the soil, where they may germinate in bunches if not consumed. The severity and size of fire influence the structure of regeneration. California red fir seems to regenerate better after a low to moderate intensity fire, or in high intensity fires of smaller size. This is most likely due to proximity to a seed source and the benefits from partial shade (Chappell and Agee 1996).

There may be an increase in understory cover after a fire, but grasses are not common in this area. Bluntlobe lupine (Lupinus obtusilobus), mountain monardella (Monardella odoratissima), spreading phlox (Phlox diffusa), woolly mule-ears (Wyethia mollis), dusky onion (Allium campanulatum), and pinemat manzanita (Arctostaphylos nevadensis) would most likely be top-killed by low to moderate intensity fires, although some may be able to resprout. More likely regeneration would occur from on-site or off-site seed sources.

Community Phase Pathway 1.2a
This is the natural pathway is to Community Phase 1.3, the young open California red fir forest. This pathway is followed in time and growth with small low to moderate intensity surface fires.

California red fir/mountain monardella-spreading phlox - Community Phase 1.3
California red fir continues to grow as an open forest in this area. This may be partly due to low pH and Al and Mn toxicity. An occasional lightening induced surface fire will also maintain an open forest.

This community phase experiences rapid growth in conifer height and an increase in canopy cover. California red fir reaches seed bearing age at between 35 to 40 years, but western white pine can bear seed at 10 years (Cope, 1993, and Griffith, 1992). Therefore California red fir needs a longer fire free interval to develop new seed crops.

This community phase begins with pole-sized trees and lasts until the trees are about 100 years old. California red fir will slowly continue to regenerate under the forest canopy during this time.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of small low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to a mature open California red fir forest (Community Phase 1.1).

Community Phase Pathway 1.3b
In the event of a canopy fire, this community phase would return to Community Phase 1.2, Stand Regeneration.

Ecological Site Interpretations

Forest 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.

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 new growth of conifers 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.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area provides excellent views of geothermal processes.

Wood Products:
The wood from California red fir is straight-grained and light. California red fir is soft, but it's 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).

Other Products:
California red fir is used for Christmas trees (Cope, 1993).

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 forests. 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 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 youngest stands in 1.1. They are selected according to guidance listed in the site index publication.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Moderately Deep Fragmental Slopes	R022BI203CA	This rangeland ecological site is dominated by woolly mule-ears.
Loamy Seeps	R022BI209CA	This is a wet rangeland site associates with seeps and springs.
Active Hydrothermal Areas (Complex)	R022BI216CA	This site is actively eroding and moving, with changing vegetation.

Similar Sites:

Site Name	Site ID	Site Narrative

Frigid Very Deep Cinder Cone Or Shield Volcano Slopes	F022BI114CA	This is an open red fir-western white pine forest on volcanic rubble.
Frigid And Cryic Gravelly Slopes	F022BI115CA	This is an open California red fir-western white pine forest with high cover of pinemat manzanita.
Frigid Landslide Undulating Slopes	F022BI118CA	This is a dense red fir forest on landslides in hydrothermally altered material.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789176
789210- site location

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	4 E
Section:	15
Datum:	NAD83
Zone:	10
Northing:	4479581
Easting:	624796
General Legal Description:	The type location is about 0.7 miles north-northwest of Diamond Peak, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104479581624796

Relationship to Other Established Classifications:

Forest Alliance = Abies magnifica - Red fir forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/22/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Very Deep Cinder Cone Or Shield Volcano Slopes

Abies magnifica - Pinus monticola / *Arctostaphylos nevadensis - Chrysolepis sempervirens* / *Angelica breweri*
(California red fir - western white pine / pinemat manzanita - bush chinquapin / Brewer's angelica)

Site ID: F022BI114CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Cinder cone, (2) Shield volcano
Elevation (feet): 6,040-8,200
Slope (percent): 8-60
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 27.0-83.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 to 44 degrees F (5 to 6.6 degrees C)
Restrictive Layer: None
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra over residuum from basalt and/or basaltic andesite; ash over colluvium and residuum from volcanic rocks
Surface Texture: (1) Ashy fine sand, (2)Very gravelly ashy loamy sand
Surface Fragments <=3" (% Cover): 0-20
Surface Fragments > 3" (% Cover): 5-35
Soil Depth (inches): >60
Vegetation: Open California red fir (Abies magnifica) and western white pine (Pinus monticola) forest with pinemat manzanita (Arctostaphylos nevadensis) in the understory and a high cover of rubble across the landscape.

Notes: This ecological site is found on cinder cones and on shield volcanoes with a high cover of volcanic rubble exposed on the surface.

Physiographic Features

This ecological site is found on cinder cones and on shield volcanoes with a high cover of volcanic rubble exposed on the surface. This site is found between 6,040 and 8,200 feet in elevation. Slopes range from 8 to 60 percent.

Landform:	(1) Cinder cone
	(2) Shield volcano

	Minimum	Maximum
Elevation (feet):	6040	8200
Slope (percent):	8	60
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very low	Medium
Aspect:	South East West	

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 between 27 to 83 inches (686 mm to 2,108 mm) and the mean annual temperature ranges between 41 to 44 degrees F (5 to 6.6 degrees C). The frost free (>32 degrees F) season is 50 to 90 days. The freeze free (>28 degrees F) season is 60 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	50	90
Freeze-free period (days):	60	200
Mean annual precipitation (inches):	27.0	83.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description:	System	Subsystem	Class

Representative Soil Features

This site is associated with the Bearrubble and Vitrandic Xerorthents soil components. These soils are very deep and somewhat excessively drained or well drained. The Bearrubble soils formed in tephra over residuum from basalt and/or basaltic andesite. They have a 0 to 3 inch O horizon consisting of pine needles and twigs over tephra deposits. The tephra deposits have developed a thin A horizon between 3 and 6 inches, and have an ashy fine sand texture with very few rock fragments. The lower portion of the tephra deposits from 6 to 13 inches is designated as a C horizon, with an extremely cobbly loamy coarse sand texture. This horizon is probably a combination of tephra mixed with colluvium and residuum. Below 13 inches there are several 2Bwb horizons with extremely cobbly ashy sandy loam, extremely stony medial sandy loam, or very stony medial fine sandy loam textures. The Bearrubble soils are Medial-skeletal, amorphic, frigid Typic Vitrixerands. The Bearrubble soils have very low (0.0 inches/ 60 inches of soil) to moderate (6.92 inches/60 inches soil) available water capacity (AWC).

Vitrandic Xerorthents formed in ash over colluvium and residuum from volcanic rocks. These soils have a very gravelly ashy loamy sand texture in the A horizon from 1 to 5 inches. There are three Bw horizons from 5 to 34 inches with extremely or very stony medial sandy loam textures. A 3C1 horizon with a gravel texture is present from 34 to 46 inches, and a 3C2 horizon with stone texture is present below 46 inches. Neither of these soils have a restrictive layer or bedrock contact within the upper 60 inches of soil. The Vitrandic Xerorthents have very low (0.18 to 2.33 inches/ 60 inches of soil) AWC. The AWC is determined by soil texture and rock fragments.
This ecological site is associated with the following soil components within the Lassen Volcanic

National Park Soil Survey Area (CA789):

Map Unit Component, Component %
102 Vitrandic Xerorthents, 25
109 Bearrubble, 10
110 Bearrubble, 50
120 Bearrubble, 3

Parent Materials:
Kind: Tephra over residuum, Volcanic ash over colluvium and residuum
Origin: Volcanic rock

Surface Texture: (1)Ashy fine sand
(2)Very gravelly ashy loamy sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	20
Surface Fragments > 3" (% Cover):	5	35
Subsurface Fragments <=3" (% Volume):	2	90
Subsurface Fragments > 3" (% Volume):	0	45

Drainage Class: Well drained To Somewhat excessively drained
Permeability Class: Moderately rapid To Rapid

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.1	7.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.0	6.92

Plant Communities

Ecological Dynamics of the Site

This ecological site is characterized by an open California red fir (Abies magnifica) and western white pine (Pinus monticola) forest with pinemat manzanita (Arctostaphylos nevadensis) in the understory and a high cover of rubble across the landscape. The tree canopy remains relatively open with a range from 15 to 40 percent. Other plants include Brewer's angelica (Angelica breweri), bush chinquapin (Chrysolepis sempervirens), white hawkweed (Hieracium albiflorum), oceanspray (Holodiscus discolor), mountain monardella (Monardella odoratissima), and wax currant (Ribes cereum).

The canopy cover in this forest site is often less than 25 percent, with wide open patches of un-vegetated rubble land between forest patches. This site could pass for a rangeland site, but the trees produce pockets of denser canopy and forest structures in areas where finer textured soils have developed from ash and tephra deposits or from colluvial soil accumulation. This site is situated on southern to western exposures on upper cinder cones and shield volcanoes, which have high solar radiation. The snow pack melts early in the season on these aspects, and soil water is lost to evaporation and to evapotranspiration. Even though the soils are very deep, they have coarse textures and a high percentage of rock fragments that allow water to drain quickly. In addition, the volcanic rubble land surrounding the forest pockets probably drains rather than holds water in the area.

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 inch 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.

Western white pine is usually present and increases in areas where there is less rubble and more soil. Western white pine is also a long lived conifer with a narrow crown. It has 2 to 4 inch long needles in bundles of 5. It produces a deep tap root and extensive lateral roots. Most of the lateral roots are within the upper 2 feet of soil. Young trees have thin bark and are very susceptible to fire due to damage to the cambial tissue. Mature trees develop thicker bark and have high branches, making them less prone to mortality from fire (Griffith, 1992). Western white pine bark, when damaged by fire, can allow infestation of pathogens that can eventually kill the tree.

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, which gradually declines through the summer (Royce and Barbour, 2001).

In the year 2000, Alan Taylor published a report on the historic fire regime of several forest types in relation to aspect on Prospect Peak. A portion of this ecological site is located on the south and western sides of Prospect Peak. This ecological site lies above the Jeffrey pine white fir forests at the lower elevations. In this study fire regimes were determined by dating cross sections of wood from fire scarred trees, or from radial growth changes in tree cores. The point fire return interval for the Jeffrey pine-white fir forest between the years of 1546 and 1903 ranged from 15.5 to 38 years, with a mean of 29.8. The point fire return interval for the red fir-western white pine forest between the years of 1685 and 1937 ranged from 26 to 109, with a mean of 70 (Taylor, 2000). Fire return intervals were shorter on the eastern slopes than on the southern and western slopes. Data was not analyzed for the northern slopes, which extend beyond the park boundary. Some of the variation in the fire return interval was attributed to the un-vegetated Fantastic Lava Beds, Painted Dunes and Cinder Cone formations to the south, which do not provide fuel and act as a fire barrier. It is probable that this red fir-western white pine ecological site has a longer fire interval than the mean listed above (70 years) for the red fir-western white pine site because of the un-vegetated rubble lands that finger through the area. Perhaps the maximum fire return interval of 109 years would be more appropriate for this site. 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 upper slopes, while low to moderate intensity fires occur only along 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). Fire size on Prospect Peak between 1627 and 1904 ranged from 39 to 1537 ha, with a mean of 457 ha. The larger fires generally occurred in the lower elevation Jeffrey pine forests (Taylor, 2000).

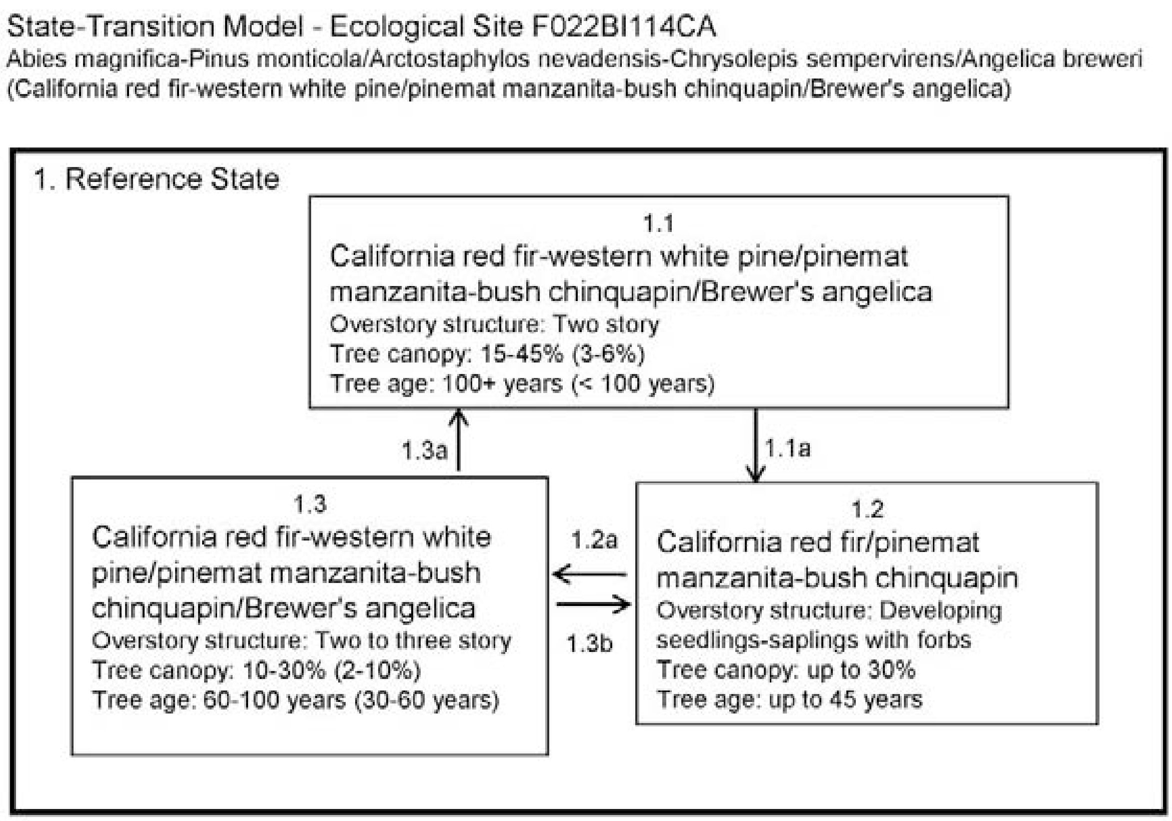
This forest is susceptible to several pathogens that can break out to epidemic levels and cause extensive stand mortality. Native pathogens are a natural component of the ecosystem and, at times, have important functions within the forest cycle. If trees are overstressed due to drought or competition for sunlight they become more vulnerable to pests and disease. Pathogens often infest the weak trees and spread in overcrowded conditions. The surviving trees may benefit from the death of overstocked trees, where canopy gaps provide an opportunity for regeneration of the same or other 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 major pathogen affecting western white pine is the 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 turn red and fall (Hagle et al., 2003). Pruning cankers from infected stems has shown to be beneficial. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are needle cast fungi (Lophodermella arcuata, Lophodermium nitens, and Bifusella linearis), butt-rot fungi (Phellinus pini, Phaeolus schweinitzii, Heterobasidion annosum, and Armillaria spp.). Insects that can cause damage include the mountain pine beetle (Dendroctonus ponderosae), and ips beetles (Ips emarginate and Ips montanus) (Graham, 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 Diagram



Reference - State 1

California red fir-western white pine/pinemat manzanita-bush chinquapin/Brewers angelica - Community Phase 1.1

Open California red fir forest

The mature open California red fir forest is the reference community phase for this ecological site. It is similar to its historic condition, with only minor changes in understory density due to the lack of fire. A natural fire regime reflects the time it takes for a forest to naturally develop fuels sufficient to carry fire. At the upper elevations in red fir dominated forests fuel accumulation is slow and relatively compact, reducing flammability. Red fir seedlings develop slowly due physiographic characteristics and climatic variables, so ladder fuels take decades to develop. The natural fire return interval may be more than 100 years for this site. There has been a significant drop in fire since the year 1905, just over 100 years ago (Taylor, 2000). Therefore this area is theoretically due for a fire according to the historic fire cycle, but it is not long overdue and impacts from fire suppression are minimal. Lightning is common in July and August, but the extensive rubble lands and open canopy limit the spread of fire.

Community Phase Pathway 1.1a
Wind-throw, fire, or tree die-off from disease creates openings in the forest that present suitable conditions for California red fir and western white pine regeneration (Community Phase 1.2)

California red fir-western white pine/pinemat manzanita-bush chinquapin/Brewers angelica Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**8**		
		Brewer's angelica	ANBR5	*Angelica breweri*	0	8	0	3
		white hawkweed	HIAL2	*Hieracium albiflorum*	0	2	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**190**	**421**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	130	270	25	40
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	60	120	10	20
		oceanspray	HODI	*Holodiscus discolor*	0	10	0	2
		mountain monardella	MOOD	*Monardella odoratissima*	0	6	0	5
		wax currant	RICE	*Ribes cereum*	0	15	0	5

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**23**		
		California red fir	ABMA	*Abies magnifica*	0	15	0	7
		western white pine	PIMO3	*Pinus monticola*	0	8	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Forb	0	5	8
Shrub/Vine	190	278	421
Tree	0	14	23
Total:	190	297	452

Structure and Cover:

Ground Cover

Vegetative Cover	**Minimum**	**Maximum**
Grass / Grasslike	0%	2%
Forb	0%	6%
Shrub/ Vine	5%	45%
Tree	15%	45%
Non-Vascular Plants	0%	1%
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	0%	85%
Surface Fragments > 0.25" and <= 3"	5%	10%
Surface Fragments > 3"	30%	80%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	0%	5%

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet			0%	2%	%	%		
> 0.5 - < 1 feet			0%	4%	5%	40%		
> 1 - <= 2 feet					2%	15%	0%	1%
> 2 - < 4.5 feet							0%	1%
> 4.5 - <= 13 feet							0%	2%
> 13 - < 40 feet							0%	2%
< 40 - >= 80 feet							15%	45%
> 80 - < 120 feet								
>= 120 feet								

Forest Overstory:

California red fir heavily dominates this forest, with western white pine found in the more lush locations of the site. The upper tree canopy height ranges from 70 to 85 feet with a canopy cover ranging from 15 to 45 percent. Mature trees are over 100 years old and have a DBH (diameter at breast height) ranging from 18 to 24 inches. Basal area ranges from 160 to 260 ft2/ acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	15	30	45

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	10.0	35.0						
western white pine *Pinus monticola*	PIMO3	N	5.0	10.0						

Forest Understory:

The understory is dominated by pinemat manzanita (Arctostaphylos nevadensis), and to a lesser extent bush chinquapin (Chrysolepis sempervirens). Other common species are Brewer's angelica (Angelica breweri), white hawkweed (Hieracium albiflorum), oceanspray (Holodiscus discolor), mountain monardella (Monardella odoratissima) and wax currant (Ribes cereum). There is a high cover of un-vegetated rubble land between and among the forested areas.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Brewer's angelica *Angelica breweri*	ANBR5	N	0	3.0		
white hawkweed *Hieracium albiflorum*	HIAL2	N	0	2.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	25.0	40.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	10.0	20.0		
oceanspray *Holodiscus discolor*	HODI	N	0	2.0		
mountain monardella *Monardella odoratissima*	MOOD	N	0	5.0		
wax currant *Ribes cereum*	RICE	N	0	5.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	0	7.0		

western white pine *Pinus monticola*	PIMO3	N	0	3.0

<u>California red fir/pinemat manzanita-bush chinquapin - Community Phase 1.2</u>

This community phase develops after a stand replacing fire or in small gaps created by a canopy disturbance. California red fir and western white pine will germinate from wind or animal dispersed seed after a fire. California red fir seedling establishment may be delayed for 3 to 4 years after a fire. This may be due to the mortality of the seedlings during the first few years or be related to the timing of cone production, which occurs in 2 to 6 year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or light litter, in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. The winged red fir seeds are wind dispersed at 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993). The seeds of western white pine can be dispersed over 2,000 feet by wind. The seeds can remain viable in litter for up to 4 years, but viability decreases quickly (Griffith, 1992). Birds, squirrels and other rodents will cache some of these seeds in the soil, which may germinate in bunches if not consumed. The severity and size of a fire influence the structure of regeneration. California red fir seems to regenerate better after a low to moderate intensity fire, or in high intensity fires of smaller size. This is most likely due to proximity to a seed source and the benefits from partial shade (Chappell and Agee 1996).

Pinemat manzanita is killed by fire. It does not resprout from the root crown but re-establishes itself from seed. It colonizes disturbed sites and continues to grow well under an open canopy as long as there is sufficient sunlight (Howard, 1993). Other forbs and grasses germinate from onsite stored seed or wind dispersed seed from adjacent areas. Some of the understory species may resprout after low to moderate intensity fires.

Bush chinquapin (Chrysolepis sempervirens) can resprout from the roots, root crown, or the stump after it has been top-killed by a fire. It can also regenerate from seed, but there is little data about seed dormancy or storage.

Community Phase Pathway 1.2a

The natural pathway is to Community Phase 1.3, the young open California red fir forest. This pathway is followed with time and growth with small low to moderate intensity surface fires.

<u>California red fir-western white pine/pinemat manzanita-bush chinquapin/Brewers angelica - Community Phase 1.3</u>

California red fir and western white pine continue to grow into an open forest due to the natural preference of sunlight and the occasional lightening induced surface fire.

This community phase experiences rapid growth in conifer height and canopy cover. California red fir reaches seed bearing age between 35 to 40 years, but western white pine can bear seed at 10 years (Cope, 1993, and Griffith, 1992). Therefore California red fir needs a longer fire free interval to develop new seed crops.

This community phase begins with pole-sized trees and lasts until the trees are about 100 years old. California red fir will slowly continue to regenerate under the forest canopy during this time.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of small low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to a mature open California red fir forest (Community Phase 1.1).

Community Phase Pathway 1.3b
In the event of a canopy fire this community would return to Community Phase 1.2, Stand Regeneration.

Ecological Site Interpretations

Forest 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*	66	66	241	241	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.
western white pine	*PIMO3*	47	47	96	96	100	570	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.

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 new growth of conifers 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.

Grasses provide forage for deer and small rodents.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
Portions of this site are extremely rubbly, which maintains open areas for good views but is not easy to travel across.
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. Mortality 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) and Haig (1932) were used to determine forest site productivity for red fir and western white pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phases 1.3. They are selected according to guidance listed in the site index publication.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes	F022BI109CA	This is a red fir-Jeffrey pine forest found on nearby slopes with less rubble.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Bouldery Glacially Scoured Ridges Or Headlands	F022BI102CA	This is an open California red fir forest on glacially scoured areas.
Frigid And Cryic Gravelly Slopes	F022BI115CA	This is an open California red fir-western white pine forest with pinemat manzanita.

State Correlation:
This site has been correlated with the following states:

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

789113
789114
789157- Site location
789186

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	6 E
Section:	28
Datum:	NAD83
Zone:	10
Northing:	4476895
Easting:	643213
General Legal Description:	The type location for the vegetation plot is about 2,000 feet west-southwest from the Mt. Harkness fire lookout; the soil pit is another 1,000 feet to the west-southwest.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104476895643213

Relationship to Other Established Classifications:
Forest Alliance = Abies magnifica – Red fir forest; Associations = Abies magnifica-Pinus monticola/Arctostaphylos nevadensis and Abies magnifica-Pinus monticola/Chrysolepis sempervirens. (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.)

Other References:
Beaty, Matthew and Taylor, Alan H. (2001). Spatial and Temporal Variation of Fire Regimes in a Mixed Conifer Forest Landscape, Southern Cascades, California, USA. Journal of Biogeography, 28, 955-966.

Bekker, Mathew F. and Taylor, Alan H. (2001). Gradient Analysis of Fire Regimes in Montane Forest of the Southern Cascade Range, Thousand Lakes Wilderness, California, USA. Plant Ecology 155: 15-23.

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/23/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid And Cryic Gravelly Slopes

Abies magnifica - Pinus monticola / *Arctostaphylos nevadensis* / *Achnatherum occidentale*
(California red fir - western white pine / pinemat manzanita / western needlegrass)

Site ID: F022BI115CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Outwash terrace, (2) Moraine, (3) Mountain slope
Elevation (feet): 5,720-8,700
Slope (percent): 0-80
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, Northeast
Mean annual precipitation (inches): 35.0-117.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 38 to 43 degrees F (3.3 to 6.1 degrees C)
Restrictive Layer: Varies -- indurated andesite bedrock is encountered between 20 to 40 inches; densic horizon from compacted till occurs at 20 to 60 inches; silica cemented duripan ranges from 20 to 40 inches
Temperature Regime: Cryic/frigid
Moisture Regime: Xeric
Parent Materials: Volcanic deposits such as ash, tephra, debris flow, or pyroclastic flow over till or colluvium
Surface Texture: (1) Ashy loamy coarse sand, (2) Gravelly ashy sandy loam, (3) Gravelly ashy loamy sand
Surface Fragments <=3" (% Cover): 0-75
Surface Fragments > 3" (% Cover): 1-75
Soil Depth (inches): 20-80
Vegetation: Open California red fir (Abies magnifica) and western white pine (Pinus monticola) forest with the understory almost a monopoly of pinemat manzanita (Arctostaphylos

nevadensis).

Physiographic Features

This site is found on outwash terraces, moraines, glacial-valley walls, glacial-valley floors, glaciated volcanic domes, and glaciated lava plateaus. Although the majority of this site is found between 6,200 and 7,500 feet in elevation, it is mapped higher or lower in some areas. Slopes are generally between 2 to 45 percent but associated map units have slopes from 0 to 80 percent.

Landform: (1) Outwash terrace
(2) Moraine
(3) Mountain slope

	Minimum	Maximum
Elevation (feet):	5720	8700
Slope (percent):	0	80
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	High
Aspect:	South East NorthEast	

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 35 to 117 inches (889 to 2,972 mm) and the mean annual temperature ranges from 38 to 43 degrees F (3.3 to 6.1 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 60 to 190 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	60	190
Mean annual precipitation (inches):	35.0	117.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with 10 soil components that straddle the cryic/frigid soil temperature regimes. Most of this site is associated with volcanic deposits such as ash, tephra, debris flow, or pyroclastic flow over till, outwash or colluvium. The soils are moderately deep to very deep and well drained. The surface textures are predominately gravelly ashy loamy coarse sand, gravelly sandy loam, and gravelly loamy sand. The subsurface soils have a high percentage of cobbles or stones with coarse textures.
A few of the soil components are discussed in more detail below.

The Cenplat soils are moderately deep well drained soils that formed in tephra over residuum from volcanic rock. They are found on glacially scoured lava plateaus. They are classified as Ashy over medial-skeletal, glassy over amorphic, frigid Typic Haploxerands. They have about 8 inches of tephra over buried soil. There is a thin layer of needles and twigs over a thin A horizon, from 0 to 2 inches below the surface. The A horizon has an ashy loamy sand texture. The lower tephra deposits are designated as a C1 and C2 horizon, and have ashy sand and extremely cobbly ashy coarse sand textures respectively. There are three Bwb horizons below the tephra deposits (from 8 to 31 inches), which have extremely cobbly medial sandy loam textures. Indurated andesite bedrock is encountered between 20 to 40 inches below the surface.

The Cascadesprings soils are moderately deep, well drained soils that formed in tephra over till from volcanic rocks. They are found on ground moraines. They are classified as Ashy over medial-skeletal, glassy over amorphic, frigid Typic Vitrixerands. There is a very thin O horizon of needles and twigs over two A horizons. The A horizons, from 0.4 to 9 inches, have gravelly ashy loamy coarse sand textures. There are two Bwb horizons from 9 to 17 and 17 to 27 inches with very gravelly medial coarse sandy loam and very stony medial loamy coarse sand textures respectively. A densic horizon from compacted till occurs at 20 to 40 inches.

The Emeraldlake soils are associated with this ecological site at the lowest extent of their range, on the south slopes of Reading Peak. The Emeraldlake soils are very deep, somewhat excessively drained soils that formed in tephra mixed with colluvium from volcanic rocks. Emeraldlake soils are on cirque walls, volcanic domes, colluvial aprons and mountain slopes. They are classified as Ashy-skeletal, amorphic, nonacid Vitrandic Cryorthents. These soils have 3 A horizons from 0 to 14 inches, with extremely gravelly ashy fine sandy loam and extremely gravelly ashy loamy sand textures. There are two Bw horizons from 14 inches to 35 inches with extremely gravelly ashy loamy coarse sand textures. These horizons have 57 to 65 percent gravels with 10 percent cobbles and 0 to 10 percent stones. The two lower Bw horizons have ashy boulder textures with 26 percent gravel and 70 percent stones and boulders.

The Terracelake soils are moderately deep, well drained soils that formed in tephra over or mixed with colluvium and residuum from volcanic rock. Terracelake soils are on glaciated volcanic domes, glaciated mountain slopes, glaciated lava flows, scoured glacial valley walls and floors, and roche moutonnees. They are classified as Ashy-skeletal, amorphic Xeric Vitricryands. There is a thin O horizon. Two A horizons from 1 to 7 inches have gravelly ashy sandy loam textures. Two Bwb horizons are between 17 to 24 inches with very gravelly ashy fine sandy loam and extremely gravelly ashy fine sandy loam textures. A Bqb horizon (which designates silica accumulation) occurs from 24 to 27 inches with an extremely stony ashy sandy loam texture. Dacite bedrock occurs between 20 to 40 inches.

The Andic Durixerepts soil component is composed of moderately deep, well drained soils that formed in ash over glacial outwash from volcanic rocks. They are found on upper elevation outwash terraces. They are classified as Ashy-skeletal, amorphic, frigid Andic Durixerepts. They have a thin layer of needles and twigs. The A horizon is from 1 to 3 inches below the surface and has a gravelly ashy loamy coarse sand texture. The two Bw horizons from 3 to 19 inches have extremely cobbly ashy coarse sandy loam and extremely gravelly ashy coarse sandy loam textures. Two Bq horizons occur from 19 to 31 inches. The upper Bq horizon has an extremely gravelly ashy loamy coarse sand texture, and the lower horizon has a cemented extremely gravelly ashy coarse sandy loam texture. The depth of the silica cemented duripan ranges from 20 to 40 inches.

The Shadowlake soils consist of deep, well drained soils that formed in tephra over or mixed with till from volcanic rocks. They are located on ground moraines and glacial-valley walls and floors. Shadowlake soils are classified as Ashy-skeletal, glassy Xeric Vitricryands. They have a thin layer of needles and twigs overlaying a thin A horizon. The A horizon is from 1 to 2 inches below the surface and has a gravelly ashy sandy loam texture. Three Bw horizons occur between 2 to 23 inches and have gravelly ashy sandy loam or very gravelly ashy sandy loam textures. A Bq horizon occurs from 23 to 41 inches and has an extremely gravelly ashy coarse sandy loam texture. A root restrictive densic horizon occurs at 41 inches, but can vary from 40 to 60 inches.

The Readingpeak soils are associated with this ecological site, the lowest extent occurring on the south side of Reading Peak. Readingpeak soils are deep and formed in tephra over colluvium and residuum weathered from andesite, dacite and rhyodacite. They are classified as Ashy-skeletal, amorphic Xeric Vitricryands. The Sueredo soil series is associated with this site as a minor component and only occurs at the highest elevations where Sueredo soils are mapped. These soils are very deep and formed in tephra over till from volcanic rocks. They are classified as Ashy-skeletal, mixed, frigid Typic Vitrixerands.

The Vitrandic Cryothents, debris flows and the Xeric Vitricryands, pyroclastic surge soil components are associated with the 1915 eruption of Lassen Peak. The Vitrandic Cryorthents, debris flows are moderately deep to very deep and formed in pyroclastic and debris flows over glacial till from volcanic rocks or debris flows. The Xeric Vitricryands, pyroclastic surge component is deep to very deep and formed in pyroclastic surges over till from volcanic rocks. The forest in this area was destroyed during the eruption, and has been going through the process of primary and secondary succession. Ecological site F022BI106CA has more detailed information about primary succession after the 1915 eruption.

Permeability varies by soil component, but in general the upper horizons have moderately rapid to very rapid permeability, and are very slowly permeable to impermeable through duripans, densic layers, or bedrock.

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

Map Unit Component, Comp %
106 Cenplat, 70
106 Cascadesprings, 5
112 Cascadesprings, 85
112 Emeraldlake, 2
113 Emeraldlake, 25
113 Readingpeak, 20
113 Cascadesprings, 2
132 Vitrandic Cryorthents-debris flows, 90
132 Xeric Vitricryands-pyroclastic surge, 3
143 Andic Durixerepts, 95
143 Cascadesprings, 3
150 Shadowlake, 40
150 Terracelake, 30
151 Terracelake, 40
151 Shadowlake, 15
151 Sueredo, 5
152 Terracelake, 35
152 Shadowlake ,30
152 Sueredo, 4

153 Vitrandic Cryorthents-debris flows, 2
154 Vitrandic Cryorthents-debris flows, 2
155 Xeric Vitricryands-pyroclastic surge, 90
155 Vitrandic Cryorthents-debris flows, 5
155 Shadowlake, 3
156 Xeric Vitricryands-pyroclastic surge, 90
156 Shadowlake, 5
171 Shadowlake, 5
175 Terracelake, 5

Parent Materials:
Kind: Tephra, Debris flow, Till
Origin: Volcanic rock

Surface Texture: (1)Ashy loamy coarse sand
(2)Gravelly ashy sandy loam
(3)Gravelly ashy loamy sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	75
Surface Fragments > 3" (% Cover):	1	75
Subsurface Fragments <=3" (% Volume):	5	70
Subsurface Fragments > 3" (% Volume):	0	70

Drainage Class: Well drained To Well drained
Permeability Class: Very rapid To Impermeable

	Minimum	Maximum
Depth (inches):	20	80
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.03	5.37

Plant Communities

Ecological Dynamics of the Site

This ecological site is dominated by an open California red fir (Abies magnifica) and western white pine (Pinus monticola) forest with the understory almost a monopoly of pinemat manzanita (Arctostaphylos nevadensis).

The canopy cover in this forest site ranges from 15 to 35 percent with wide open patches of pinemat manzanita. In some areas this site could pass for a rangeland site, but these trees have the potential to develop denser canopies and forest structures. This site is most commonly found on northeastern exposures, but aspect varies from north to southwest. The western exposures tend to have more cover of green leaf manzanita (Arctostaphylos patula) and bush chinquapin (Chrysolepis sempervirons).

The soils associated with this site have several similarities. Most are moderately deep and the deep and very deep soils are skeletal, meaning they have greater than 35 percent rock fragments. Because of root limiting layers and/or high rock fragments these soils have very low to moderate available water capacity (AWC). The Terracelake and Sueredo soils are the only soils with moderate AWC. Most of these soils have ash or tephra deposits 3 to 10 inches deep which overlay or are mixed in with the pre-existing soil. The tephra deposits have very similar surface textures. Unmixed tephra deposits have an ashy loamy sand or gravelly ashy loamy coarse sand textures. When the tephra mixed with colluvium and/or residuum, extremely gravelly ashy fine sandy loams and gravelly ashy sandy loam textures develop. The tephra deposits are from various sources, depending on the location. The eruptions from Chaos Crags (about 1,100 years ago), Cinder Cone (about 300 years ago), and/or Lassen Peak deposited tephra and ash on these soils. The A horizons are generally very thin with low organic matter accumulation over an undeveloped C horizon. Buried soils below generally have sandy loam textures, with developed soil structure and mineral weathering. The tephra layer can act as an insulator from heat and reduce water loss from the lower soil horizons. It may also reduce the capillary flow from the lower soils to the surface, allowing free water to infiltrate to deeper depths.

Pinemat manzanita resprouts from adventitious roots, when branches are buried by soil. This regeneration strategy may have enabled pinemat manzanita to re-establish through the tephra deposits. It produces and collects litter slowly and will accumulate organic matter in the tephra. Pinemat manzanita is very low growing but can provide limited shade for conifer seedlings.

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 inch 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.

Western white pine is also a long lived conifer with a narrow crown. It has 2 to 4 inch long needles in bundles of 5. It produces a deep tap root and extensive lateral roots. Most of the lateral roots are within the upper 2 feet of soil. Young trees have thin bark and are very susceptible to fire due to damage to the cambial tissue. Mature trees develop thicker bark and have higher branches, making them less prone to mortality from fire (Griffith, 1992). Western white pine bark, when damaged by fire, can allow infestation of pathogens that can eventually kill the tree.

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, which gradually declines through the summer (Royce and Barbour, 2001).

This forest has evolved with fire over the centuries. It is relatively open, slow growing, and accumulates fuels slowly. Therefore fire spreads across this site less frequently than lower elevation conifer forests. 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 forest is has a very open canopy with low fuel loads, the fire return interval seem like it would be longer than the average red fir western white pine forest. A fire return interval for this site might range from 70 to 109 years. 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).

Evidence of fire suppression is everywhere in this forest type. Even in the most open forests, young seedlings and saplings are filling in the understory and shading out pinemat manzanita. Some areas are further along than others 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. Areas that still have open canopies and very little understory recruitment may have experienced fire or wind throw events. Open forests may have microclimates that are warmer and droughtier than other areas with this site, due to aspect, slope position and/or slope shape. Therefore, tree recruitment is slower in some areas than others.

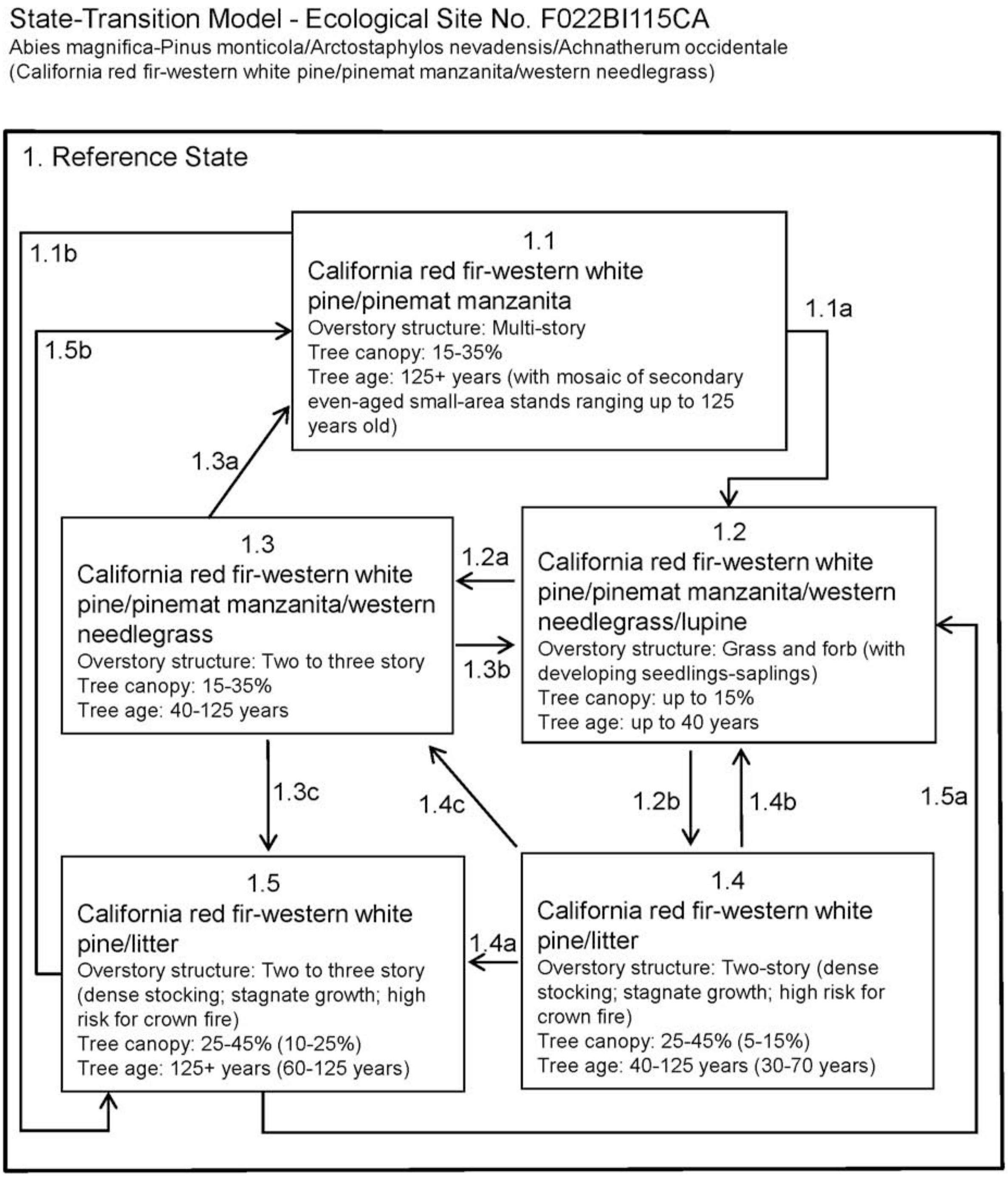
This forest is susceptible to several pathogens that can break out to epidemic levels and cause extensive stand mortality. Native pathogens are a natural component of the ecosystem and, at times, have important functions within the forest cycle. If trees are overstressed due to drought or competition for sunlight, they become more vulnerable to pests and disease. Pathogens often infest the weak trees and spread in overcrowded conditions. The surviving trees may benefit from the death of overstocked trees, and canopy gaps provide an opportunity for regeneration of the same or other 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 major pathogen affecting western white pine is the 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 and causing the leaves to turn red and fall (Hagle et al., 2003). Pruning cankers from infected stems has shown to be beneficial. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are needle cast fungi (Lophodermella arcuata, Lophodermium nitens, and Bifusella linearis) and butt-rot fungi (Phellinus pini, Phaeolus schweinitzii, Heterobasidion annosum, and Armillaria spp.). Insects that can cause damage include the mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Graham, 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 Diagram



Reference - State 1

California red fir-western white pine/pinemat manzanita - Community Phase 1.1

California red fir-western white pine forest

The mature open California red fir forest is the reference community phase for this ecological site. It is similar to its historic condition, with only minor changes in understory density due to the lack of fire. A natural fire regime reflects the time it takes for a forest to naturally develop fuels sufficient to carry fire. At the upper elevations in red fir dominated forests, fuel accumulation is slow and relatively compact, reducing flammability. Red fir seedlings develop slowly due physiographic characteristics and climatic variables, so ladder fuels take decades to develop. The natural fire return interval may be 70 to 100 years for this site. Taylor (2000) reports a significant drop in fire after 1905 on Prospect Peak, just over 100 years ago. Therefore this area is theoretically due for a fire according to the historic fire cycle, but it is not long overdue and impacts from fire suppression are minimal. Understory growth is visible in the community photo. A number of the understory trees would be killed in the event of a fire.

Community Phase Pathway 1.1a
Wind throw, fire, or tree die off from disease creates openings in the forest that present suitable conditions for California red fir and western white pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b

If fire is excluded from the old growth community phase, tree density continues to increase in the understory and shifts the community phase toward the closed California red fir forest (Community Phase 1.5).

California red fir-western white pine/pinemat manzanita Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**91**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	1	0	1
		scarlet gilia	IPAG	*Ipomopsis aggregata*	0	17	0	10
		narrowleaf lupine	LUAN4	*Lupinus angustifolius*	0	25	0	3
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	0	48	0	5

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**40**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	15	0	5
		Ross' sedge	CARO5	*Carex rossii*	0	5	0	1
		squirreltail	ELEL5	*Elymus elymoides*	0	20	0	5

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**100**	**725**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	100	600	15	90
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	0	100	0	5
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	0	25	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**30**		
		California red fir	ABMA	*Abies magnifica*	0	20	0	4
		Sierra lodgepole pine	PICOM	*Pinus contorta var.*	0	2	0	1

		murrayana				
western white pine	PIMO3	*Pinus monticola*	0	8	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	17	40
Forb	0	0	91
Shrub/Vine	100	380	725
Tree	0	17	30
Total:	100	414	886

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	8%
Forb	0%	15%
Shrub/ Vine	15%	90%
Tree	15%	40%
Non-Vascular Plants	0%	1%
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	40%	95%
Surface Fragments > 0.25" and <= 3"	1%	25%
Surface Fragments > 3"	7%	35%
Bedrock	0%	1%
Water	0%	0%
Bare Ground	0%	18%

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	4%	0%	1%	%	%		
> 0.5 - < 1 feet	0%	4%	0%	1%	15%	90%		
> 1 - <= 2 feet			0%	13%			0%	1%
> 2 - < 4.5 feet					0%	5%	0%	1%
> 4.5 - <= 13 feet							0%	2%
> 13 - < 40 feet							1%	2%

< 40 - >= 80 feet							2%	10%
> 80 - < 120 feet							10%	30%
>= 120 feet								

Forest Overstory:

The overstory canopy cover ranges from 15 to 35 percent, dominated by California red fir. Less than half the canopy is composed of western white pine. Sierra lodgepole pine, white fir, or mountain hemlock are occasionally present. The upper canopy height is between 90 to 120 tall, with 110 to 300 year old trees. The dbh (diameter at breast height) of the overstory trees ranges from 25 to 40 inches and basal area ranges from 50 to 80 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	15	30	35

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	10.0	20.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0						
western white pine *Pinus monticola*	PIMO3	N	5.0	13.0						

Forest Understory:

The understory consists of 15 to 90 percent cover of pinemat manzanita (Arctostaphylos nevadensis). The diversity of species is relatively low. Other plants that may be present with low cover include western needlegrass (Achnatherum occidentale), greenleaf manzanita (Arctostaphylos patula), pioneer rockcress (Arabis platysperma), squirreltail (Elymus elymoides), scarlet gilia (Ipomopsis aggregata), narrowleaf lupine (Lupinus angustifolius), and bluntlobe lupine (Lupinus obtusilobus).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	5.0		
Ross' sedge *Carex rossii*	CARO5	N	0	1.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	5.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	1.0		
scarlet gilia *Ipomopsis aggregata*	IPAG	N	0	10.0		
narrowleaf lupine *Lupinus angustifolius*	LUAN4	N	0	3.0		
bluntlobe lupine *Lupinus obtusilobus*	LUOB	N	0	5.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	15.0	90.0		
greenleaf manzanita *Arctostaphylos patula*	ARPA6	N	0	5.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	0	2.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	0	4.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	1.0		
western white pine *Pinus monticola*	PIMO3	N	0	3.0		

California red fir-western white pine/pinemat manzanita/western needlegrass/lupine - Community Phase 1.2

This community phase develops after a stand replacing fire or in small gaps created by a canopy disturbance. California red fir and western white pine will germinate from wind or animal dispersed seed after a fire, although California red fir seedling establishment may be delayed for 3 to 4 years. This may be due to the mortality of the seedlings during the first few years or be related to the timing of cone production, which occurs in 2 to 6 year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or in light litter, in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. The winged red fir seeds are wind dispersed 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993). The seeds of western white pine can be dispersed over 2,000 feet by wind. Seeds can remain viable in litter for up to 4 years, but viability decreases quickly (Griffith, 1992). Birds, squirrels and other rodents will cache some of these seeds in the soil, which may germinate in bunches if not consumed. The severity and size of a fire influence the structure of regeneration. California red fir seems to regenerate better after a low to moderate intensity fire, or in high intensity fires of smaller size. This is most likely due to proximity to a seed source and the benefits from partial shade

(Chappell and Agee 1996).

Pinemat manzanita is killed by fire. It does not resprout from the root crown but re-establishes itself from seed. It colonizes disturbed sites and continues to grow well under an open canopy as long as there is sufficient sunlight (Howard, 1993). Other forbs and grasses germinate from on-site stored seed or wind dispersed seed from adjacent areas. Some of the understory species may resprout after low to moderate intensity fires.

Community Phase Pathway 1.2a
The natural pathway is to Community Phase 1.3, the young open California red fir forest. This pathway is followed in time and growth with small low to moderate intensity surface fires.

Community Phase Pathway 1.2b
An alternate pathway is created when fire is excluded from the system and leads to the Young Closed California red fir forest (Community Phase 1.4). This pathway is unlikely given the natural tendency for this site to maintain an open canopy, even in the absence of fire for 70 years or more. However, if seed is available and soil moisture and climatic conditions are favorable for seedling survival, a dense even aged forest could develop.

California red fir-western white pine/pinemat manzanita/western needlegrass - Community Phase 1.3
California red fir and western white pine continue to grow into an open forest due to the natural preference of sunlight and the occasional lightening induced surface fire.

This community phase experiences rapid growth in conifer height and canopy cover. California red fir can reach seed bearing age at 35 to 40 years, but western white pine can bear seed at 10 years (Cope, 1993, and Griffith, 1992). Therefore California red fir needs a longer fire free interval to develop new seed crops.

This community phasae begins with pole-sized trees and lasts until the trees are about 100 years old. California red fir will slowly continue to regenerate under the forest canopy during this time.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of small low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to a mature open California red fir forest (Community Phase 1.1).

Community Phase Pathway 1.3b
In the event of a canopy fire this community phase would return to Community Phase 1.2, Stand Regeneration.

Community Phase Pathway 1.3c
If fire does not occur, forest density increases. The increased density shifts this community phase toward the closed California red fir forest (Community Phase 1.5).

California red fir-western white pine/litter - Community Phase 1.4

The development of this community phase within this ecological site is relatively uncommon since young even aged dense stands generally do not form, due to poor forest productivity. Dense stands seem to form more often through pathway 1.1b, from increased understory growth under the mature open canopy. This forest develops after a period of forest regeneration. The trees may be pole-sized and even aged at first, but will develop into a mature forest over time. Density increases as California red fir and western white pine continue to establish in the understory, creating multiple canopy layers. When this forest develops it is defined by a dense canopy and high basal area of California red fir and, to a lesser degree, western white pine. Canopy cover ranges from 30 to 60 percent. The overstory trees may be up to 125 years old. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients. This stress makes the trees more susceptible to death from infestation and drought. Fire hazard increases in this community, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a

If fire continues to be excluded from this system the mature closed California red fir forest develops (Community Phase 1.5).

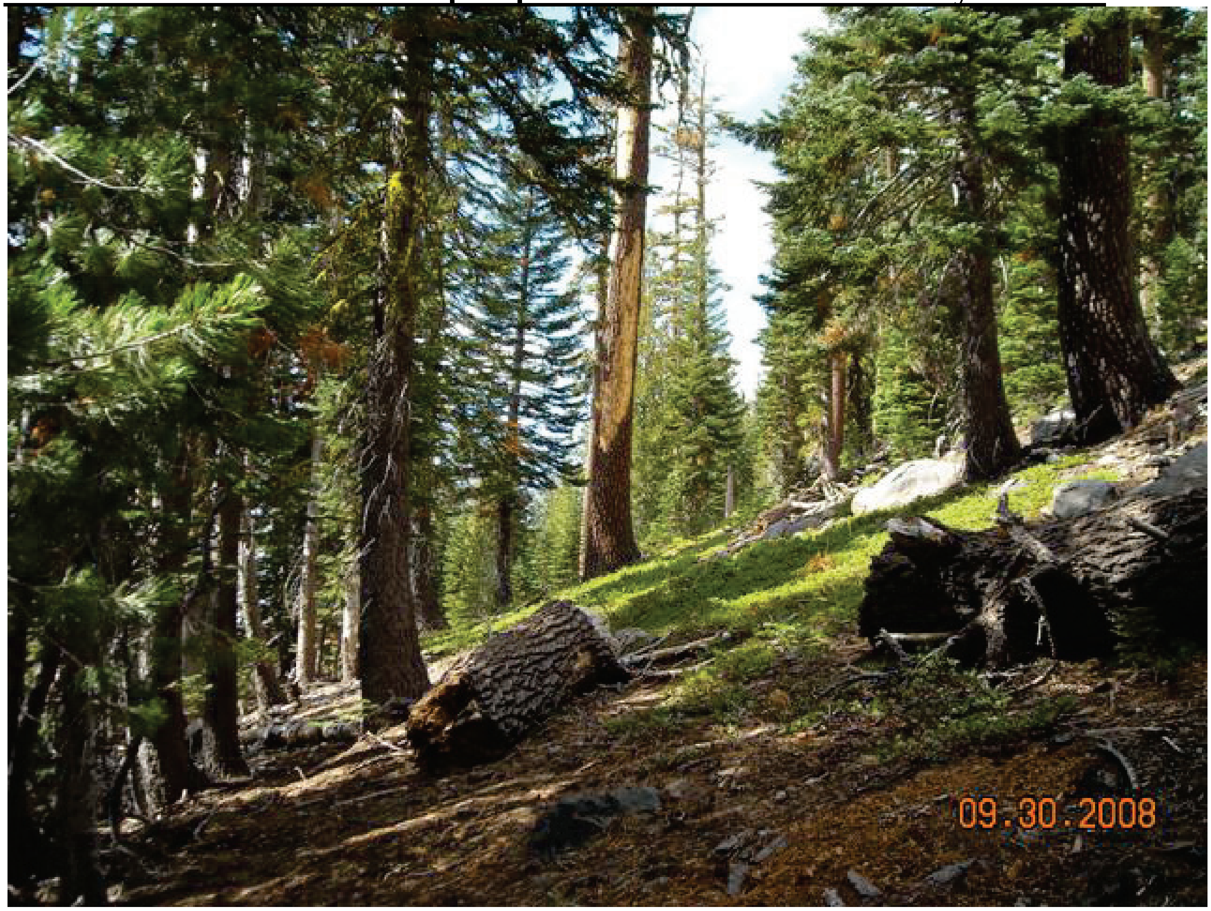
Community Phase Pathway 1.4b

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

Community Phase Pathway 1.4c

The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it had developed with fire over time. Manual treatments to thin out the trees and fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to its natural state of an open California red fir-western white pine forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3.

California red fir-western white pine/pinemat manzanita - Community Phase 1.5



Closed California red fir forest

The mature closed California red fir forest develops with the continued exclusion of fire, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continue, and tree health and vigor decreases. The overstory trees are over 125 years old. As mentioned above, the dense community phase is usually reached by community pathway 1.1b, with tree density increasing from the development of the understory under the mature open canopy.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate conifer regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b
The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it had developed with fire over time. Manual treatments to thin out the understory trees and other fuels, and/or prescribed burns, could be implemented to shift this forest back to its natural state of an open California red fir-western white pine forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1.

Forest Overstory:
The canopy cover ranges from 35 to 60 percent with an average of about 50 percent. California red fir is dominant, with western white pine composing about a third of the overstory. The overstory trees are 100 to 120 feet tall with a mid-canopy layer around 60 to 80 feet. Basal area ranges from 110 to 180 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	50	60

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	25.0	40.0						
western white pine *Pinus monticola*	PIMO3	N	10.0	20.0						

Forest Understory:
Pinemat manzanita is still the dominant understory vegetation, but cover has reduced to 2 to 40 percent. Other species mentioned in Community 1.1 may be present in trace amounts. California red fir seedlings and saplings have about 10 percent cover. Western white pine is regenerating as well, and may have 0 to 8 percent cover.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	2.0	40.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	5.0	15.0		
western white pine *Pinus monticola*	PIMO3	N	0	8.0		

Ecological Site Interpretations

Forest 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*	34	45	116	153	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.
Sierra lodgepole pine	*PICOM*	60	68	49	66	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.
western white pine	*PIMO3*	38	46	81	94	100	570	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.

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 new growth of conifers 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.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This site is suitable for trails and provides excellent views.

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 trees are stressed due to drought, annosus root rot, dwarf mistletoe, or from fire damage. (Burns, et al., 1990).
SITE INDEX DOCUMENTATION:

Schumacher (1928), Haig (1932), and Alexander (1966) were used to determine forest site productivity for red fir, western white pine, and Sierra 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. 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.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Moderately Deep Slopes	F022BI107CA	This is a California red fir-white fir forest found at lower elevations.
Glaciated Mountain Slopes	R022BI204CA	This is a pinemat manzanita rangeland site, which does not develop into a forest.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Bouldery Glacially Scoured Ridges Or Headlands	F022BI102CA	This is an open California red fir forest with some western white pine and Sierra lodgepole pine, with exposed bedrock outcrops.
Frigid Very Deep Cinder Cone Or Shield Volcano Slopes	F022BI114CA	This is an open California red fir-western white pine forest with high cover of volcanic rubble.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789174
789187- site location
789189
789209
789226
789229
789231
789255
789321
789355
789356
789360

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	5 E
Section:	35
Datum:	NAD83
Zone:	10
Northing:	4484530
Easting:	636025
General Legal Description:	The type location is about 0.75 miles east of the base of Hat Mountain in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104484530636025

Relationship to Other Established Classifications:

Forest Alliance = Abies magnifica – Red fir forest; Association = Abies magnifica-Pinus monticola/Arctostaphylos nevadensis. (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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/13/2011

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/23/2010	Kendra Moseley	1/12/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Coarse Glaciolacustrine Gentle Slopes

Abies magnifica - Pinus contorta var. murrayana / / *Elymus elymoides*
(California red fir - Sierra lodgepole pine / / squirreltail)

Site ID: F022BI117CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Outwash terrace, (2) Outwash plain
Elevation (feet): 6,280-6,800
Slope (percent): 0-15
Water Table Depth (inches): 7-60
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 57.0-63.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 degrees F (5 degrees C)
Restrictive Layer: Silica cemented duripan varies from 20 to 60 inches
Temperature Regime: Frigid
Moisture Regime: Xeric/Aquic
Parent materials: Volcanic ash over glaciolacustrine deposits over outwash from volcanic rocks
Surface Texture: Gravelly ashy loamy coarse sand
Surface Fragments <=3" (% Cover): 10-50
Surface Fragments > 3" (% Cover): 0-5
Soil Depth (inches): 20-60
Vegetation: Sierra lodgepole pine and California red fir.
Notes: This ecological site occurs on glacial outwash plains and outwash terraces.

Physiographic Features

This ecological site occurs on glacial outwash plains and outwash terraces. It is between 6,280 and 6,800 feet in elevation. Slopes range from 0 to 15 percent.

The Duric Vitraquands soil component has a seasonal water table that fluctuates between the duripan to 7 inches below the surface.

Landform:	(1) Outwash terrace
	(2) Outwash plain

	Minimum	Maximum
Elevation (feet):	6280	6800
Slope (percent):	0	15
Water Table Depth (inches):	7	60
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Very high
Aspect:	No Influence on this site	

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 57 to 63 inches (1,499 to 1,600 mm) and the mean annual temperature is about 41 degrees F (5 degrees C). The frost free (>32F) season is 50 to 85 days. The freeze free (>28F) season is 60 to 190 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	60	190
Mean annual precipitation (inches):	57.0	63.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System Subsystem Class

Representative Soil Features

This site is correlated with the Duric Vitraquands and Vitrixerands soil components.
Duric Vitraquands are deep, somewhat poorly drained soils that formed in volcanic ash over glaciolacustrine deposits over outwash from volcanic rocks. The surface texture is gravelly ashy loamy coarse sand, with similar subsurface textures. Redoximorphic features are present below 7 inches. The depth to the silica cemented duripan varies from 40 to 60 inches below the surface.

Vitrixerands are moderately deep and deep, well drained soils that formed in glaciolacustrine deposits from volcanic rocks. The surface texture is gravelly ashy loamy coarse sand with similar subsurface textures to 21 inches, below is a horizon with a very stony medial loamy sand texture. The depth to the silica cemented duripan varies from 20 to 60 inches below the surface.

These soils have very low to low AWC (available water capacity) in the upper 60 inches of soil. Permeability is rapid to moderately rapid through the upper horizons and very slow through the duripan.

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

Map Unit Component / Component %
139 Duric Vitraquands / 60
139 Vitrixerands / 1
140 Vitrixerands / 90
140 Duric Vitraquands / 10
163 Duric Vitraquands / 1

Parent Materials:
Kind: Volcanic ash, Glaciolacustrine deposits, Outwash
Origin: Volcanic rock

Surface Texture: (1) Gravelly ashy loamy coarse sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	10	50
Surface Fragments > 3" (% Cover):	0	5
Subsurface Fragments <=3" (% Volume):	15	45
Subsurface Fragments > 3" (% Volume):	1	35

Drainage Class: Somewhat poorly drained To Well drained
Permeability Class: Rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	60
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.27	3.79

Plant Communities

Ecological Dynamics of the Site

This ecological site is located on outwash terraces and glacial outwash plains with a root restrictive duripan occurring at varying depths between 20 to 60 inches. The Duric Vitraquands have a seasonal water table which fluctuates from above the duripan to 7 inches below the surface after snow melt. Shallow seasonal water tables and root restrictive layers are often associated with Sierra lodgepole pine forests due to the exclusion of other conifers. However, the conditions are not extreme enough at this site to exclude California red fir.

In 2009, the forest communities are mainly dominated by Sierra lodgepole pine (Pinus contorta var. murrayana), but a partial canopy of older California red fir (Abies magnifica) exists over the lodgepole pine canopy. Past disturbances created conditions for Sierra lodgepole pine regeneration, but did not remove all of the red fir in the overstory. If this site continues without disturbance, California red fir will eventually prevail. The understory is sparse with carex (Carex spp.), little prince's pine (Chimaphila menziesii), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), squirreltail (Elymus elymoides), sulphur-flower buckwheat (Eriogonum umbellatum), and white hawkweed (Hieracium albiflorum).

Sierra lodgepole pine can be long-lived exceeding 150 years old. The overstory trees cored to obtain representative site index data were between 110 to 135 years old. Sierra lodgepole pine does not usually gain much in girth with age, and the older trees averaged 16 to 21 inches in diameter. It grows tall and narrow with short branches. Needles are 1.2 to 2.4 inches long, in fascicles of two. Although its thin bark and shallow root system make Sierra lodgepole pine susceptible to fire, it is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow, which enable it to grow on this site. Sierra lodgepole pine produces a taproot, but it may atrophy or grow horizontally in cases of a high water table or a root restrictive layer.

Sierra lodgepole pine regenerates prolifically after fire and evenly aged stands are formed. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly and at a low intensity. However, even low intensity fire can cause damage to live trees, and fire damaged trees are more susceptible to the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine or California red fir regeneration. Over time these gaps break up the uniformity of evenly aged stands that formed after the last large fire event. This site rarely develops into old growth lodgepole pine since red fir establishes in the understory and eventually overtops and shades out the shade-intolerant Sierra lodgepole pine.

California red fir is a tall, long-lived conifer with short branches and a narrow crown. It produces single 0.8 to 1.4 inch 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. Trees are adapted to cold wet winters in areas with deep snow accumulation followed by warm summers. Young trees have thin bark and are very susceptible to fire, but as the trees mature the bark thickens and fire resistance increases.

California red fir is a shade tolerant conifer and is able to establish in the understory of the Sierra lodgepole pine on this site. It will continue to grow and reproduce in the understory and eventually dominate the forest in the absence of disturbance. In the past, the natural fire regime kept these forests from developing into the later successional stages dominated by red fir (Taylor, and Solem, 2001).
Sierra lodgepole pine has a complex disturbance regime which includes cyclic beetle infestations and fire. Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates of the lodgepole pine (Taylor and Solem, 1995). 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, the point fire return interval ranged from 4 to 55 years, with a mean of 24 for red fir-white fir forests. In the Caribou Wilderness, the mean fire return interval between the years of 1768 and 1874 was 66 years for the red fir-western white pine forest (Taylor and Solem, 2001). A fire return interval for this site might range from 24 to 70 years. Topography and aspect affect fire frequency and intensity (Beaty and Taylor, 2001). This site is in a basin with low slopes. Fire tends to burn upward with increasing intensity as it preheats the fuels. Since this site is in a low position it may experience low to moderate fires, rather than high intensity fires. However, Sierra lodgepole pine will have high mortality rates even after low and moderate intensity fires. Mature California red fir is more likely to survive these fires.

The mountain pine beetle is the most significant forest pathogen affecting this site, but several other pathogens have the potential to cause mortality or diminished productivity. Most of these pathogens represent a natural cycle of regulation and can push the closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests.

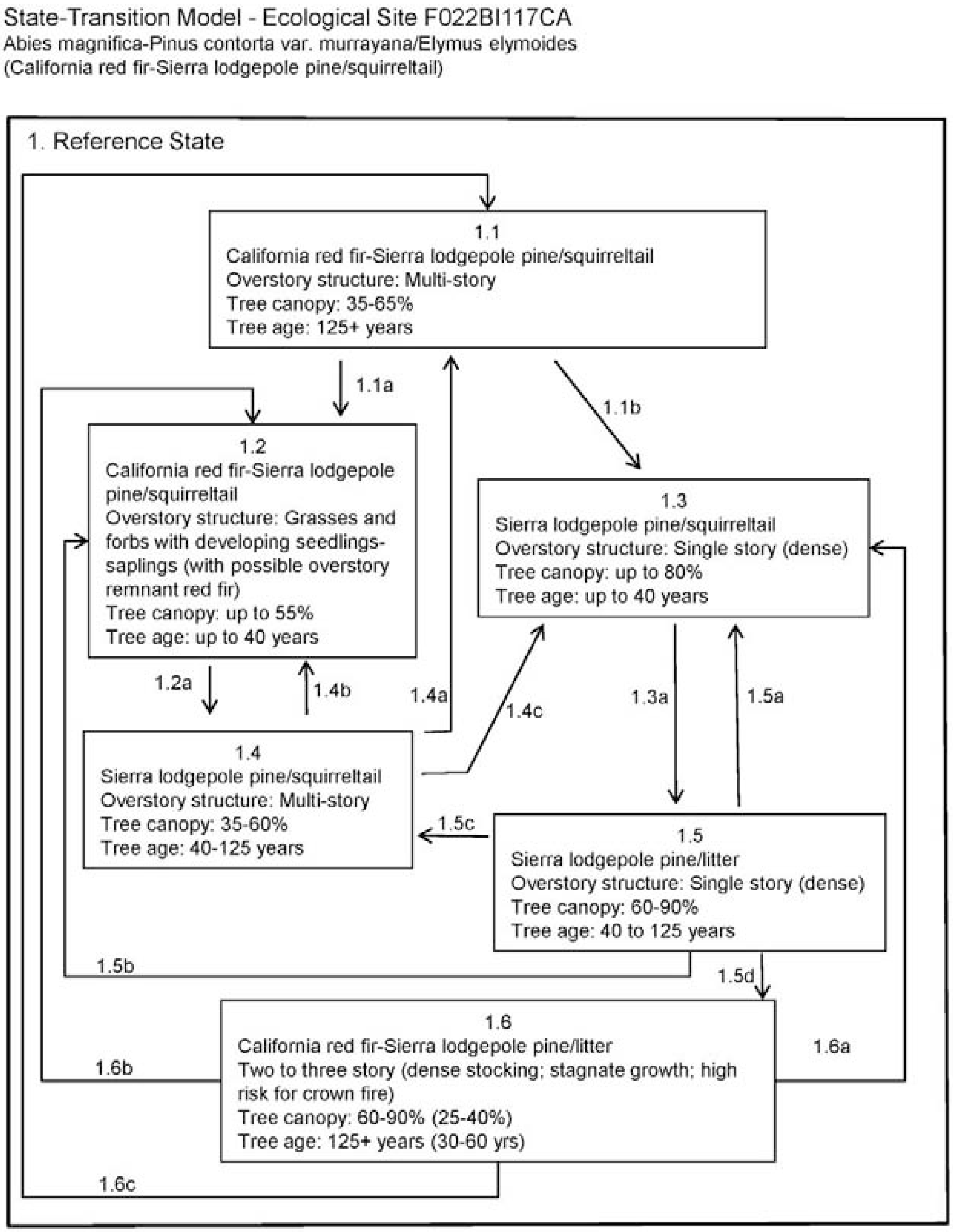
There is evidence that warming temperatures are allowing mountain pine beetles to exist farther north and into upper elevations. Warmer temperatures are altering the reproductive cycles and distribution of the mountain pine beetle. It is possible that the warmer temperatures will increase mountain pine beetle infestations for several decades. The southern mountain pine beetle may move northward due to temperature change as well (Carroll et al, 2003)

Pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), weevil (Magdalis gentiles), lodgepole terminal weevil (Pissodes terminalis), Warren's collar weevil (Hylobius warreni), pine needle scale (Chionaspis pinifoliae), black pineleaf scale (Nuculaspis californica), spruce spider mite (Oligonychus ununguis), lodgepole sawfly (Neodiprion burkei), lodgepole needle miner (Coleotechnites milleri), sugar pine tortrix (Choristoneura lambertiana), pine tube moth (Argyrotaenia pinatubana), and the pandora moth (Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips also can build up in windthrows. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 1990).

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).

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 Diagram



Reference - State 1

California red fir-Sierra lodgepole pine/squirreltail - Community Phase 1.1


California red fir-Sierra lodgepole pine forest

This mature California red fir-Sierra lodgepole pine forest develops with small scale disturbances that create gaps in the canopy. These gaps (single tree fall to 0.25 acre in size) provide suitable sites for Sierra lodgepole pine regeneration and, over time, create an uneven forest structure and composition. Several age classes of Sierra lodgepole pine and California red fir are present. The tallest Sierra lodgepole pines to persist in the overstory provide a seed source for gap areas.

Occasional small scale, very low intensity understory burns can perpetuate community structure and conditions, by killing the young understory of California red fir and some of the overstory Sierra lodgepole pine trees.

Community Phase Pathway 1.1a

This pathway is created by a high mortality fire or forest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b

This pathway is created by a high mortality fire or forest infestation with favorable conditions for dense Sierra lodgepole pine seedling regeneration (Community Phase 1.3) based on ample cones and seeds and optimum conditions for seed germination.

California red fir-Sierra lodgepole pine/squirreltail Plant Species Composition:

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**40**		
		sedge	CAREX	*Carex*	0	10	0	2
		squirreltail	ELEL5	*Elymus elymoides*	0	30	0	3

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**4**		
		little prince's pine	CHME	*Chimaphila menziesii*	0	1	0	1
		sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0	3	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**3**	**20**		
		California red fir	ABMA	*Abies magnifica*	3	15	1	5
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	5	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	8	40
Forb	0	1	5
Shrub/Vine	0	3	4
Tree	3	11	20
Total:	3	23	69

Forest Overstory:

A patchy overstory canopy of large California red fir exists over the younger and shorter statured Sierra lodgepole pine canopy. Canopy cover of the red fir ranges from 10 to 30 percent and is 110 to 130 feet above the forest floor. The large red fir trees are over 200 years old. The cover of the Sierra lodgepole pine ranges from 20 to 40 percent, and is between 75 to 100 feet tall. Total canopy cover ranges from 35 to 65 percent. Basal area ranges from 95 to 200 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	40	65

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	10.0	30.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	20.0	40.0						

Forest Understory:

The understory is very sparse. Common plants are carex (Carex sp.), little prince's pine (Chimaphila menziesii), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), squirreltail (Elymus elymoides), sulphur-flower buckwheat (Eriogonum umbellatum), and white hawkweed (Hieracium albiflorum).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
sedge *Carex*	CAREX	N	0	2.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	3.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Mt. Hood pussypaws *Cistanthe umbellata var. umbellata*	CIUMU	N	0	2.0		
white hawkweed *Hieracium albiflorum*	HIAL2	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
little prince's pine *Chimaphila menziesii*	CHME	N	0	1.0		

sulphur-flower buckwheat *Eriogonum umbellatum*	ERUM	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	1.0	5.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0		

California red fir-Sierra lodgepole pine/squirreltail - Community Phase 1.2

After a stand replacing event such as a high mortality fire or mountain pine beetle infestation, Sierra lodgepole pine will regenerate from wind dispersed seed. This site generally has less than 500 stems per acre and will develop into a relatively open forest. The seedlings can develop into pole sized trees, with up to 55 percent canopy cover. Grasses and forbs may increase in cover for a few years. There may be 5 to 25 percent canopy cover from mature California red fir that survived the fire or other high mortality event.

Community Phase Pathway 1.2a

This pathway is followed with time and growth and small scale canopy disturbances. An open multi-age lodgepole pine forest develops (Community Phase 1.4).

Sierra lodgepole pine/squirreltail - Community Phase 1.3

This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined which distinguish the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. There are many variables that influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid October. These seeds can be stored in the soil for several years, but regeneration is often from wind dispersed seeds deposited after the fire. Therefore, the season of a burn and its timing in relation to seed crop cycles may affect seedling density. Smaller fires may produce higher seedling densities due to the proximity of an available seed source. Fires leave bare soil and disturbed duff in open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. Seasonal precipitation patterns and air temperatures during the season influence the germination and survival of seedlings.

As the seedlings develop they form dense thickets. The trees will self-thin their lower branches to some extent as they grow taller and thinner, but most will persist even with limited sunlight on their canopy. Growth becomes stagnant due to competition for light, water and nutrients. After a certain point of stagnation, Sierra lodgepole pine may not respond to competitive releases from thinning, disease, or fire.

There may be 5 to 25 percent canopy cover from mature California red fir that survived the fire or other high mortality event.

Community Phase Pathway 1.3a
With time and growth the stand remains dense and evenly aged (Dense lodgepole pine forest, Community Phase 1.5). Trees are generally healthy and few gaps are created from tree mortality in this young forest.

<u>Sierra lodgepole pine/squirreltail - Community Phase 1.4</u>

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. Mountain pine beetle infestations are the most significant disturbance to create canopy openings. After a pest infestation, patches of the stand die, leaving gaps for lodgepole pine regeneration. Since low intensity fire is often fatal to mature lodgepole pine and can be a stand replacing event, small fire-created gaps are uncommon. However low intensity smoldering fires have been documented which spread through downed trees after a mountain pine beetle infestation. The smoldering fires occasionally created fire scars on the live trees, rendering them more susceptible to the next mountain pine beetle attack. Shallow roots make lodgepole pine more susceptible to wind throw, also creating canopy gaps.

The California red fir that survived the last major fire event create an open upper canopy, with young seedlings regenerating in the shade of the lodgepole pine.

Community Phase Pathway 1.4a
With time and growth and small scale disturbances, this forest continues to develop into an open California red fir-Sierra lodgepole pine forest (Community Phase 1.1) with a multi-aged, complex forest structure.

Community Phase Pathway 1.4b
This pathway is triggered by a high mortality fire, which initiates open Sierra lodgepole pine regeneration (Community Phase 1.2)

Community Phase Pathway 1.4c
This pathway is triggered by a high mortality fire, which initiates dense Sierra lodgepole pine regeneration (Community Phase 1.3).

<u>Sierra lodgepole pine/litter - Community Phase 1.5</u>

This dense Sierra lodgepole pine forest develops after dense seedling establishment and the absence of canopy disturbance. The forest is even-aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. The self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees will enable the pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

The surviving California red fir from the last major fire event create an open canopy above the dense lodgepole pine canopy. California red fir seedlings regenerate in the shade of the lodgepole pine.

Community Phase Pathway 1.5a

This pathway is triggered by a high mortality fire, with appropriate conditions for dense lodgepole pine regeneration (Community Phase 1.3) based on ample presence of cones and seed and optimum germination of seeds. It is common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. Such a fire return interval does not allow for later succession communities (Community Phases 1.1 and 1.6) to develop.

Community Phase Pathway 1.5b

This pathway is triggered by a high mortality fire, with appropriate conditions for open lodgepole pine regeneration (Community Phase 1.2). It is common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. Such a fire return interval does not allow for later succession communities (Community Phases 1.1 and 1.6) to develop.

Community Phase Pathway 1.5c

This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low-mortality fires, or wind throw. The forest becomes a more open Sierra lodgepole pine forest (Community Phase 1.4) with several age classes. With continued small scale disturbances it can eventually develop into Community Phase 1.1.

Community Phase Pathway 1.5d

With time and growth and the absence of disturbance, the stand remains evenly aged and dense. California red fir establishes in the understory and becomes increasingly prevalent in the canopy, creating a dense California red fir-Sierra lodgepole pine forest (Community Phase 1.6).

California red fir-Sierra lodgepole pine/litter - Community Phase 1.6

The dense California red fir-Sierra lodgepole pine forest develops with the continued exclusion of fire or other disturbances, allowing the tree density to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the red fir for some time, but eventually declines due to the lack of sunlight and natural senescence. Fuel loads are high from the trees dying in the understory. Understory vegetation is absent due to the high cover of litter and debris and the lack of sunlight on the forest floor.

Community Phase Pathway 1.6a

A severe fire would initiate dense lodgepole pine regeneration (Community Phase 1.3) based on ample presence of cones and seeds and optimum germination of seeds.

Community Phase Pathway 1.6b

A severe fire would initiate open lodgepole pine regeneration (Community 1.2)

Community Phase Pathway 1.6c

This pathway is created in time with a high incidence of small scale disturbances that break up the uniformity and density of this forest. With continued disturbances, the open multi-aged California red fir-Sierra lodgepole pine forest (Community Phase 1.1) may develop. The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels and low fire tolerance of the dominant tree species. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with small scale disturbances over time.

Ecological Site Interpretations

Forest 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.
Sierra lodgepole pine	*PICOM*	82	94	91	111	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.

Animal Community:

Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. These forests have high productivity in the understory with abundant forage for wildlife. They are often located near water bodies and open meadows, which increases the wildlife activity in these forests. Thirty-one mammals and almost fifty bird species have been documented to use Sierra lodgepole pine forests. Snags and downed logs are important for cavity-nesting birds and mammals. Other animals forage on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

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. The California red fir cones are cut and cached by squirrels (Cope, 1993).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area may suitable for trails and camping, as long as the nearby watercourses, meadows and wildlife are not affected.

Wood Products:
Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light and straight grained with consistent texture (Cope 1993).

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).

Other Products:

Other Information:
Addtional information on 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) and Alexander (1966) were used to determine forest site productivity for California red fir 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. 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 phase 1.4 and the older community stands 1.2 and 1.3. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Moist Sandy Lake Or Stream Terraces	F022BI108CA	This is a moist Sierra lodgepole pine forest found in lower positions closer to the stream channel.
Cryic Lacustrine Flat	R022BI206CA	This is a meadow ecological site associated with a stream channel.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This is a mixed white fir-Sierra lodgepole pine site found in lower elevations in wetter conditions.
Frigid Flat Outwash Terraces	F022BI123CA	This is a similar site found at lower elevations with white fir in place of red fir.
Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	F022BI125CA	This is a Sierra lodgepole pine forest found in cold air drainages and basins.
Cold Frigid Tephra Over Moraine Slopes	F022BI126CA	This is a Sierra lodgepole pine forest that is replaced by Jeffrey pine and ponderosa pine over time without disturbance.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789193
789225- site location

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	5 E
Section:	33
Datum:	NAD83
Zone:	10
Northing:	4484467
Easting:	633249
General Legal Description:	The type location is about 0.47 miles north-northwest of Summit Lake, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104484467633249

Relationship to Other Established Classifications:

Forest Alliance = Abies magnifica - Red fir forest; Association = Abies magnifica-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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra E Moseley	2/16/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/23/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Landslide Undulating Slopes

Abies magnifica / / *Carex* - *Hieracium albiflorum*
(California red fir / / carex - white hawkweed)

Site ID: F022BI118CA

Major Land Resource Area: 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.

Physiographic Features

This ecological site is found on landslides from hydrothermally altered volcanic rocks between 5,830 and 8,100 feet in elevation. Slopes range from 10 to 50 percent.

Landform: (1) Landslide

	Minimum	Maximum
Elevation (feet):	5830	8100
Slope (percent):	10	50
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	Medium
Aspect:	South East West	

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.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	99.0	113.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description:	System	Subsystem	Class

Representative Soil Features

The Typic Dystroxerepts, 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 Dystroxerepts, landslides/ 90

Parent Materials:
Kind: Landslide deposits
Origin: Hydrothermally altered rock
Surface Texture: (1)Ashy Fine sandy loam
Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	8	20
Surface Fragments > 3" (% Cover):	12	55
Subsurface Fragments <=3" (% Volume):	4	75
Subsurface Fragments > 3" (% Volume):	0	50

Drainage Class: Well drained To Well drained
Permeability Class: Moderate To Moderate

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.19	7.83

Plant Communities

Ecological Dynamics of the Site

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 (H_2S), carbon dioxide (CO_2), hydrogen gas (H_2), 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).

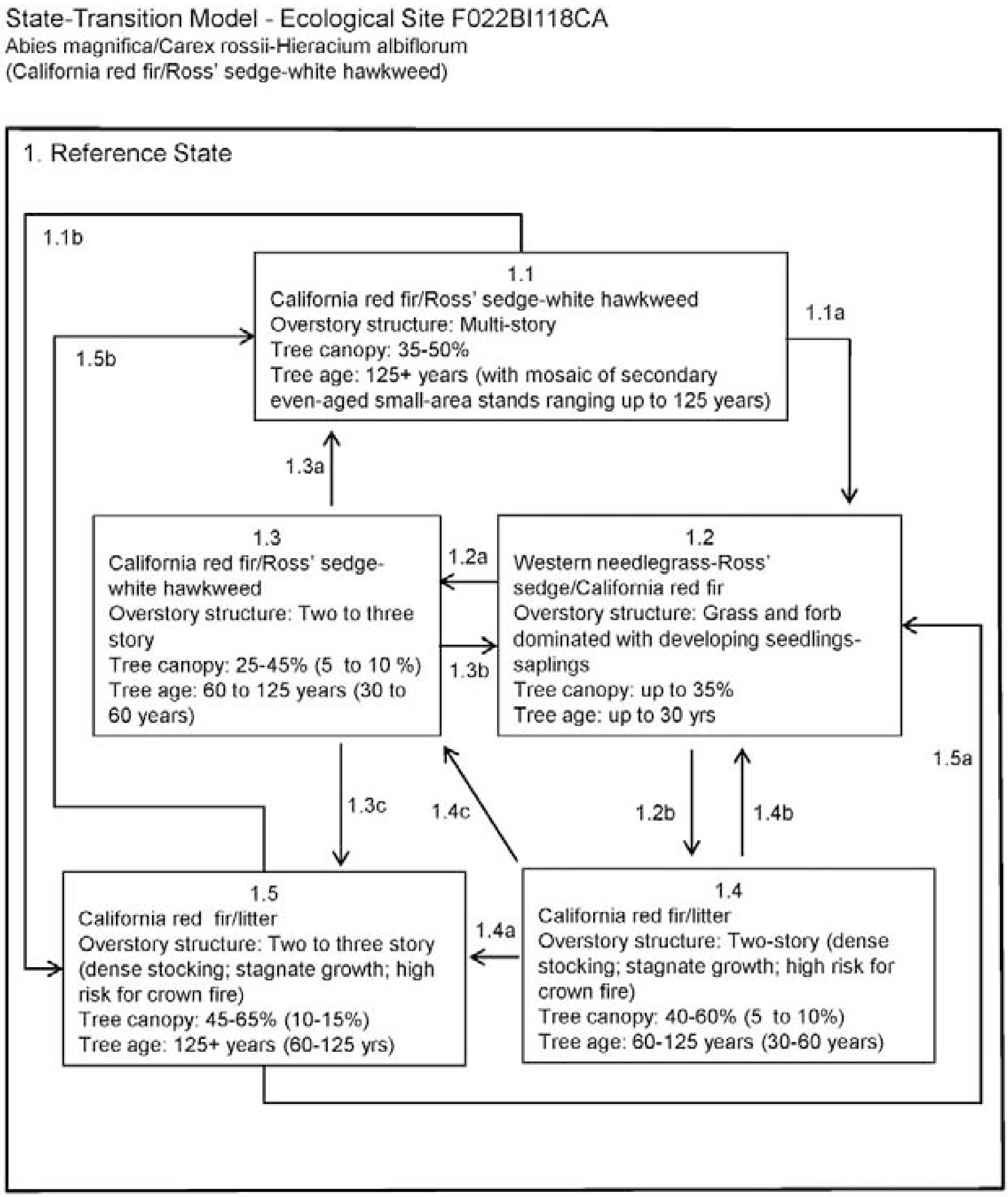
There is evidence everywhere in this forest type of fire suppression. Young seedlings and saplings are filling in the understory and shading out pinemat manzanita. Some of this area is further along in understory development, with several canopy layers dominated by California red fir. As the canopy cover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

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 Diagram



Reference - State 1

California red fir/Ross sedge-white hawkweed - Community Phase 1.1

California red fir forest

The mature open California red fir forest community phase is of very limited extent. In most areas California red fir has continued to reproduce in the understory, creating very dense forest. This community phase needs fire in order to maintain an open understory and reduce dense understory canopy layers. The historic fire return interval for this site may be between 9 to 91 years, with an average of 20 years. If the average of 20 years is correct, this site has missed up to 5 fire cycles.

The natural fire regime reflects the time it takes for a forest to naturally develop fuels sufficient to carry fire. At the upper elevations in red fir dominated forests, fuel accumulation is slow and relatively compact, reducing flammability. Red fir seedlings develop slowly due to physiographic characteristics and climatic variables, so ladder fuels take decades to develop.

Understory growth is visible in the community phase photo. Some of the understory trees would be killed in the event of a fire.

Community Phase Pathway 1.1a
Wind throw, fire, or tree die off from disease creates openings in the forest that present suitable conditions for California red fir (Community Phase 1.2).

Community Phase Pathway 1.1b
If fire is excluded from the old growth community phase, tree density continues to increase in the understory and shifts the community toward the closed California red fir forest (Community Phase 1.5).

California red fir/Ross sedge-white hawkweed Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**6**		
		Holboell's rockcress	ARHO2	*Arabis holboellii*	0	1	0	1
		white hawkweed	HIAL2	*Hieracium albiflorum*	0	2	0	1
		slender penstemon	PEGR4	*Penstemon gracilentus*	0	3	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**12**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	3	0	1
		Ross' sedge	CARO5	*Carex rossii*	0	6	0	2
		squirreltail	ELEL5	*Elymus elymoides*	0	3	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**16**		
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	1	0	1
		gooseberry currant	RIMO2	*Ribes montigenum*	0	15	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**31**		
		California red fir	ABMA	*Abies magnifica*	0	23	0	5

western white pine	PIMO3	*Pinus monticola*	0	2	0	1
mountain hemlock	TSME	*Tsuga mertensiana*	0	6	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	6	12
Forb	0	0	6
Shrub/Vine	0	10	16
Tree	0	15	31
Total:	0	31	65

Forest Overstory:

This forest is composed of large California red fir trees with a dbh (diameter at breast height) of 30 inches or greater. Canopy cover ranges from 35 to 50 percent. Canopy height is over 100 feet. Basal area is approximately 180 ft/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	40	50

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	40.0	50.0						
western white pine *Pinus monticola*	PIMO3	N	2.0	5.0						
mountain hemlock *Tsuga mertensiana*	TSME	N	1.0	3.0						

Forest Understory:

Understory data was not collected under an open canopy. The species listed below are from a closed forest and may increase in cover under an open canopy.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	1.0		

Ross' sedge *Carex rossii*	CARO5	N	0	2.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	1.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Holboell's rockcress *Arabis holboellii*	ARHO2	N	0	1.0		
white hawkweed *Hieracium albiflorum*	HIAL2	N	0	1.0		
slender penstemon *Penstemon gracilentus*	PEGR4	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	1.0		
gooseberry currant *Ribes montigenum*	RIMO2	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California red fir *Abies magnifica*	ABMA	N	0	5.0		
western white pine *Pinus monticola*	PIMO3	N	0	1.0		
mountain hemlock *Tsuga mertensiana*	TSME	N	0	2.0		

Western needlegrass-Ross sedge/California red fir - Community Phase 1.2

This community develops after a stand replacing fire, in small gaps created by a canopy disturbance, or landslides. California red fir will germinate from wind or animal dispersed seed after a fire. California red fir seedling establishment may be delayed for 3 to 4 years after a fire. This may be due to the mortality of the seedlings during the first few years or be related to the timing of cone production, which occurs in 2 to 6 year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or in light litter, in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. The winged red fir seeds are wind dispersed 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993). Birds, squirrels and other rodents will cache some of these seeds in soil, where they may germinate in bunches if not consumed. The severity and size of a fire influences the structure of regeneration. California red fir seems to regenerate better after a low to moderate intensity fire, or in high intensity fires of smaller size. This is most likely due to proximity to a seed source and the benefits from partial shade (Chappell and Agee 1996).

Community Phase Pathway 1.2a
The natural pathway is to Community Phase 1.3, the open California red fir forest. This pathway includes the effects of time and growth with periodic small low to moderate intensity surface fires.

Community Phase Pathway 1.2b
An alternate pathway is created when fire is excluded from the system and leads to the closed California red fir forest (Community Phase 1.4).

California red fir/Ross sedge-white hawkweed - Community Phase 1.3
California red fir continues to grow in the overstory and understory, but lightening induced surface fires are needed to maintain an open forest.

This community phase experiences rapid growth in conifer height and canopy cover. California red fir reaches seed bearing age in 35 to 40 years (Cope, 1993).

This community phase begins with pole-sized trees and lasts until the trees are about 125 years old. California red fir will slowly continue to regenerate under the forest canopy during this time.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic fire regime of periodic low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to a mature open California red fir forest (Community Phase 1.1).

Community Phase Pathway 1.3b
In the event of a canopy fire this community phase would return to Community Phase 1.2, Stand Regeneration.

Community Phase Pathway 1.3c
If fire does not occur, forest density increases. The increased density shifts this community phase toward the closed California red fir community phase 1.5.

California red fir/litter - Community Phase 1.4
The development of this community phase within this ecological site is relatively common; however dense stands seem to form more often through pathway 1.1b, from increased understory growth under the mature open canopy.

This forest develops after a period of forest regeneration. The trees may be pole-sized and even aged at first, developing into a mature forest over time. Density increases as California red fir continues to establish in the understory, creating multiple canopy layers. When this forest develops it is defined by a dense canopy and high basal area of California red fir and, to a lesser degree, western white pine. Canopy cover ranges from 40 to 60 percent and overstory trees may be up to 125 years old. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients. This stress makes the trees more susceptible to death from infection and drought. Fire hazard increases in this community, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a

If fire continues to be excluded from this system the mature closed California red fir forest develops (Community Phase 1.5).

Community Phase Pathway 1.4b

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

Community Phase Pathway 1.4c

The natural event of a moderate or surface fire in this forest is unlikely due to high fuel accumulation. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it had developed with fire over time. Manual treatments to thin the red fir and other fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to its natural state of a California red fir forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3.

California red fir/litter - Community Phase 1.5

Closed California red fir forest with disease

The mature closed California red fir forest develops with the continued exclusion of fire, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continues, and tree health and vigor decreases. An estimated age for this community is from 100 to 200+ years. As mentioned above, the dense community phase is usually reached by community pathway 1.1b, with tree density increasing from the development of the understory under the mature open canopy.

The plant community phase photo shows an opening created by red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) and probably other forest pathogens. The photo is not the best representation of the closed forest community phase but depicts what can happen if forests become overstocked and diseased. Young California red fir is regenerating in the openings, but they may become infected as well.

Community Phase Pathway 1.5a

A fire would likely be severe and would initiate conifer regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b

The natural event of a moderate or surface fire in this forest is unlikely due to high fuel accumulation. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it had developed with fire over time. Manual treatments to thin out the understory trees and other fuels, and/or prescribed burns, could be implemented to shift this forest back to its natural state of an open California red fir forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1.

Forest Overstory:

California red fir forms several canopy layers which provide 50 to 70 percent cover. The upper canopy is over 100 feet tall and the trees have a dbh of 30 inches or greater. A secondary canopy is layered at 80 to 90 feet. These trees are 60 to 90 years old and have an average dbh of 20 inches. Basal area ranges from 220 to over 330 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	50	60	70

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	10.0	15.0		90.0				
California red fir *Abies magnifica*	ABMA	N	45.0	65.0	100.0					

Forest Understory:

The understory is very sparse.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Ecological Site Interpretations

Forest 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.

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 growth of conifers in 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.

Plant Preference by Animal Kind:

Hydrology Functions:

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.

Supporting Information

Associated Sites:

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

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Loam Moraines Or Lake Terraces	F022BI112CA	This site is not associated with the hydrothermally altered soils but has dense red fir.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789177
789363
789364- type location

Type Locality:

State:	CA
County:	Tehama
Township:	30 N
Range:	4 E
Section:	28
Datum:	NAD83
Zone:	10
Northing:	
Easting:	623426
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.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD8310623426

Relationship to Other Established Classifications:

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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/14/2011

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/23/2010	Kendra Moseley	1/14/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Low Precip Frigid Sandy Moraine Slopes

Abies concolor - Pinus jeffreyi / / Chimaphila menziesii
(white fir - Jeffrey pine / / little prince's pine)

Site ID: F022BI119CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: Moraine
Elevation (feet): 5,980-7,600
Slope (percent): 20-65
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: West, Northwest, Southwest
Mean annual precipitation (inches): 25.0-45.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 42 to 44 degrees F (5.5 to 6.6 degrees C)
Restrictive Layer: Densic layer
Temperature Regime: Frigid
Moisture Regime:Xeric
Parent materials: Deposited tephra (350 years old) over till from volcanic rocks
Surface Texture: Ashy Sand
Surface Fragments <=3" (% Cover): 0-5
Surface Fragments > 3" (% Cover): 0-3
Soil Depth (inches): 40-60
Vegetation: White fir (Abies concolor) prevails over Jeffrey pine (Pinus jeffreyi). Fire exclusion has permitted white fir to become dense in the understory. Understory cover is sparse, consisting of rabbitbrush (Ericameria bloomeri), slender penstemon (Penstemon gracilentus), little prince’s pine (Chimaphila menziesii), whitevein shinleaf (Pyrola picta), lettuce wirelettuce (Stephanomeria lactucina), and bush chinquapin (Chrysolepis sempervirens).
Notes: This ecological site is found on moraines on the eastern side of Butte Lake.

Physiographic Features

This ecological site is found on moraines on the eastern side of Butte Lake at elevations between 5,980 and 7,600 feet. Slopes range from 20 to 65 percent.

Landform: (1) Moraine

	Minimum	Maximum
Elevation (feet):	5980	7600
Slope (percent):	20	65
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	Medium
Aspect:	West NorthWest SouthWest	

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 25 to 45 inches (635 to 1,143 mm) and the mean annual temperature is between 42 to 44 degrees F (5.5 to 6.6 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.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	25.0	45.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This ecological site is associated with the Buttelake soil series on 20 to 65 percent slopes. The Buttelake soils are deep and well-drained and formed in deposited tephra over till from volcanic rocks. The tephra deposits are from the eruption of Cinder Cone, about 350 years ago. The surface texture is ashy sand, with coarse sand textures in the lower horizons. Dense material is at a depth of 40 to 60 inches.

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 it left the surface sterile, black, and coarse textured. The thickness, texture and chemistry of the ash deposits affect the survival and regeneration of the pre-existing vegetation. Ash layers greater than 15 centimeters are considered thick burials. A thick burial isolates the old soil from oxygen, effectively sterilizing it. Younger trees were probably killed by the Cinder Cone ash deposits, while older trees were most likely injured by the weight of the ash on their branches (http://volcanoes.usgs.gov/ash/agric/index.html#intro).

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

Map Unit Component, Component %
107 Buttelake, 3
120 Buttelake,65

Parent Materials:
Kind: Tephra, Till
Origin: Volcanic rock
Surface Texture: (1)Ashy sand
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	5
Surface Fragments > 3" (% Cover):	0	3
Subsurface Fragments <=3" (% Volume):	1	55
Subsurface Fragments > 3" (% Volume):	0	55

Drainage Class: Well drained To Well drained
Permeability Class: Very slow To Very slow

	Minimum	Maximum
Depth (inches):	40	60
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.9	7.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.77	6.57

Plant Communities

Ecological Dynamics of the Site

This site is similar to F022BI100CA, which has a Jeffery pine forest associated with the Buttelake and Buttewash soils. This site correlates with steeper slopes and less solar radiation however, allowing white fir (Abies concolor) to prevail over Jeffrey pine (Pinus jeffreyi). Fire exclusion has permitted white fir to become dense in the understory. Understory cover is sparse, consisting of rabbitbrush (Ericameria bloomeri), slender penstemon (Penstemon gracilentus), little prince’s pine (Chimaphila menziesii), whitevein shinleaf (Pyrola picta), lettuce wirelettuce (Stephanomeria lactucina), and bush chinquapin (Chrysolepis sempervirens). Total canopy cover ranges from 60 to 80 percent.

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 length from 4.7 to 12 inches. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007) that 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. Mature Jeffrey pines are somewhat adapted to fire because their thick bark 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 that can graft to other white fir roots and spread root rots (Zouhar, 2001).

This ecological site is affected by tephra deposits from the eruption of Cider 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 phase 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 lower slope to upper slope positions. Their study also indicates a slightly later burn season in the Southern Cascades than in the Sierra Nevada. Fire scars in the Southern Cascades 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). Moderate and low intensity fires seem to have kept this forest open by removing the less fire tolerant white fir seedlings and saplings 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 (Taylor and Solem, 2001).

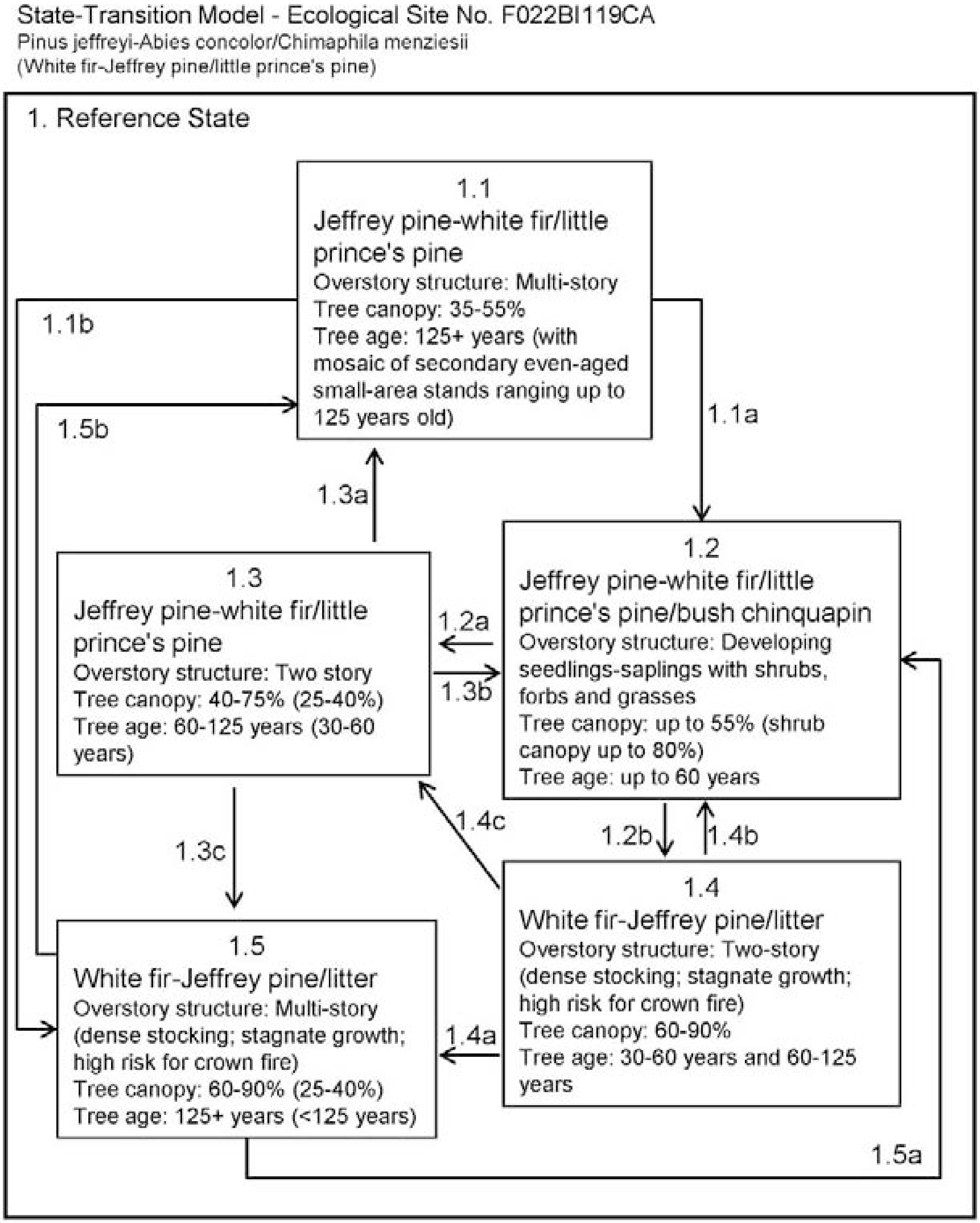
Tree pathogens and insect infestations can have significant impacts on the composition and structure of mid and upper montane coniferous forests. Small infestations may affect just a few trees but large outbreaks can kill the dominant trees over large areas of forest, creating large canopy openings and stand regeneration. Most of these pathogens represent 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 (Dendroctonus 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 (Melampsporella 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 Diagram



Reference - State 1

Jeffrey pine-white fir/little princes pine - Community Phase 1.1

This is the reference community phase for this ecological site, but data was not collected from a representative site. This phase develops 150 to 300 years after a major disturbance event such as fire. The trees are large with wide reaching canopies. White fir and Jeffrey pine co-dominate. This forest develops with frequent low intensity fires or occasional small high severity fires that either remove understory trees or create small openings in the forest for gap regeneration. This community phase needs continual disturbance from low intensity fires to maintain the open understory and reduce competition between the trees for water, nutrients, and sunlight.

It is difficult to find a representative site for this community phase because most of the area has missed several fire rotations, resulting in a large amount of cover of white fir in the understory.

Community Phase Pathway 1.1a

The primary threat to a Jeffrey pine-white fir forest is a severe canopy fire. In the event of a severe canopy fire this community phase would return to the regeneration community phase (Community Phase 1.2).

Community Phase Pathway 1.1b

If fire is excluded from the old growth community phase, tree density continues to increase and shifts the community toward the closed white fir-Jeffrey pine community phase (Community Phase 1.5).

Jeffrey pine-white fir/little princes pine/bush chinquapin - Community Phase 1.2

This community phase develops when the majority of the overstory trees succumb to a high intensity canopy fire. A few overstory trees may survive, becoming important seed sources for regeneration. Mature Jeffrey pine, with thicker bark and higher tree branches than white fir, are more likely to survive a fire and supply seed for regeneration. White fir prefers partial shade for regeneration. Because Jeffrey pine seedlings germinate well in full sun and mineral soils after fire, it has the advantage during early phases of regeneration which assures their existence and sometimes prevalence in older stands.

Bush chinquapin (Chrysolepis sempervirons) is the only documented shrub in this area, and it can resprout from the roots, root crown and stump after being top-killed by fire.

Community Phase Pathway 1.2a

The natural pathway is to Community Phase 1.3, a Jeffrey pine-white fir forest. This pathway is followed with a natural fire regime. Manual thinning with prescribed burns can imitate the natural cycle and lead to a similar community phase.

Community Phase Pathway 1.2b

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

Jeffrey pine-white fir/little princes pine - Community Phase 1.3

This forest community phase develops with a natural fire regime, or with manual thinning and prescribed fires. Low to moderate intensity fires clear the understory and remove fuels before they reach hazardous levels, although severe high-intensity canopy fires are possible. If Jeffrey pine establishes during stand initiation it will maintain a fair percentage of cover in the upper canopy. Jeffrey pine is shade intolerant and has difficulty regenerating and growing well in the understory canopy. Its growth and presence is dependent upon fire or other disturbances to maintain an open forest structure with canopy openings.

Community Phase Pathway 1.3a

This is the natural pathway for this community phase, which evolved with a historic fire regime of relatively frequent surface and moderate severity fires, and/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 reference community phase (Community Phase 1.1).

Community Phase Pathway 1.3b

In the event of a canopy fire this community phase would return to Community Phase 1.2, forest regeneration.

Community Phase Pathway 1.3c

If fire does not occur, forest density increases. This will favor white fir over Jeffrey pine. The increased density shifts this community phase toward the closed white fir community phase (Community Phase 1.5).

White fir-Jeffrey pine/litter - Community Phase 1.4

This community phase is defined by a dense canopy and high basal area dominated by white fir. Jeffrey pine is slowly being replaced by shade tolerant white fir. Canopy cover ranges from 65 to 85 percent. The trees are overcrowded and stressed due disease or 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 phase, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a

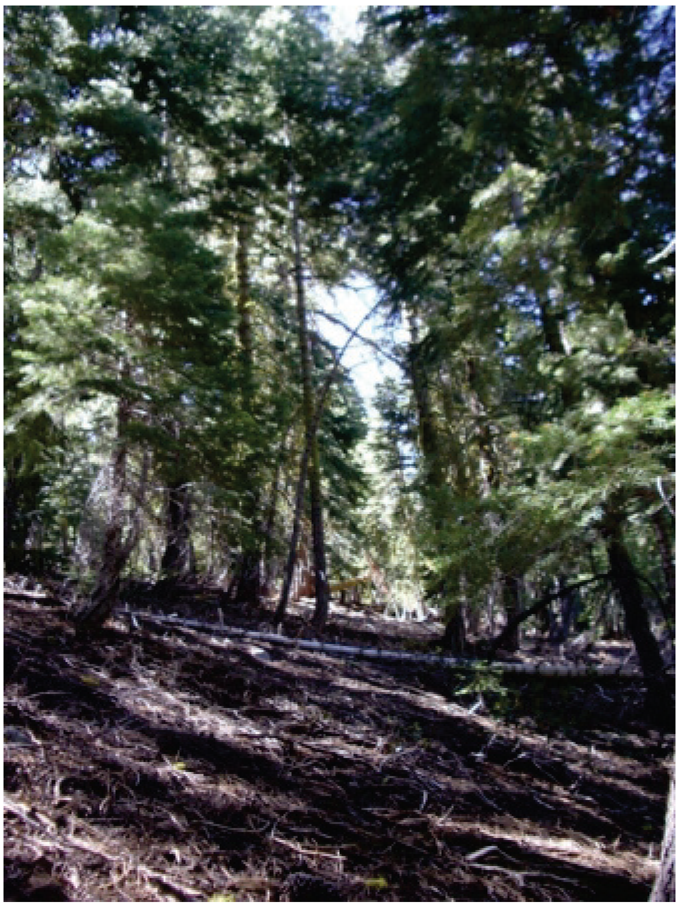
If fire continues to be excluded from this system the mature closed white fir–Jeffrey pine forest community phase develops (Community Phase 1.5).

Community Phase Pathway 1.4b

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

Community Phase Pathway 1.4c
The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with fire over time. Manual treatments to thin the white fir and other fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to its natural state of an open Jeffrey pine-white fir forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3.

White fir-Jeffrey pine/litter - Community Phase 1.5


White fir-Jeffrey pine forest

The mature closed white fir-Jeffrey pine forest develops with the continued exclusion of fire, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continues, and tree health and vigor decreases. Jeffrey pine is less and less prevalent because it does not reproduce well under the dense forest canopy. An estimated age for this community phase is from around 125 to 200+ years.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate stand regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b

The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with fire over time. Manual treatments to thin the understory trees and other fuels, and/or prescribed burns, could be implemented to shift this forest back to its natural state of an open white fir-mixed conifer community (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1.

White fir-Jeffrey pine/litter Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Forb**				**0**	**6**		
		slender penstemon	PEGR4	*Penstemon gracilentus*	0	3	0	1
		lettuce wirelettuce	STLA	*Stephanomeria lactucina*	0	3	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Shrub**				**0**	**52**		
		little prince's pine	CHME	*Chimaphila menziesii*	0	1	0	1
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	0	45	0	4
		rabbitbush	ERBL2	*Ericameria bloomeri*	0	5	0	1
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	1	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0	**-Tree (understory only)**				**7**	**31**		
		white fir	ABCO	*Abies concolor*	5	25	1	5
		Jeffrey pine	PIJE	*Pinus jeffreyi*	2	6	1	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Forb	0	1	6
Shrub/Vine	0	21	52
Tree	7	17	31
Total:	7	39	89

Forest Overstory:

This forest has a mixed canopy of Jeffrey pine and white fir. Data collected at this site indicates an overstory canopy dominated by older and taller Jeffrey pine. The larger Jeffrey pines are over 150 years old. There are several understory canopy layers dominated by white fir. One major canopy layer of white fir is between 60 to 70 feet tall, with 70 to 90 year old trees. Total canopy cover ranges from 60 to 90 percent.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	60	75	90

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	20.0	40.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	40.0	50.0						

Forest Understory:

The understory is sparse due to the high canopy cover from the dense forest. Common forbs are little prince's pine (Chimaphila menziesii), rabbitbush (Ericameria bloomeri), slender penstemon (Penstemon gracilentus), whitevein shinleaf (Pyrola picta), and lettuce wirelettuce (Stephanomeria lactucina). Scattered individual bush chinquapins (Chrysolepis sempervirens) are present in small canopy openings.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
slender penstemon *Penstemon gracilentus*	PEGR4	N	0	1.0		
lettuce wirelettuce *Stephanomeria lactucina*	STLA	N	0	2.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
little prince's pine *Chimaphila menziesii*	CHME	N	0	1.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	0	4.0		
rabbitbush *Ericameria bloomeri*	ERBL2	N	0	1.0		
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	1.0	5.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	1.0	3.0		

Ecological Site Interpretations

Forest 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	45	45	77	77	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.
Jeffrey pine	PIJE	66	66	51	51	52	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:

White fir-Jeffrey pine forests provide browse, cover and nesting sites for a variety of wildlife species. The type and quality of the wildlife habitat varies with the community type. The mature open forests, closed dense white fir forests, young forests, and shrub lands provide different opportunities for habitat and forage. Deer and bear can heavily browse young fir shoots. Porcupines eat the bark of white fir and can kill saplings. Rodents feed on white fir cambial tissue; young white fir seedlings and seeds are eaten by animals as well. Douglas squirrels cut and cache white fir cones before the cones are fully mature.

There are about 33 species of mammals commonly present in the white fir forest type in California and, of these, 7 are generally associated with mature forests. About 123 species of birds are found in the white fir forest type of California and southern Oregon, about 50 of which are associated primarily with mature forests. Many of these birds use mature white fir trees and snags for foraging, roosting, nesting and/or breeding. Included are bald eagle, California spotted owl, brown creeper, pileated woodpecker, white-headed woodpecker and, when near lakes or streams, osprey. Reptiles in white fir forests are represented by 17 species, mostly at lower elevations, 8 of which are associated with mature forests (Zouhar, 2001).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
These areas are suitable for hiking trails.

Wood Products:
White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production, hence it provides poor firewood compared to other conifers (Zouhar, 2001).

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber (Gucker, 2007).

Other Products:
Jeffrey pine seeds are edible. Jeffrey pine sap was used by Native Americans to treat pulmonary disorders and, later, heptane was distilled from the sap and sold to treat pulmonary problems and tuberculosis. Jeffrey pine heptane was also used to develop the octane scale used to rate petroleum used in automobiles (Gucker, 2007).

Other Information:
Additional information on the common white fir pathogens:

White fir dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris) is a parasitic plant common in the survey area as evident by witches brooms, top kill, stem cankers and swellings. The vegetative shoots of the dwarf mistletoe are often present from spring to fall. A fungus (Cytospora abietis) kills the branches that are infected with dwarf mistletoe. The reduced vigor makes the tree more susceptible to bark beetle and other diseases. The mistletoe cankers crack the bark, creating entry points for other diseases such as heart rots (Burns and Honkala, 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 it barren and dead looking. The alternate host for this rust is the chickweeds (Stellaria spp. and Cerastium spp.). This disease can damage tree growth by reducing crown development. Mortality is less common in mature trees than in younger regeneration trees. Secondary infection is possible from heart rots entering through openings in the infected areas (Burns and Honkala, 1990).

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 the 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 and Honkala, 1990).

The fir engraver beetle (Scolytus ventralis) can cause extensive damage to white fir forests. 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.

Additional information on Jeffrey pine pathogens:

Infections from western dwarf mistletoe (Arceuthobium campylopodium) cause witches brooms, reduced growth and tree mortality. Sticky seeds are spread in fall and infest nearby and understory trees. In years of severe drought dwarf mistletoe has induced 60 to 80 percent of the Jeffery pine mortality (Burns and Honkala, 1990).

Jeffrey pine bark beetles (Dendroctonus jeffreyi) are native beetles that can only reproduce in Jeffrey pine. They are a natural cycle in maintaining forest health. They generally attack older weaker trees, but in times of drought or other disturbances such as lightning or fire, epidemic levels can break out and cause extensive damage to the forest. These beetles infest the lower stem and bole of the trees, usually after a pine engraver (Ips pini) infestation in the upper portion of the tree. The beetles slowly destroy the cambium, inhibiting the flow of nutrients. A sign of infestation is the changing color of the pine needles from green to yellow or reddish brown, beginning from the top down (Hagle et al., 2003; Smith, 1971).

SITE INDEX DOCUMENTATION:

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

Conifer trees appropriate for site index measurement typically occur in community phases 1.3 and 1.4. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Moderately Deep Slopes	F022BI107CA	This red fir-white fir-Jeffrey pine forest is found above this site.
Talus Slope	R022BI200CA	This is a rangeland site with scattered Jeffrey pine found on rocky slopes.

Similar Sites:

Site Name	Site ID	Site Narrative
Low Precip Frigid Sandy Tephra Gentle Slopes	F022BI100CA	This Jeffrey pine forest is on lower foot slopes and valley bottoms.
Frigid Tephra Over Slopes And Flats	F022BI103CA	This white fir-Jeffrey pine forest has the potential to develop a dense shrub community after fire.
Frigid Humic Loamy Gentle Slopes	F022BI110CA	This is a white fir-mixed conifer forest found at lower elevations on the south-eastern portion of the park.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

The following NRCS vegetation plot was used to describe this ecological site:

789108- type location

Type Locality:

State:	CA
County:	Lassen
Township:	31 N
Range:	6 E
Section:	11
Datum:	NAD83
Zone:	10
Northing:	4491575
Easting:	645813
General Legal Description:	The type location is about 0.5 miles north-north east of Sunrise Peak, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	

Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104491575645813

Relationship to Other Established Classifications:
Forest Alliance = Pinus jeffreyi - Jeffrey Pine forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/25/2011

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/29/2010		

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Gravelly Sandy Loam Outwash-Stream Terraces

Abies concolor - Pinus contorta var. murrayana / / *Elymus glaucus*
(white fir - Sierra lodgepole pine / / blue wildrye)

Site ID: F022BI120CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Outwash terrace, (2) Stream terrace
Elevation (feet): 5,240-6,760
Slope (percent): 2-30
Water Table Depth (inches): 16-80
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, South, East
Mean annual precipitation (inches): 45.0-91.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 to 43 degrees F (5 to 6.1 degrees C)
Restrictive layer: Silica-cemented duripan occurs at varying depths from 20 to 60 inches or more
Temperature Regime: Frigid
Moisture Regime: Xeric/Aquic
Parent Materials: Glacial outwash or alluvium from volcanic rocks
Surface Texture: (1) Gravelly medial sandy loam
Surface Fragments <=3" (% Cover): 20-35
Surface Fragments > 3" (% Cover): 0-5
Soil Depth (inches): 20-60+
Vegetation: White fir (Abies concolor)-Sierra lodgepole pine (Pinus contorta ssp. murrayana) forest; incense cedar (Calocedrus decurrens) is fairly common, with an occasional Jeffrey pine (Pinus jeffreyi) and sugar pine (Pinus lambertiana). This forest has a grassy understory dominated by blue wild-rye (Elymus glaucus) in some areas, but has very sparse cover in other areas. Common species are Columbia needlegrass (Achnatherum nelsonii), western needlegrass (Achnatherum occidentale), California brome (Bromus carinatus), Ross' sedge (Carex rossii),

naked buckwheat (Eriogonum nudum), spreading groundsmoke (Gayophytum diffusum), white hawkweed (Hieracium albiflorum), and silverleaf phacelia (Phacelia hastata).
Notes: This ecological site occurs on outwash terraces and stream terraces.

Physiographic Features

This ecological site occurs on outwash terraces and stream terraces at elevations of 5,240 to 6,760 in feet. Slopes range from 2 to 30 percent. The site has a fluctuating water table, which may extend from 16 to 80 inches below the surface.

Landform:	(1) Outwash terrace
	(2) Stream terrace

	Minimum	Maximum
Elevation (feet):	5240	6760
Slope (percent):	2	30
Water Table Depth (inches):	16	80
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Very high
Aspect:	North South East	

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 45 to 91 inches (1,143 to 2,311 mm) and the mean annual temperature ranges from 41 to 43 degrees F (5 to 6.1 degrees C). The frost free (>32F) season is 70 to 90 days. The freeze free (>28F) season is 85 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	70	90
Freeze-free period (days):	85	200
Mean annual precipitation (inches):	45.0	91.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the Aquic Haploxerands and the Humic Haploxerands, stream terrace soil components.

The Aquic Haploxerands are moderately deep, somewhat poorly drained soils, which formed in glacial outwash from volcanic rocks. They have a gravelly medial sandy loam surface texture and gravelly fine sandy loam subsurface textures with about 5 percent cobbles. Redoximorphic features are present below 16 inches, indicating periods of water saturation. A root restrictive, silica-cemented duripan occurs at varying depths from 20 to 40 inches.

The Humic Haploxerands, stream terrace soils are very deep, moderately well and well drained soils, formed in ash-influenced alluvium from volcanic rocks. These soils are on stream terraces along Hot Springs Creek and the North Fork of Bailey Creek, where the stream gradients decrease and allow lateral deposition. They have a gravelly medial sandy loam surface texture. Percent rock fragments increase with depth. The subsurface textures, listed by increasing depth, are gravelly medial coarse sandy loam, extremely stony medial coarse sandy loam, extremely stony medial loamy coarse sand, and ashy stones. The lower horizons have 83-89 percent sub-rounded, stream deposited, rock fragments.
These soils have very low to low AWC (available water capacity) in the upper 60 inches of soil. Permeability is moderately rapid to rapid, but is slow to very slow through the duripan in Aquic Haploxerands soils.

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

Map Unit Component / Component %
125 Humic Haploxerands, stream terrace /55
164 Aquic Haploxerands /20
165 Humic Haploxerands, stream terrace / 5
166 Aquic Haploxerands /50

Parent Materials:
Kind: Outwash, Alluvium
Origin: Volcanic rock
Surface Texture: (1)Gravelly medial sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	20	35
Surface Fragments > 3" (% Cover):	0	5
Subsurface Fragments <=3" (% Volume):	20	60
Subsurface Fragments > 3" (% Volume):	5	89

Drainage Class: Somewhat poorly drained To Well drained
Permeability Class: Rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.75	7.35

Plant Communities

Ecological Dynamics of the Site

This ecological site is associated with a white fir (Abies concolor)-Sierra lodgepole pine (Pinus contorta ssp. murrayana) forest. Incense cedar (Calocedrus decurrens) is fairly common, with an occasional Jeffrey pine (Pinus jeffreyi) and sugar pine (Pinus lambertiana). This forest has a grassy understory dominated by blue wild-rye (Elymus glaucus) in some areas, but has very sparse cover in other areas. Common species are Columbia needlegrass (Achnatherum nelsonii), western needlegrass (Achnatherum occidentale), California brome (Bromus carinatus), Ross' sedge (Carex rossii), naked buckwheat (Eriogonum nudum), spreading groundsmoke (Gayophytum diffusum), white hawkweed (Hieracium albiflorum), and silverleaf phacelia (Phacelia hastata).

This ecological site is located on stream terraces with very deep soils and outwash terraces with a root restrictive duripan between 20 to 40 inches below the surface. These soils have a seasonal water table. The Aquic Haploxerands, situated in the upper basin of a large valley, accumulate water from snowmelt, springs, and groundwater flow. The duripan impedes downward infiltration of water so the water moves laterally across gentle slopes. From December to June, a fluctuating water table may be anywhere between the duripan and 16 inches below the surface. The water table eventually drops below 80 inches in the drier months. The Humic Haploxerands, stream terrace component has a seasonal water table that is associated with the hydrology of the adjacent stream channel. Ground water flows through the coarse textured horizons and may, in some areas, mingle with surface flow from the stream. The water table is about 40 inches below the surface during snowmelt, gradually dropping to below 80 inches in the drier months. Shallow seasonal water tables and root restrictive layers are often associated with Sierra lodgepole pine forests due to the exclusion of other conifers. However, the conditions at this site are not extreme enough to exclude other conifers.

Sierra lodgepole pine can be long-lived. The overstory trees cored for this site index data were between 120 to 160 years old. Sierra lodgepole pine does not usually gain much in girth with age, and older trees averaged 19 to 23 inches in diameter. The roots of Sierra lodgepole pine are generally shallow. Trees will produce taproots that may atrophy or grow horizontally in cases of high water tables or root restrictive layers. Sierra lodgepole pine grows tall and narrow, with short branches and 1.2 to 2.4 inch needles in fascicles of two. Although its thin bark and shallow roots make it susceptible to fire, Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. Sierra lodgepole pine is a pioneer species after fire or other canopy disturbances.

White fir is a large long-lived tree in this area. It commonly reaches heights of 120 to 140 feet and can live for 300 to 400 years. It produces single needles ranging from 1.2 to 2.8 inches that are distributed along the young branches. Because the female seed cones open and fall apart while still attached to the tree, cones are not often seen on the forest floor. White fir tends to develop a shallow root system that can graft to other white fir roots and spread root rots (Zouhar, 2001). White fir is a shade-tolerant conifer and is able to establish in the understory of Sierra lodgepole pine. If it continues to grow and reproduce in the understory, it will eventually dominate the forest in the absence of disturbance. White fir has thin bark and low live crown heights, which make it susceptible to fire.

Sierra lodgepole pine has a complex disturbance regime which includes cyclic beetle infestations and fire. Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates of the lodgepole pine (Taylor and Solem, 1995). Sierra lodgepole pine regenerates prolifically after fire and evenly aged stands are formed. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly and at a low intensity. Even low intensity fire causes damage to live trees however, making them more susceptible to the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine or white fir regeneration. Over time these gaps break up the uniformity of the evenly aged stands that formed after the last large fire event.

Fire regime studies, using tree rings and fire scars, report historic median fire return intervals in Jeffrey pine-white fir forests of 14, 18.8, and 70 years (Bekker and Taylor; Skinner and Chang; Taylor and Solem, respectively). Beaty and Taylor report that fire frequency and intensity is additionally associated with slope position, aspect, and climatic fluctuations. Fire return intervals are longer for north facing slopes than for south facing slopes, and fire intensity increases from the lower slope 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 in the Southern Cascade are primarily found at the annual tree ring boundary, indicating the trees were dormant at the time of the fire, whereas in the Sierra Nevada fires scars are often found in the late-season wood. This shift may be due to the timing of summer drought conditions, which begin earlier in the south. In July and August, thunderstorms are common in Lassen Volcanic National Park and the 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). Beaty and Taylor report that stand replacing fire is more common on upper slopes, while low to moderate intensity fires occur only along lower slopes. This is probably due to the tendency of fire to burn upslope, preheating the fuels as it goes (Beaty and Taylor, 2001). In the past, prior to fire suppression, this ecological site would not have developed as often into the later successional stages dominated by white fir, and therefore the Sierra lodgepole pine forest may have been more extensive (Taylor, and Solem, 2001).

The mountain pine beetle is the most significant forest pathogen to affect this site, but several other pathogens have the potential to cause mortality or diminished productivity. Most of these pathogens represent natural cycles of regulation and can push closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests.

There is evidence that warming temperatures are allowing mountain pine beetles to exist farther north and into upper elevations. Warmer temperatures are altering the reproductive cycles and distribution of the mountain pine beetle. It is possible that the warmer temperatures will increase mountain pine beetle infestations for several decades. The southern mountain pine beetle may move northward due to temperature change as well (Carroll et al, 2003)

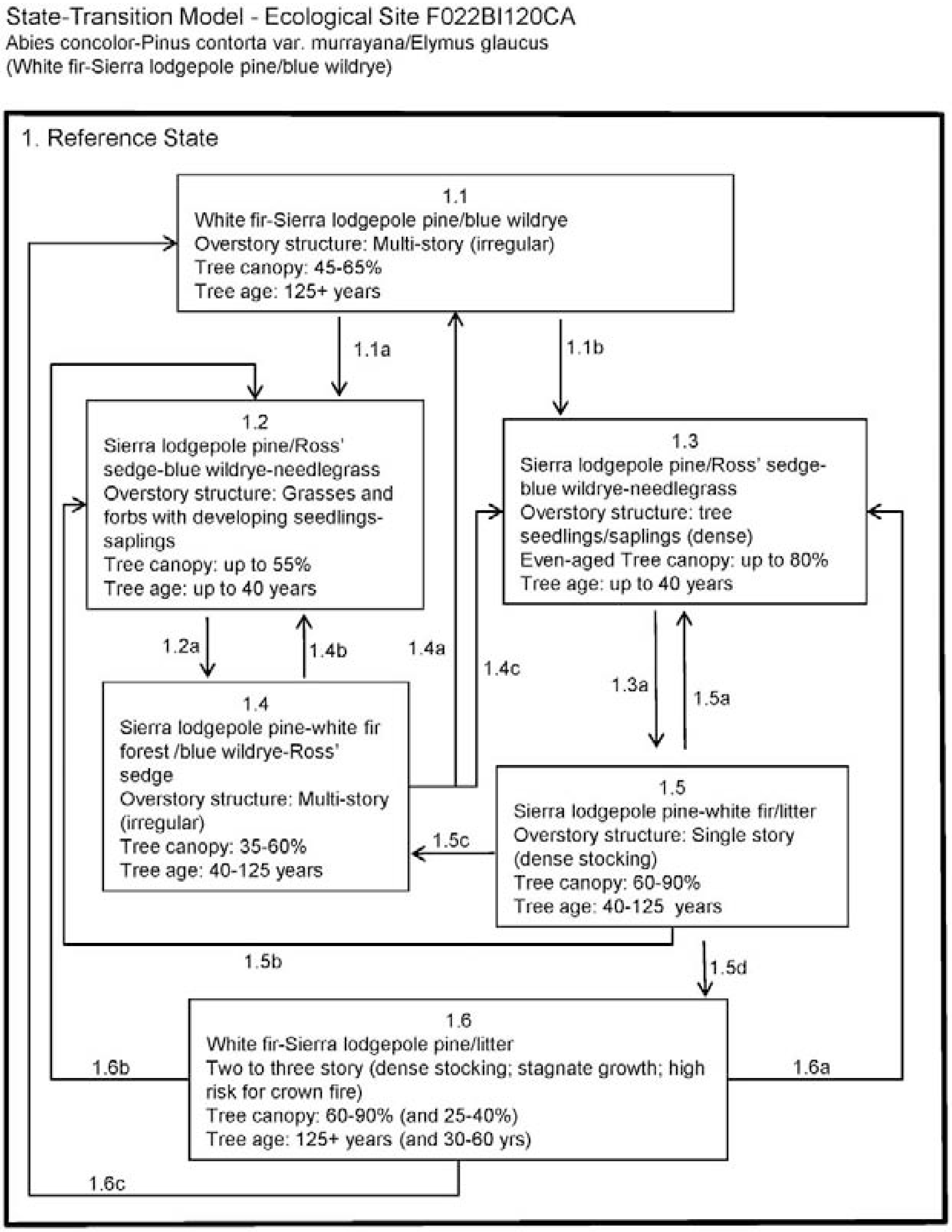
Other pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), weevil (Magdalis gentiles), lodgepole terminal weevil (Pissodes terminalis), Warren's collar weevil (Hylobius warreni), pine needle scale (Chionaspis pinifoliae), black pineleaf scale (Nuculaspis californica), the spruce spider mite (Oligonychus ununguis), lodgepole sawfly (Neodiprion burkei), lodgepole needle miner (Coleotechnites milleri), sugar pine tortrix (Choristoneura lambertiana), pine tube moth (Argyrotaenia pinatubana), the pandora moth

(Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips can also build up in windthrows. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 1990).

Pathogens that affect white fir are the dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melampsorella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), 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 Diagram



Reference - State 1

White fir-Sierra lodgepole pine/blue wildrye - Community Phase 1.1

This mature white fir-Sierra lodgepole pine forest develops with small scale disturbances that create gaps in the canopy. These gaps (single tree fall to 0.25 acre in size) provide suitable sites for Sierra lodgepole pine regeneration and, over time, create an uneven forest structure and composition. Several age classes of Sierra lodgepole pine and white fir are present. The tallest overstory Sierra lodgepole pines provide a seed source for gap areas. Jeffrey pine (Pinus jeffreyi), incense cedar (Calocedrus decurrens), and sugar pine (Pinus lambertiana) of various ages are also present with low cover. A low or moderate intensity surface fire would cause high mortality to all ages of Sierra lodgepole pine and to young white fir, although some mature white fir may survive. This would open the forest and shift the species composition. An open forest allows more sunlight through the canopy, enhancing the establishment and survival of shade-intolerant Jeffrey pine and sugar pine. With low to moderate understory burns, Sierra lodgepole pine will decline in composition, and a white fir-mixed conifer forest may develop.

Community Phase Pathway 1.1a

This pathway is created by a high mortality fire or forest pest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community Phase 1.2).

Community Phase Pathway 1.2b

This pathway is created by a high mortality fire or forest pest infestation with favorable conditions for dense Sierra lodgepole pine seedling regeneration (Community Phase 1.3) based on ample presence of cones and seed and optimum germination of seeds.

Sierra lodgepole pine/Ross sedge-blue wildrye-needlegrass - Community Phase 1.2

After a stand replacing event such as a high mortality fire or mountain pine beetle infestation, Sierra lodgepole pine will regenerate from wind dispersed seed. This site generally has less than 500 stems per acre and develops into a relatively open forest. The seedlings develop into pole sized trees with up to 55 percent canopy cover. Grasses and forbs may increase in cover for a few years.

Community Phase Pathway 1.2a

This pathway is followed with time and growth and small scale canopy disturbances. An open multi-age lodgepole pine forest develops (Community Phase 1.4).

Sierra lodgepole pine/Ross sedge-blue wildrye-needlegrass - Community Phase 1.3

This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined which distinguish the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. There are many variables that influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid October. Though seeds can be stored in the soil for several years, regeneration tends to occur from wind dispersed seeds deposited after a fire. Therefore, the season of a burn and its timing in relation to seed crop cycles may affect seedling density. Smaller fires may promote higher seedling density due to the proximity of an available seed source. Fires leave bare soil and disturbed duff in open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. Seasonal precipitation patterns and air temperatures influence the germination and survival of seedlings.

As the seedlings develop they form dense thickets. The trees self thin as they grow taller to some extent, but most will persist even with limited sunlight on their canopies. Growth becomes stagnant however, due to competition for light, water and nutrients. After a certain point of stagnation, Sierra lodgepole pine may not respond to competitive releases from thinning, disease, or fire.

Community Phase Pathway 1.3a

With time and growth the stand remains dense and evenly aged (Dense lodgepole pine forest, Community Phase 1.6). Trees are generally healthy and few gaps are created from tree mortality in this young forest.

Sierra lodgepole pine-white fir forest /blue wildrye-Ross sedge - Community Phase 1.4

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. Mountain pine beetle infestations create the most significant canopy openings. After a pest infestation, patches of the stand die, leaving gaps for lodgepole pine regeneration. Low intensity fire is often fatal to mature lodgepole pine, so even low severity fire can be a stand replacing event. The event of fire creating small gaps is uncommon; however low intensity smoldering fires have been documented which spread through downed trees after a mountain pine beetle infestation. Although minor damage to the live trees was noted, some with fire scars were rendered more susceptible to the next mountain pine beetle attack. Shallow roots make lodgepole pine susceptible to wind throw, which also creates canopy gaps.

White fir has established in the understory, and is co-dominant to Sierra lodgepole pine in some areas. White fir is multi-aged and has a patchy distribution due to stand disturbances.

Community Phase Pathway 1.4a

With time and growth and small scale disturbances, this forest continues to develop into an open white fir-Sierra lodgepole pine forest (Community Phase 1.1) with a multi-aged, complex forest structure.

Community Phase Pathway 1.4b

This pathway is triggered by a high mortality fire which initiates an open Sierra lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c
This pathway is triggered by a high mortality fire which initiates a dense Sierra lodgepole pine regeneration (Community Phase 1.3) provided there is ample cones and seed and optimum germination of seeds.

Sierra lodgepole pine-white fir/litter - Community Phase 1.5

This dense Sierra lodgepole pine-white fir forest develops after dense seedling establishment and the absence of canopy disturbance. This forest has an even-aged upper canopy of Sierra lodgepole pine, with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. The self-thinning process is slow and does not eliminate competition. White fir is established in the understory, and eventually becomes co-dominant to the Sierra lodgepole pine. There is almost no Sierra lodgepole pine regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees will enable the pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

Community Phase Pathway 1.5a
This pathway is triggered by a high mortality fire which leads to dense Sierra lodgepole pine regeneration (Community Phase 1.3) provided there is ample presence of cones and seed and optimum germination of seeds.

Community Phase Pathway 1.5b
This pathway is triggered by a high mortality fire which leads to open Sierra lodgepole pine regeneration (Community Phase 1.2). Pathways 1.5a and 1.5b are common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. A 67-year fire return interval does not allow for later succession community phase (Community Phases 1.1 and 1.6) to develop.

Community Phase Pathway 1.5c
This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low-mortality fires, or wind throw. The forest becomes a more open Sierra lodgepole pine forest (Community Phase 1.4) with several age classes and, with continued small scale disturbances, can eventually develop into Community 1.1.

Community Phase Pathway 1.5d
With time and growth in the absence of disturbance, the stand remains evenly aged and dense. White fir has established in the understory and become increasingly prevalent in the canopy, creating a dense white fir-Sierra lodgepole pine forest (Community Phase 1.6).

White fir-Sierra lodgepole pine/litter - Community Phase 1.6

Dense white fir-Sierra lodgepole pine forest

The dense white fir-Sierra lodgepole pine forest develops with the continued exclusion of fire and lack of other disturbances, allowing the tree densities to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the white fir for some time, but eventually declines due to the lack of sunlight and natural senescence. Fuel loads are high from the trees dying in the understory. Understory vegetation is absent due to the high cover of litter and debris and the lack of sunlight on the forest floor.

Community Phase Pathway 1.6a

Depending on cone and seed conditions, a severe fire would initiate dense Sierra lodgepole pine regeneration (Community Phase 1.3) based on ample presence of cones and seed and optimum germination of seeds.

Community Phase Pathway 1.6b

Depending on cone and seed conditions, a severe fire would initiate open Sierra lodgepole pine regeneration (Community 1.2).

Community Phase Pathway 1.6c

This pathway is created in time with a high incidence of small scale disturbances, which break up the uniformity and density of this forest. With continued disturbances, the open multi-aged white fir-Sierra lodgepole pine forest (Community Phase 1.1) may develop. The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels and low fire tolerance of the dominant tree species. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with small scale disturbances over time.

White fir-Sierra lodgepole pine/litter Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**10**		
		white hawkweed	HIAL2	*Hieracium albiflorum*	0	10	0	3

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**180**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	25	0	8
		Ross' sedge	CARO5	*Carex rossii*	0	50	0	10
		squirreltail	ELEL5	*Elymus elymoides*	0	30	0	7
		blue wildrye	ELGL	*Elymus glaucus*	0	60	0	10
		spike trisetum	TRSP2	*Trisetum spicatum*	0	15	0	5

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**10**		
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	10	0	5

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**3**	**44**		
		white fir	ABCO	*Abies concolor*	3	25	1	5

incense cedar	CADE27	*Calocedrus decurrens*	0	10	0	2
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	5	0	2
Jeffrey pine	PIJE	*Pinus jeffreyi*	0	2	0	1
sugar pine	PILA	*Pinus lambertiana*	0	2	0	1

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	63	180
Forb	0	3	10
Shrub/Vine	0	4	10
Tree	3	17	44
Total:	3	87	244

Forest Overstory:

White fir dominates the overstory with 20 to 50 percent cover. The cover of Sierra lodgepole pine is about 20 percent, but the trees are dying so their canopy is declining. Total canopy cover ranges from 60 to 90 percent. The overstory canopy is about 100 to 120 feet tall, with several understory canopies of white fir. There is an occasional Jeffrey pine, incense cedar, and sugar pine in the overstory.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	60	67	90

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	40.0	50.0						
incense cedar *Calocedrus decurrens*	CADE27	N	0	4.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	20.0	30.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	3.0						
sugar pine *Pinus lambertiana*	PILA	N	0	3.0						

Forest Understory:

Understory cover and production is low and quite variable due high canopy cover and thick accumulations of litter and debris on the forest floor. White fir and incense cedar saplings and seedlings are common. Other species are western needlegrass (Achnatherum occidentale), Ross' sedge (Carex rossii), squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), naked buckwheat (Eriogonum nudum), white hawkweed (Hieracium albiflorum), and spike trisetum (Trisetum spicatum).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	8.0		
Ross' sedge *Carex rossii*	CARO5	N	0	10.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	7.0		
blue wildrye *Elymus glaucus*	ELGL	N	0	10.0		
spike trisetum *Trisetum spicatum*	TRSP2	N	0	5.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white hawkweed *Hieracium albiflorum*	HIAL2	N	0	3.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
naked buckwheat *Eriogonum nudum*	ERNU3	N	0	5.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	1.0	5.0		
incense cedar *Calocedrus decurrens*	CADE27	N	0	2.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	1.0		
sugar pine *Pinus lambertiana*	PILA	N	0	1.0		

Ecological Site Interpretations

Forest 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*	59	59	124	124	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*	94	94	111	111	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.

Animal Community:

Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. These forests have high productivity in the understory with abundant forage for wildlife. They are often located adjacent to water bodies and open meadows, which increases the wildlife activity in these forests. Thirty-one mammals and almost fifty bird species have been documented to use Sierra lodgepole pine forests. Snags and downed logs are important for cavity-nesting birds, and mammals. Other animals forage on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

White fir forests provide browse, cover and nesting sites for a variety of wildlife species. The type and quality of the wildlife habitat varies with the community type. Mature open forests, closed dense white fir forests, young forests and shrub lands provide different habitats and forage. Deer and bear can heavily browse young white fir shoots. Porcupines eat the bark of white fir and can kill saplings. Rodents feed on the cambial tissue. Young seedlings and seeds are eaten by animals as well. Douglas squirrels cut and cache white fir cones before the cones are fully mature.

There are about 33 species of mammals commonly present in the white fir forest type in California and, of these, 7 are generally associated with mature forests. About 123 species of birds are found in the white fir forest type of California and southern Oregon, about 50 of which are associated primarily with mature forests. Many of these birds use mature white fir trees and snags for foraging, roosting, nesting and/or breeding. Included are bald eagle, California spotted owl, brown creeper, pileated woodpecker, white-headed woodpecker and, when near lakes or streams, osprey. Reptiles in white fir forests are represented by 17 species, mostly at lower elevations, 8 of which are associated with mature forests (Zouhar, 2001).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:

This area is suitable for hiking trails and wildlife viewing.

Wood Products:
Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction material. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light and straight-grained, with consistent texture (Cope 1993).

White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production, hence it provides poor firewood compared to other conifers (Zouhar, 2001).

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber (Gucker, 2007).

Incense cedar wood is resistant to decay, making it very desirable for exterior use. This wood is used as mud sills, window sashes, sheathing under stucco or brick veneer construction, greenhouse benches, fencing, poles and trellises. It is also widely used for exterior and interior siding. Much of the top quality incense cedar is used in the manufacture of pencils (Habeck, 2008).

Other Products:
Jeffrey pine seeds are edible. Jeffrey pine sap was used by Native Americans to treat pulmonary disorders and, later, heptane was distilled from the sap and sold to treat pulmonary problems and tuberculosis. Jeffrey pine heptane was also used to develop the octane scale used to rate petroleum used in automobiles (Gucker, 2007).

Other Information:
Additional information on the common white fir pathogens:

White fir dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris) is a parasitic plant common in the survey area as evident by witches brooms, top kill, stem cankers and swellings. The vegetative shoots of the dwarf mistletoe are often present from spring to fall. A fungus (Cytospora abietis) kills the branches that are infected with dwarf mistletoe. The reduced vigor makes the tree more susceptible to bark beetle and other diseases. The mistletoe cankers produce cracks in the bark that create entry points for other diseases such as heart rots (Burns and Honkala, 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.). This disease can damage tree growth by reducing crown development. Mortality is less common in mature trees than in younger regeneration trees. Secondary infection is possible from heart rots entering through openings in the infected areas (Burns and Honkala, 1990).

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 the 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 white fir directly, but it weakens the tree and makes it easier for bark beetles (Scolytus spp.) to infest the tree (Burns and Honkala, 1990).

The fir engraver beetle (Scolytus ventralis) can cause extensive damage to white fir forests. 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.

Additional information on Jeffrey pine pathogens:

Infections from western dwarf mistletoe (Arceuthobium campylopodium) cause witches brooms, reduced growth and tree mortality. Sticky seeds are spread in fall and infest nearby and understory trees. In years of severe drought dwarf mistletoe has induced 60 to 80 percent of the Jeffery pine mortality (Burns and Honkala, 1990).

Jeffrey pine bark beetles (Dendroctonus jeffreyi) are native beetles that can only reproduce in Jeffrey pine. They are a natural cycle in maintaining forest health. They generally attack older weaker trees, but in times of drought or other disturbances such as lightning or fire, epidemic levels can break out and cause extensive damage to the forest. These beetles infest the lower stem and bole of the trees, usually after a pine engraver (Ips pini) infestation in the upper portion of the tree. The beetles slowly destroy the cambium, inhibiting the flow of nutrients. A sign of infestation is the changing color of the pine needles from green to yellow or reddish brown, beginning from the top down (Hagle et al., 2003; Smith, 1971).

Additional information about the mountain pine beetle, which can affect sugar pine, as well as other pines:

The mountain pine beetle (Dendroctonus ponderosae) creates pitch tubes on the bark at the point of entry. Boring dust is evident at the base of the tree. These beetles feed on the phloem layer in the inner bark of the tree, eventually girdling the tree. A blue stain fungus is inoculated into the tree by the beetles and reduces the flow of water. These beetles generally infest trees that are weakened by drought or other stresses and usually kill the tree. The engraver beetles (Ips spp.)

are a secondary bark beetle, coming in after the mountain pine beetle. They eat the inner bark of the tree and inoculate the blue stain fungus as mentioned above, but the trees have a lower mortality rate. These beetles can be distinguished by their feeding patterns in the wood, and by the shape of the adults.

SITE INDEX DOCUMENTATION:

Alexander (1966) and Schumacher (1926) were used to determine forest site productivity for Sierra lodgepole 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.

Conifer trees appropriate for site index measurement typically occur in community phase 1.4 and the older stands in community phases 1.2 and 1.3.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Humic Loamy Gentle Slopes	F022BI110CA	This is a white fir-mixed conifer forest found on drier positions.
Frigid Alluvial Flat	R022BI202CA	This is a meadow ecological site which this forest often fringes.
Frigid Loamy Flood Plains	R022BI210CA	This is a riparian site associated with Hot Springs Creek.
Spring Complex	R022BI211CA	This spring complex is often found intermingled with this forest site.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Coarse Glaciolacustrine Gentle Slopes	F022BI117CA	This is a California red fir-Sierra lodgepole pine forest found at higher elevations.
Frigid Flat Outwash Terraces	F022BI123CA	This is a white fir-Sierra lodgepole pine forest found in drier conditions.
Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	F022BI125CA	This is a Sierra lodgepole pine forest found in cold air drainages and basins.
Cold Frigid Tephra Over Moraine Slopes	F022BI126CA	This is a Sierra lodgepole pine forest that is replaced by Jeffrey pine and ponderosa pine over time without disturbance.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

The following NRCS vegetation plots was used to describe this ecological site.

789347- type location

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	5 E
Section:	21
Datum:	NAD83
Zone:	10
Northing:	4477934
Easting:	633873
General Legal Description:	The type location is about 1 mile west of Drakesbad in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104477934633873

Relationship to Other Established Classifications:

Forest Alliance = Abies concolor - White fir forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra E Moseley	2/16/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/29/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes

Pinus jeffreyi / *Arctostaphylos patula* /
(Jeffrey pine / greenleaf manzanita /)

Site ID: F022BI121CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Glacial-valley wall, (2) Volcanic dome, (3) Lava flow
Elevation (feet): 5,250-7,490
Slope (percent): 5-90, but generally 15-50
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 39.0-91.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 and 44 degrees F (5 and 6.6 degrees C)
Restrictive Layer: Bedrock
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Ash mixed with colluvium over residuum, or in tephra over colluvium and residuum, or in residuum from volcanic rock
Surface Texture: (1) Ashy fine sandy loam, (2) Very gravelly ashy sandy loam, (3) Very bouldery medial loamy sand, (4) Very stony ashy sand
Surface Fragments <=3" (% Cover): 5-65
Surface Fragments > 3" (% Cover): 0-60
Soil Depth (inches): 10-60+
Vegetation: Open Jeffrey pine (Pinus jeffreyi) forest with a heavy understory of greenleaf manzanita (Arctostaphylos patula), bush chinquapin (Chrysolepis sempervirens), and huckleberry oak (Quercus vacciniifolia). Sugar pine (Pinus lambertiana), ponderosa pine (Pinus ponderosa), white fir (Abies concolor) and/or California red fir (Abies magnifica) are

occasionally present. These forests remain relatively open because of rock outcrops, bedrock depth, high percentage of rock fragments within the soils, and the consequential extremely droughty nature of the soils.
Notes: This ecological site occurs on glacial-valley walls, lava flows and glacially scoured volcanic domes.

Physiographic Features

This ecological site occurs on glacial-valley walls, lava flows and glacially scoured volcanic domes. Elevation is primarily between 5,290 and 7,490 feet. Slopes range from 5 to 90 percent, but are generally between 15 and 50 percent.

Landform: (1) Glacial-valley wall
(2) Volcanic dome
(3) Lava flow

	Minimum	Maximum
Elevation (feet):	5290	7490
Slope (percent):	5	90
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	Very high
Aspect:	South East West	

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 39 to 91 inches (991 to 2,311 mm) and the mean annual temperature is between 41 and 44 degrees F (5 and 6.6 degrees C). The frost free (>32F) season is 60 to 90 days. The freeze free (>28F) season is 75 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	60	90
Freeze-free period (days):	75	200
Mean annual precipitation (inches):	39.0	91.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description:	System	Subsystem	Class

Representative Soil Features

This site is associated with the Scoured, Dittmar, Typic Vitrixerands, bouldery and Typic Vitrixerands, unglaciated soil components. These soils developed in ash mixed with colluvium over residuum, or in tephra over colluvium and residuum, or in residuum from volcanic rock. They are shallow to deep over bedrock. These soils are all well drained, with high amounts of rock fragments, and very low to low AWC. The surface textures are ashy fine sandy loam, very gravelly ashy sandy loam, very bouldery medial loamy sand, and very stony ashy fine sand. Permeability is rapid in the upper horizons and impermeable through bedrock.

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

Map Unit Component / Component %

104 Dittmar/ 5
107 Dittmar/ 3
126 Dittmar/ 20
127 Dittmar/ 5
146 Scoured/ 3
157 Typic Vitrixerands, unglaciated/ 3
158 Typic Vitrixerands, unglaciated/ 75
159 Typic Vitrixerands, bouldery/ 40

169 Scoured/ 15
176 Scoured/ 5

Parent Materials:
Kind: Volcanic ash, Tephra, Colluvium
Origin: Volcanic rock
Surface Texture: (1)Ashy fine sandy loam
(2)Very gravelly ashy sandy loam
(3)Very bouldery medial loamy sand
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	5	65
Surface Fragments > 3" (% Cover):	0	60
Subsurface Fragments <=3" (% Volume):	2	45
Subsurface Fragments > 3" (% Volume):	3	90

Drainage Class: Well drained To Somewhat excessively drained
Permeability Class: Rapid To Impermeable

	Minimum	Maximum
Depth (inches):	10	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.0	3.98

Plant Communities

Ecological Dynamics of the Site

An open Jeffrey pine (Pinus jeffreyi) forest with a heavy understory of greenleaf manzanita (Arctostaphylos patula), bush chinquapin (Chrysolepis sempervirens), and huckleberry oak (Quercus vacciniifolia) is associated with this site. Sugar pine (Pinus lambertiana), ponderosa pine (Pinus ponderosa), white fir (Abies concolor) and/or California red fir (Abies magnifica) are occasionally present. These forests remain relatively open because of rock outcrops, bedrock depth, high percentage of rock fragments within the soils, and the consequential extremely droughty nature of the soils. They are often located on the upper ridgelines where water drains earlier in the season and desiccating winds remove snow, drying out the soils. Other associated plants for this site include western needlegrass (Achnatherum occidentale), western serviceberry (Amelanchier utahensis), prostrate ceanothus (Ceanothus prostratus), lace lipfern (Cheilanthes gracillima), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), spreading groundsmoke (Gayophytum diffusum), Sierra cliffbrake (Pellaea brachyptera), Plumas County beardtongue

(Penstemon neotericus), and mountain pride (Penstemon newberryi).

Jeffrey pine, the dominant tree associated with this site, is relatively large and long-lived. 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 length from 4.7 to 12 inches. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007) that are intolerant of wet conditions. It looks similar to ponderosa pine but has a vanilla-like odor in the bark, which is not as yellow as ponderosa pine. Jeffrey pine is shade intolerant and can be replaced over time by white fir if fire is excluded from the system. Mature Jeffrey pines are somewhat adapted to fire because their bark is thicker and 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 20 to 30 meters above the forest floor.

Conifers have evolved with their environment and have developed 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. Heavy shrub cover may delay soil warming, thus delaying conifer growth. 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 (Royce and Barbour, 2001).

Soil characteristics such as depth and texture determine how much water the soil can hold and how long it will remain before filtering through, evaporating away, or being lost to evapotranspiration. The soils associated with this site have very low to low water holding capacities. Under the same climatic conditions, drought would come earlier to these soils than those with higher water holding capacities.

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 are 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 in the Southern Cascades 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). 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).

This ecological site has a post-fire shrub phase that may last indefinitely. Shrubs persist on these sites because of the droughty soils and because of fire prone landscape positions. Greenleaf manzanita (Arctostaphylos patula), bush chinquapin (Chrysolepis sempervirens), and huckleberry oak (Quercus vacciniifolia) can have high cover post-fire and may have some negative affects on conifer regeneration.

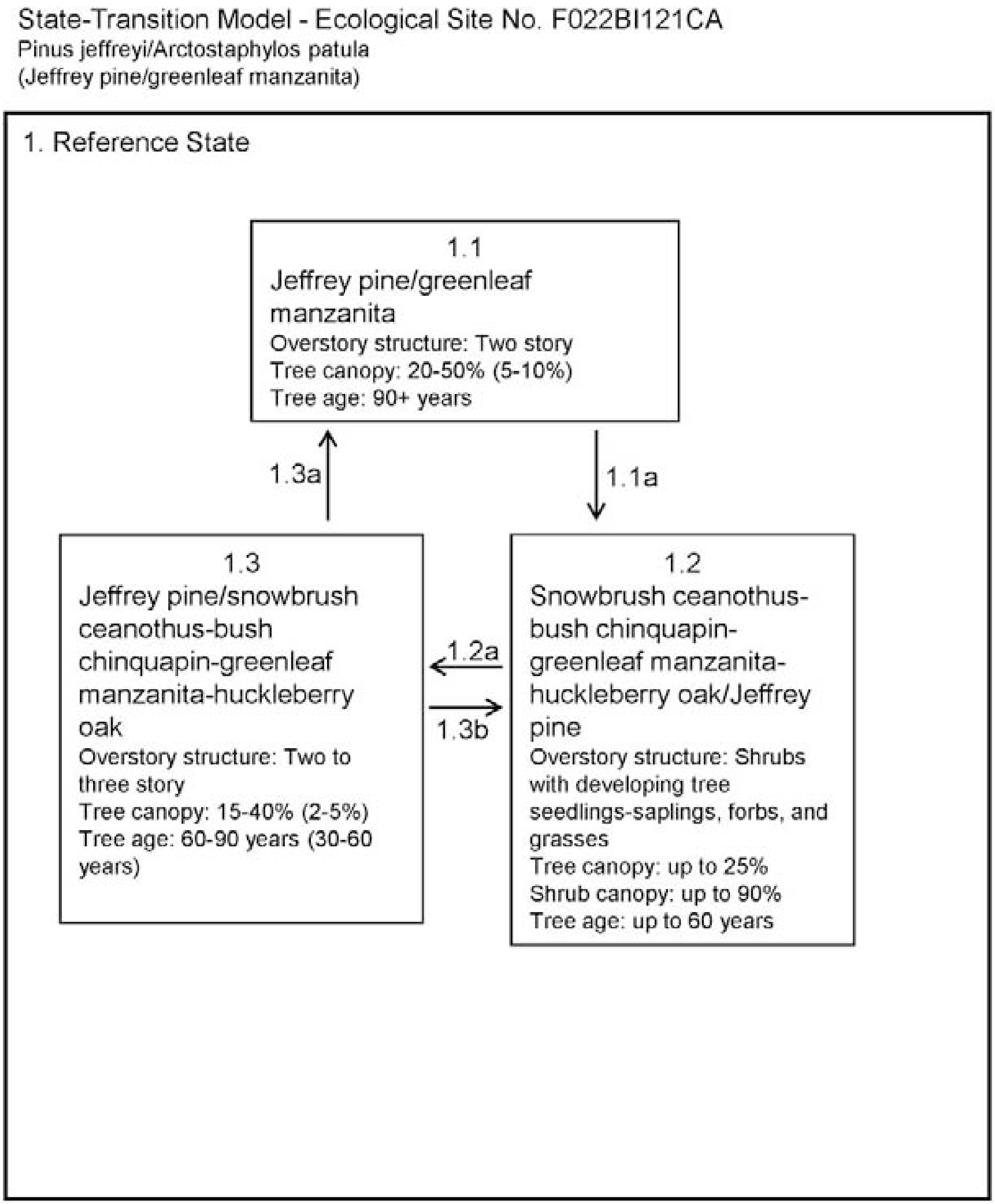
Tree pathogens and insect infestations can have significant impacts on the composition and structure of mid and upper montane coniferous forests. Small infestations may affect just a few trees but large outbreaks can kill the dominant trees over large areas of forest, creating large canopy openings and 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 (Dendroctonus 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 (Melampsorella 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 Diagram



Reference - State 1

Jeffrey pine/greenleaf manzanita - Community Phase 1.1

Open Jeffrey pine forest with shrubs

This community phase is the reference community phase for this ecological site. Jeffrey pine is generally dominant, although sugar pine may exhibit a major presence in one area of the park, and a mix of Jeffrey pine, white fir, red fir, sugar pine, western white pine and ponderosa pine exist in another area. The central concept is an open forest with high shrub cover. Total tree cover is low, ranging from 20 to 30 percent, with 10 to 60 percent shrub cover. Greenleaf manzanita (Arctostaphylos patula), bush chinquapin (Chrysolepis sempervirens), snowbrush ceanothus (Ceanothus velutinus) and huckleberry oak (Quercus vacciniifolia) may be present. Huckleberry oak is more common on the eastern side of the park, while snowbrush ceanothus is more common on the western side of the park. This may be a result of the fire history or seed source.

This community phase has evolved with fire, but it does not need fire to maintain an open forest. Forest productivity is limited by soil depth, available water, and competition for resources within the shrub community.

Community Phase Pathway 1.1a

Fire is the primary disturbance for this site that will initiate shrubland and conifer regeneration (Community Phase 1.2).

Jeffrey pine/greenleaf manzanita Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**15**		
		lace lipfern	CHGR	*Cheilanthes gracillima*	0	1	0	1
		Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0	1	0	1
		spreading groundsmoke	GADI2	*Gayophytum diffusum*	0	1	0	1
		Sierra cliffbrake	PEBR3	*Pellaea brachyptera*	0	1	0	1
		Indian warrior	PEDE	*Pedicularis densiflora*	0	5	0	1
		Plumas County beardtongue	PENE2	*Penstemon neotericus*	0	3	0	1
		mountain pride	PENE3	*Penstemon newberryi*	0	3	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**10**		
		western needlegrass	ACOCO	*Achnatherum occidentale ssp. occidentale*	0	10	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**1076**		
		Utah serviceberry	AMUT	*Amelanchier utahensis*	0	10	0	1
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	0	360	0	35
		prostrate ceanothus	CEPR	*Ceanothus prostratus*	0	21	0	3
		snowbrush ceanothus	CEVE	*Ceanothus velutinus*	0	120	0	10
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	0	65	0	5
		huckleberry oak	QUVA	*Quercus vacciniifolia*	0	500	0	35

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**14**		
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	12	0	5
		sugar pine	PILA	*Pinus lambertiana*	0	2	0	1

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	4	10
Forb	0	5	15
Shrub/Vine	0	445	1076
Tree	0	8	14
Total:	0	462	1115

Forest Overstory:

Jeffrey pine is generally dominant with 20 to 30 percent canopy cover. Tree heights and age are variable, and the forest is rarely evenly aged. Sampled trees ranged from 60 to 250 years old with canopy heights between 60 to 100 feet. Basal area ranged from 100 to 120 ft/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	20	28	30

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
California red fir *Abies magnifica*	ABMA	N	0	0.5						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	20.0	27.0						
sugar pine *Pinus lambertiana*	PILA	N	0	3.0						

Forest Understory:

Montane shrubs dominate this site. A variety of associated species may be found. Dominant shrubs are greenleaf manzanita (Arctostaphylos patula), prostrate ceanothus (Ceanothus prostratus), bush chinquapin (Chrysolepis sempervirens) huckleberry oak (Quercus vacciniifolia) and/or snowbrush ceanothus (Ceanothus velutinus). Other plants encountered on this site are western needlegrass (Achnatherum occidentale ssp. occidentale), western serviceberry (Amelanchier utahensis), lace lipfern (Cheilanthes gracillima), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), spreading groundsmoke (Gayophytum diffusum), Sierra cliffbrake (Pellaea brachyptera), Indian warrior (Pedicularis densiflora), Plumas County beardtongue (Penstemon neotericus), and mountain pride (Penstemon newberryi). Understory species varied from the east to west side of the park.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale ssp. occidentale*	ACOCO	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
lace lipfern *Cheilanthes gracillima*	CHGR	N	0	1.0		
Mt. Hood pussypaws *Cistanthe umbellata var. umbellata*	CIUMU	N	0	1.0		
spreading groundsmoke *Gayophytum diffusum*	GADI2	N	0	1.0		
Sierra cliffbrake *Pellaea brachyptera*	PEBR3	N	0	1.0		
Indian warrior *Pedicularis densiflora*	PEDE	N	0	1.0		
Plumas County beardtongue *Penstemon neotericus*	PENE2	N	0	1.0		
mountain pride *Penstemon newberryi*	PENE3	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Utah serviceberry *Amelanchier utahensis*	AMUT	N	0	1.0		
greenleaf manzanita *Arctostaphylos patula*	ARPA6	N	0	35.0		
prostrate ceanothus *Ceanothus prostratus*	CEPR	N	0	3.0		
snowbrush ceanothus *Ceanothus velutinus*	CEVE	N	0	10.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	0	5.0		
huckleberry oak *Quercus vacciniifolia*	QUVA	N	0	35.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	5.0		
sugar pine *Pinus lambertiana*	PILA	N	0	1.0		

Snowbrush ceanothus-bush chinquapin-greenleaf manzanita-huckleberry oak/Jeffrey pine - Community Phase 1.2

When large fires burn into the forest canopy and kill the majority of the overstory trees, a montane shrub community phase thrives in the new openings. Even if shrubs were not present at the time of a fire, their seeds may be stored in the soil. Greenleaf manzanita and snowbrush ceanothus seeds can lie dormant in the soil for several hundred years, until the heat from a fire scarifies the seed coat and initiates germination. These seeds also require light and cold stratification for germination. If present at the time of a fire, snowbrush ceanothus, bush chinquapin, and huckleberry oak can resprout. Hauser (2007) states that greenleaf manzanita does not resprout after fire in this area.

The size and the intensity of a burn may influence the shrub expression. Shrubs were found associated with large burn size, whereas trees were not able to establish across the landscape (Royce and Barbour, 2001). The intensity of burn may affect the scarification of seeds. Shrubs can prevail in areas prone to frequent fire, such as ridges and wind tunnels. Greenleaf manzanita is a strong competitor for water. It continues to deplete water after conifer species have gone dormant for the drought season. This competition for water and sunlight between the shrubs and conifer seedlings can delay the establishment of a forest (Royce and Barbour, 2001). The shrub community phase can be perpetuated by frequent fire or other disturbances.

Community Phase Pathway 1.2a

The natural pathway is to Community Phase 1.3, the open Jeffrey pine forest with shrubs. This pathway is followed with time and establishes the tree canopy over the shrubs.

Jeffrey pine/snowbrush ceanothus-bush chinquapin-greenleaf manzanita-huckleberry oak - Community Phase 1.3

This community phase develops as trees begin to have presence above the shrubs. The trees establish in the openings in the shrubs or encroach upon them from the edges of the shrub field. This is a slow process and could take up to 100 years.

Community Phase Pathway 1.3a

This pathway leads to Community Phase 1.1, the open Jeffrey pine forest with shrubs. This pathway is created with time by the dominance of the trees over the shrubs. Total tree canopy should be at least 20 percent. Low to moderate intensity fires may occur, but the heavy shrub creates ladder fuels that would most likely lead to a canopy fire.

Community Phase Pathway 1.3b

In the case of a severe canopy fire, the conifer and shrubland regeneration community phase 1.2 is initiated.

Ecological Site Interpretations

Forest 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*	55	55	192	192	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.
Jeffrey pine	*PIJE*	61	67	47	52	55	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).
sugar pine	*PILA*	157	157	146	146	70	605	300TA	Dunning, Duncan. 1942. A site classification for the mixed-conifer selection forest of the Sierra Nevada. USDA, Forest Service. California Forest and Range Experiment Station Research Note 28.

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).

Although the leaves of the montane shrubs are not a highly desired browse, their berries and seeds are eaten in large quantities. Greenleaf manzanita berries and seeds are eaten in large quantities by bears and other wildlife. Bush chinquapin seeds are a staple food for several birds and rodents. Huckleberry oak acorns are eaten by small mammals.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This site is suitable for trails, and may provide open views.

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:
Site index Documentation:

Meyer (1961), Dunning (1942), and Schumacher (1928) were used to determine forest site productivity for Jeffrey pine, sugar pine, and California red fir respectively. Both sugar pine and red fir are of very limited extent. 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 1.1 and 1.3. They are selected according to guidance listed in the site index publication.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Bouldery Glacially Scoured Ridges Or Headlands	F022BI102CA	This is a red fir-western white pine-pinemat manzanita site found at higher elevations.

Frigid Tephra Over Slopes And Flats	F022BI103CA	This is a white fir-Jeffrey pine forest found on the western portion of the park.
Frigid Humic Loamy Gentle Slopes	F022BI110CA	This is a white fir-mixed conifer forest found on the eastern side of the park.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789131- Typic Vitrixerands, boulders
789305- Dittmar- site location
789312- Typic Vitrixerands, unglaciated

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	6 E
Section:	30
Datum:	NAD83
Zone:	10
Northing:	4477532
Easting:	639009
General Legal Description:	The type location is about 0.25 miles northwest of Kelly Camp in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104477532639009

Relationship to Other Established Classifications:

Forest Alliance = Pinus jeffreyi - Jeffrey pine forest; Association = Pinus jeffreyi/Arctostaphylos patula. (Sawyer, John O., Keeler-Wolf, Todd, and Evens, Julie M. 2009. A Manual of California

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/25/2011

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/29/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Extremely Gravelly Sandy Landslides

Pinus jeffreyi - Abies concolor / *Arctostaphylos patula* /
(Jeffrey pine - white fir / greenleaf manzanita /)

Site ID: F022BI122CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: Rockfall avalanche
Elevation (feet): 5,760-7,200
Slope (percent): 2-30
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, East, West
Mean annual precipitation (inches): 39.0-93.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 40 to 45 degrees F (4.4 to 7.2 degrees C)
Restrictive Layer: None
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Rockfall avalanche deposits derived from volcanic rock
Surface Texture: Extremely gravelly ashy coarse sand
Surface Fragments <=3" (% Cover): 15-60
Surface Fragments > 3" (% Cover): 12-100
Soil Depth (inches): 60
Vegetation: These older rockfall avalanche deposits are further along in forest development, the oldest exhibiting well-developed Jeffrey pine-white fir forests. All the tree species established in Lassen Volcanic National Park are found within the Chaos Jumbles, except whitebark pine.
Notes: A number of large rockfall avalanches have originated from Chaos Crags. The majority of this site is associated with the Chaos Jumbles.

Physiographic Features

This ecological site is found on rockfall avalanche deposits. Located between 5,760 and 7,200 feet in elevation, slopes for this site range from 2 to 30 percent.

Landform: (1) Rockfall avalanche

	Minimum	Maximum
Elevation (feet):	5760	7200
Slope (percent):	2	30
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Negligible	Negligible
Aspect:	North East West	

Climatic Features

This ecological site receives most of its annual precipitation during the winter months in the form of snow. The mean annual precipitation ranges from 39 to 93 inches (991 to 2,362 mm) and the mean annual temperature is between 40 to 45 degrees F (4.4 to 7.2 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.

	Minimum	Maximum
Frost-free period (days):	60	90
Freeze-free period (days):	75	200
Mean annual precipitation (inches):	39.0	93.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.21	0.3	1.37	0.56	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.0

Precip. Max.	18.54	13.68	14.05	10.78	10.23	6.09	2.52	4.57	6.36	14.76	15.45	19.42
Temp. Min.	20.2	21.0	23.1	27.6	34.6	40.9	45.5	44.1	40.4	34.0	26.7	22.1
Temp. Max.	41.0	42.7	45.0	51.2	60.5	69.9	78.9	77.6	71.6	60.5	47.2	42.0

Climate Stations: (1) 045311, Manzanita Lake, CA. Period of record 1949 - 2005

Influencing Water Features

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

Wetland Description: System Subsystem Class

Representative Soil Features

The Chaos soil component associated with this site consists of very deep somewhat excessively drained soils. The surface texture is extremely gravelly ashy coarse sand, with gravelly ashy sand textures below. Most of the soil profile contains greater than 35 percent large and small rock fragments. These soils have very low AWC (available water capacity) in the upper 60 inches of soil. They are classified as Loamy-skeletal, isotic, nonacid, frigid Typic Xerorthents.

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

Map Unit Component/ Component %
134 Chaos/ 85

Parent Materials:
Kind: Rockfall avalanche deposits
Origin: Volcanic rock

Surface Texture: (1)Extremely gravelly ashy coarse sand
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	15	60
Surface Fragments > 3" (% Cover):	12	100
Subsurface Fragments <=3" (% Volume):	12	85
Subsurface Fragments > 3" (% Volume):	0	80

Drainage Class: Somewhat excessively drained
Permeability Class: Moderately rapid

	Minimum	Maximum
Depth (inches):	60	

Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	7.0
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.6	6.31

Plant Communities

Ecological Dynamics of the Site

A number of large rockfall avalanches have tumbled down the slopes from Chaos Crags, primarily during 3 distinct episodes. The area is called Chaos Jumbles. The oldest event was the largest and has been roughly dated to 1,500 years ago. The middle event was smaller than the first, occurring approximately 750 years ago. The smallest and most recent event occurred around 300 years ago. Because the more recent events were consecutively smaller, the older rockfall avalanche deposits were not completely buried (Heath, 1967) and different stages of soil and forest development are visible. The hummocky rock-strewn debris from the youngest event is very noticeable and remains exposed across the landscape. Now 300 years after the event, scattered conifers, forbs, and sub-shrubs are slowly going through the process of primary succession. The hummocky landform from older deposits is still present, but the surface has smoothed and a mineral soil has formed due to physical weathering, microbial activity, and organic matter accumulation. These older rockfall avalanche deposits are further along in forest development, the oldest exhibiting well-developed Jeffrey pine-white fir forests. All the tree species established in Lassen Volcanic National Park are found within the Chaos Jumbles, except whitebark pine.

The initial colonization of plants on newly exposed parent material initiates a wide range of processes. Nitrogen fixation is commonly one of the first processes to be initiated by pioneering plant species and microorganisms. It converts atmospheric nitrogen gas into ammonia (NH_4^+) through chemical and biological reactions. The resultant ammonia is converted to nitrate (NO_3^-) by microorganisms via nitrification. In this process, plants assimilate inorganic nitrogen in the form ammonia and nitrate. As plants continue to establish on the new substrate, they absorb CO_2 from the atmosphere and convert it to plant carbon through the process of photosynthesis. The carbon is sequestered as either above-ground or below-ground biomass, or as soil carbon. Soil organisms are responsible for the decomposition of plant material. When soil organisms die and decompose, nutrients are processed back into the soil. Plant material and dead soil organisms provide the bulk of organic matter in soil. The process of CO_2 production and the accumulation of organic matter begin to transform freshly exposed parent material by providing nutrients and creating better water availability for plants and microorganisms, affecting pH and weathering minerals. Over time, as these organisms eat, grow and move through the soil, they transform it into a more vibrant biologic substrate. Most of these processes are concentrated in the upper A horizon of the soil. The B horizon, located directly below, is influenced by the leaching of acids and other products from the A horizon.

Living and dead plant material stabilize the soil surface by physically buffering raindrop impact and impeding surface runoff. Within the soil, plants, animals and microbes bind the soil together as aggregates with roots, hyphae, fecal pellets and decomposed organic matter. The micro-structure formed by the combined processes of buffering and binding increases soil stability, porosity, water infiltration and water holding capacity (NRCS, 2010).

Trees and burrowing animal activity produce rather large pores and mix soil on a greater scale than processes provided by buffering and binding. Ants and gophers transport soil material by depositing subsoil on the surface as they build tunnels and nests. Dead tree roots produce macropores that often accumulate surface material and incorporate organic matter deeper into the profile (NRCS, 2010).

Many of the trees in the center of this site are chloritic because they lack available plant nutrients. A variety of conifer species are present, some being outside their usual elevation range. Sierra lodgepole pine (Pinus contorta var. murrayana) is generally the dominant tree species during primary succession, but Jeffrey pine (Pinus jeffreyi), white fir (Abies concolor), California red fir (Abies magnifica), sugar pine (Pinus lambertiana), western white pine (Pinus monticola), and mountain hemlock (Tsuga mertensiana) are also present in small amounts. Commonly associated plants are western needlegrass (Achnatherum occidentale), rockcress (Arabis sp.), pinemat manzanita (Arctostaphylos nevadensis), greenleaf manzanita (Arctostaphylos patula), carex (Carex sp.), bush chinquapin (Chrysolepis sempervirens), buckwheats (Eriogonum spp.), and oceanspray (Holodiscus microphyllus).

Conifers are rarely documented as the initial colonizers during primary succession. More common is a forb and grass phase with species that are able to fix nitrogen. An interesting study was conducted on an ectomycorrhizal association of the blue staining slippery jack fungi (Suillus tomentosus) with a variety of lodgepole pine (Pinus contorta var. latifolia) found north of California and extending into Canada and Alaska. Lodgepole pine (Pinus contorta var. latifolia) formed tuberculate ectomycorrhizae (TEM) with Suillus tomentosus, and the nitrogen-fixing bacteria Paenibacillus amylolyticus and Methylobacterium mesophilicum were shown to reside within the TEM (Paul, 2002). The results of the study indicate high nitrogenase activity, which was attributed to the TEM association. This indicates a symbiotic relationship similar to that of alder (Alnus spp.) and lupine (Lupinus spp.), wherein nitrogen fixing bacteria (Frankia spp. and Rhizobium spp. respectively) are found within root nodules. Several studies indicate a direct correlation between nitrogen fixation and nitrogen demand that varies depending upon season, soil chemistry, and stand age (Paul et al., 2007). The study of the symbiotic relationship between lodgepole pine (Pinus contorta var. latifolia) and Suillus tomentosus may not apply directly to this area, or to the Sierra lodgepole pine (Pinus contorta var. murrayana) variety; however, Suillus tomentosus is a common mushroom throughout the area and is documented in lodgepole pine forests in northern California and the Sierra Nevada (Arora, 1986).

Once the forest develops it has the same successional pattern as other Jeffrey pine-white fir forests. Sierra lodgepole pine and Jeffrey pine are shade intolerant species which dominate after disturbances. Jeffrey pine is generally a taller and longer-lived species than Sierra lodgepole pine, and will eventually overtop and shade it out. White fir will eventually establish in the understory in the absence of fire.

Sierra lodgepole pine grows tall and narrow with short branches. Needles are 1.2 to 2.4 inches long in fascicles of 2. Although its thin bark and shallow root system make Sierra lodgepole pine susceptible to fire, it is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow, which enable it to grow on this site. Sierra lodgepole pine produces a taproot that can atrophy or grow horizontally in cases of a high water table or a root restrictive layer. Sierra lodgepole pine is shade intolerant and is an early successional species on this site. Though it often reproduces abundantly after fire, it is unknown if it will dominate this site after fire.

Jeffrey pine dominates this site after the early stages of primary succession, and through later succession with reoccurring understory burns. Jeffrey pine produces 3 to 8-inch needles in bundles of 3. The female seed cones range from 4.7 to 12 inches in length. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007) that 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. Jeffrey pine is shade intolerant and can be replaced over time by white fir if fire is excluded from the system. Older Jeffrey pines are somewhat adapted to fire because their bark is thick enough to provide protection from moderate intensity fires. Additionally, their branches tend to thin along the lower portion of the tree trunk, leaving the crown 65 to 100 feet above the forest floor.

White fir is common in the later successional stages if there is an absence of fire. White fir produces single needles 1.2 to 2.8 inches long that are distributed along 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 that can graft to other white fir roots and spread root rots (Zouhar, 2001).

Fire regime studies based on tree rings and fire scars report historic median fire return intervals in Jeffrey pine-white fir forests of 14, 18.8, and 70 years (Bekker and Taylor; Skinner and Chang; Taylor and Solem respectively). Beaty and Taylor report that fire frequency and intensity is additionally associated with slope position, aspect, and climatic fluctuations. Fire return intervals are longer on north facing slopes than on south facing slopes. Stand-replacing fire is more common on upper slopes, while low to moderate intensity fires occur only along lower slopes. This is probably due to the tendency of fire to burn upslope, preheating the fuels as it goes (Beaty and Taylor, 2001). In July and August, thunderstorms are common in Lassen Volcanic National Park and the 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). Beaty and Taylor report that after a stand-replacing fire, evenly aged forests are formed. The current management practice of fire suppression has shifted forest density and composition by allowing the fire intolerant and shade tolerant firs to increase in cover and density, eventually out-competing the fire tolerant and shade intolerant pines (Taylor 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 significant tracts of forest, creating large canopy openings and stand regeneration. Most of these pathogens are natural cycles of regulation that can push closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests. Fuel loads are frequently high after outbreaks, creating ideal conditions for high intensity fires.

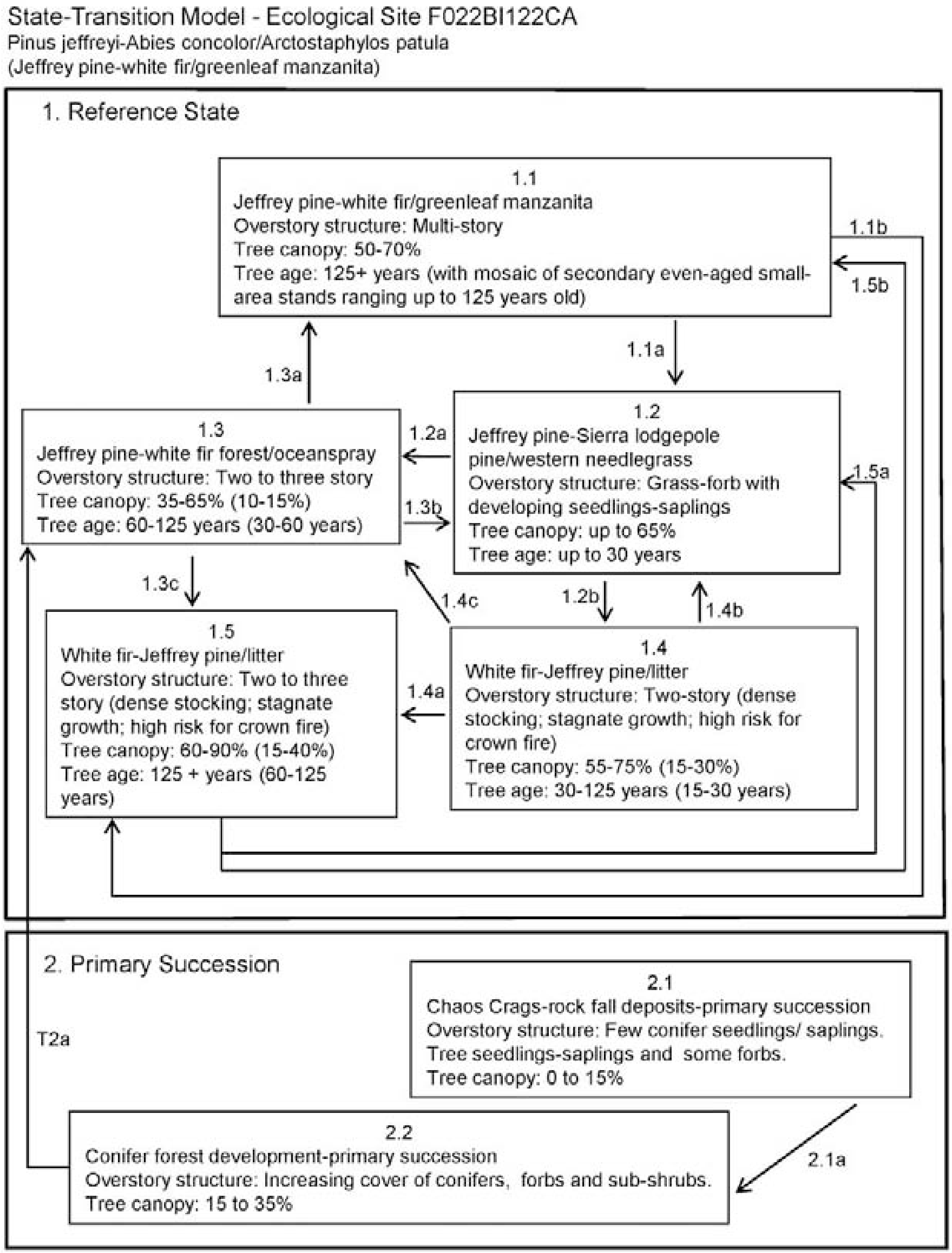
Jeffrey pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. Pathogens that affect Jeffrey pine in this area are dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle, (Dendroctonus 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 (Melampsorella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), trunk rot (Echinodontium tinctorium) and fir engravers (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).

The most serious pest for Sierra lodgepole pine is the mountain pine beetle (Dendroctonus ponderosae). It is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40-year cycles (Cope, 1993). Prominent among the other insects to affect Sierra lodgepole pine is the Ips beetle (Ips spp.), which commonly develops in moist, shaded logging slash. Prompt slash disposal is an effective control measure. Ips also can build up in windthrows. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 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 Diagram



Reference - State 1

Jeffrey pine-white fir/greenleaf manzanita - Community Phase 1.1

Large openly spaced Jeffrey pine trees dominate this forest. Community Phase 1.1 (and community phase 1.5 described later) are found on the older rockfall avalanches. This community phase is maintained by low and moderate intensity fires that remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires can kill some of the overstory trees as well, leaving canopy openings that are favorable for Jeffrey pine and western white pine regeneration. These moderate intensity fires breakup the uniformity of the older stands with pockets of young forests intermixed.

Community Phase Pathway 1.1a

A severe canopy fire will initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b

This pathway is created when fire is excluded from the old growth community phase. White fir continues to regenerate in the understory, increasing tree density and shifting this community phase toward the white fir-Jeffrey pine forest (Community Phase 1.5).

Jeffrey pine-Sierra lodgepole pine/western needlegrass - Community Phase 1.2

This regeneration community phase develops after a severe crown fire. It differs from primary succession in that the soil has developed structure and accumulated organic matter, providing nutrients in the upper horizon. Seeds may survive onsite after the fire, allowing tree seedlings, grasses, and forbs to establish quickly. The few surviving canopy trees are a valuable source of seed for tree regeneration. Nearby trees disperse their seed downwind to distances about twice their height, and possibly farther under windy conditions.

Community Phase Pathway 1.2a

The natural pathway is to Community Phase 1.3, a young open Jeffrey pine-white fir forest. This pathway is followed with a natural fire regime. Manual thinning and prescribed burns can imitate the natural cycle and lead to the same open community phase.

Community Phase Pathway 1.2b

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

Jeffrey pine-white fir forest/oceanspray - Community Phase 1.3

As this community phase develops from primary succession, Jeffrey pine and white fir overtop the older but shorter Sierra lodgepole pines and the understory is covered with a thin layer of pine needles. A young forest develops with several canopy layers.

This community phase also represents the young forest that would develop from Community Phase 1.2, the post fire conifer regeneration community phase. These forests would have some differences in structure and development but are combined to simplify the state and transition models. The conifer species diversity may be higher after primary succession than secondary succession. Seedling establishment and forest structure will most likely develop more quickly during secondary succession because the soil has developed better structure and accumulated organic matter, microbes, and other physical properties that enhance seedling survival and plant growth.

Low to moderate intensity fire maintains an open forest structure. The fires kill many of the young fire intolerant seedlings in the understory, which reduces the competition between trees and lowers the potential for a severe canopy fire. The structure, composition, age, and moisture 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.

Community Phase Pathway 1.3a
This is the natural pathway for this community phase, which evolved with a historic regime of relatively frequent surface to moderate severity fires and/or pest outbreaks that create partial tree mortality. This pathway leads to the mature Jeffrey pine-white fir forest (Community Phase 1.1).

Community Phase Pathway 1.3b
A severe canopy fire would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.3c
If fire does not occur, then the density of the forest increases. The increased density shifts this community phase toward the white fir-Jeffrey pine forest (Community Phase 1.5).

White fir-Jeffrey pine/litter - Community Phase 1.4

Jeffrey pine dominates the upper canopy, but there is heavy recruitment of white fir in the understory.

This community is defined by a dense canopy and high basal area of white fir and Jeffrey pine dominates the upper canopy, but there is heavy recruitment of white fir in the understory.

This community phase is defined by a dense canopy and high basal area of white fir and Jeffrey pine. Canopy cover ranges from 50 to 80 percent. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients, making them more susceptible to death. Fire hazard is potentially high in this community phase due to the deep accumulation of litter, the standing dead and downed trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.4a
If fire continues to be excluded from this system, the dense white fir-Jeffrey pine forest develops (Community Phase 1.5).

Community Phase Pathway 1.4b
At this point, the density of ground fuels and the mid-canopy ladder fuels create conditions for a

high intensity canopy fire. A severe fire would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c

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 had it developed with fire over time. Manual treatments to thin the white fir and other fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to its natural state of a more open Jeffrey pine-white fir forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3 but the subsequent tree mortality would increase the already high accumulation of fuels.

White fir-Jeffrey pine/litter - Community Phase 1.5

White fir-Jeffrey pine forest

This community phase develops with the continued exclusion of fire. Community Phase 1.5 (and community phase 1.1 described above) are found on the older rockfall avalanches. White fir dominates during this phase and eventually shades-out the associated pine species. This community phase is defined by a dense canopy and high basal area. Canopy cover ranges from 60 to 95 percent. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients. The understory is almost absent because of lack of sunlight on the forest floor. Fire hazard is high in this community phase, caused by the deep accumulation of litter, standing dead and downed trees, and the dense multi-layered structure of the forest.

Community Phase Pathway 1.5a
At this point a severe fire is likely and would initiate forest regeneration (Community Phase 1.2).

Community Phase Pathway 1.5b
The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with fire over time. Manual treatments to thin the understory trees and other fuels, and/or prescribed burns, could be implemented to shift this forest back to a more open Jeffrey pine-white fir forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1 but the subsequent tree mortality would increase the already high accumulation of fuels.

White fir-Jeffrey pine/litter Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**1**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	1	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**6**		
		sedge	CAREX	*Carex*	0	6	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**55**		
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	0	20	0	2
		little prince's pine	CHME	*Chimaphila menziesii*	0	1	0	1
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	0	18	0	2
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	1	0	1

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
		oceanspray	HODI	*Holodiscus discolor*	0	15	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**37**		
		white fir	ABCO	*Abies concolor*	0	20	0	5
		California red fir	ABMA	*Abies magnifica*	0	3	0	1
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	4	0	2
		sugar pine	PILA	*Pinus lambertiana*	0	2	0	1

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	3	6
Forb	0	0	1
Shrub/Vine	0	19	55
Tree	0	14	37
Total:	0	36	99

Forest Overstory:

This forest is dominated by younger strata of white fir. Older Jeffrey pines still stand above most of the white fir. The Jeffrey pine trees cored for site index were 180 to 400 years old, and the white fir were 150 to 170 years old. (These trees do not reflect the oldest trees or necessarily a specific canopy age, and white fir has limited data.) The upper canopy is about 100 to 130 feet tall. Dbh (diameter at breast height) of the overstory trees ranges from 20 to 32 inches. Basal area data is limited, but is greater than 190-ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	60	74	90

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	40.0	50.0						
California red fir *Abies magnifica*	ABMA	N	0	2.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0						

Jeffrey pine *Pinus jeffreyi*	PIJE	N	20.0	35.0
sugar pine *Pinus lambertiana*	PILA	N	0	1.0

Forest Understory:

The understory is sparse due to dense shade and heavy accumulations of litter and woody debris. Plants encountered on the site include greenleaf manzanita (Arctostaphylos patula), pioneer rockcress, (Arabis platysperma), carex sp. (Carex sp.), little prince's pine (Chimaphila menziesii), Chrysolepis sempervirens (bush chinquapin), naked buckwheat (Eriogonum nudum), and oceanspray (Holodiscus discolor).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
sedge *Carex*	CAREX	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
greenleaf manzanita *Arctostaphylos patula*	ARPA6	N	0	2.0		
little prince's pine *Chimaphila menziesii*	CHME	N	0	1.0		
bush chinquapin *Chrysolepis sempervirens*	CHSE11	N	0	2.0		
naked buckwheat *Eriogonum nudum*	ERNU3	N	0	1.0		
oceanspray *Holodiscus discolor*	HODI	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	5.0		
California red fir *Abies magnifica*	ABMA	N	0	1.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	2.0		

Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	4.0
sugar pine *Pinus lambertiana*	PILA	N	0	1.0

Primary Succession (preceding the Reference State) - State 2

Chaos Crags- rockfall avalanche deposits-primary succession - Community Phase 2.1

It may take a century of physical and biological weathering before the debris material can create conditions suitable for primary conifer succession. Once plants pioneer into the rocky substrate, they begin to accumulate organic matter and provide limited shade. Sierra lodgepole pine is an early pioneer on the exposed debris, commonly accompanied by Jeffrey pine. Other conifer species generally establish later, in the shade and litter of the early pioneer species.

The intact forests adjacent to the debris deposits provide seeds for colonization. As those forests on the periphery develop, more seed is produced and disseminated further into the debris deposits. With normal wind conditions, Jeffrey pine, red fir, white fir, Sierra lodgepole pine and western white pine disperse seed within 200 feet of the source. One report states that western white pine seed can be windblown over 2,000 feet. In addition to the wind, animals often cache the pine seeds. The presence of Sierra lodgepole pine in the early succession may be in part due to its high production of viable seeds and the tolerance of the seedlings to open sunlight (Cope, 1993; Jenkinson, 1990; and Zouhar, 2001.).

Community Phase Pathway 2.1a

With time primary succession continues, and a conifer forest slowly develops (Community Phase 2.2).

Conifer forest development-primary succession - Community Phase 2.2


Conifer forest development

This community phase slowly develops as conditions become more hospitable for tree growth. The trees that established on the barren debris deposits have increased in size, creating a layer of litter and a zone of shade under the canopy. Many of the trees have reached reproductive maturity, providing a local seed source for continual seedling establishment. Sierra lodgepole pine and Jeffrey pine are the dominant trees. White fir seedlings are present in the shadow of the pines. The understory is limited, with scattered forbs and subshrubs among the rock fragments. The forbs and subshrubs create fertile pockets of organic matter. There is a range in tree age due to the continual establishment of seedlings in the open areas.

As time progresses, forest canopy and structure develops. Eventually it develops into a relatively open Jeffrey pine-white fir forest (Community Phase 1.3), and follows the community pathways outlined in the state and transition model.

Transition - T2a

As time progresses, forest canopy and structure develops. Eventually it develops into a relatively open Jeffrey pine-white fir forest (Community Phase 1.3), and follows the community pathways outlined in the state and transition model.

Conifer forest development-primary succession Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**1**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	1	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**6**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	2	0	1
		sedge	CAREX	*Carex*	0	2	0	1
		squirreltail	ELEL5	*Elymus elymoides*	0	2	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**41**		
		serviceberry	AMELA	*Amelanchier*	0	3	0	1
		marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	0	2	0	1
		rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	0	6	0	2
		sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0	2	0	1
		oceanspray	HODI	*Holodiscus discolor*	0	25	0	5
		granite prickly phlox	LIPU11	*Linanthus pungens*	0	2	0	1
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	1	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**2**	**23**		
		white fir	ABCO	*Abies concolor*	0	5	0	2
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	2	6	1	3
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	4	0	2

sugar pine	PILA	*Pinus lambertiana*	0	4	0	2
mountain hemlock	TSME	*Tsuga mertensiana*	0	3	0	1

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	0	6
Forb	0	0	1
Shrub/Vine	0	8	41
Tree	2	11	23
Total:	2	19	71

Forest Overstory:

Jeffrey pine and Sierra lodgepole pine dominate during the early successional phases of this site. Sugar pine, western white pine, white fir and mountain hemlock are scattered throughout the area but with low cover. Canopy cover ranges from 10 to 35 percent. Trees generally grow less than 40 feet in height, although some are taller.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	10	20	35

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	1.0	4.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	2.0	9.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	5.0	15.0						
sugar pine *Pinus lambertiana*	PILA	N	2.0	6.0						
mountain hemlock *Tsuga mertensiana*	TSME	N	0	1.0						

Forest Understory:

There is some diversity of species present, but understory cover is generally less than 10 percent. Common species are western needlegrass (Achnatherum occidentale), serviceberry (Amelanchier sp.), pioneer rockcress (Arabis platysperma), sedge (Carex sp.), squirreltail (Elymus elymoides), marumleaf buckwheat (Eriogonum marifolium), rubber rabbitbrush (Ericameria nauseosa ssp. nauseosa var. nauseosa), sulphur-flower buckwheat (Eriogonum umbellatum), oceanspray (Holodiscus discolor), granite prickly phlox (Linanthus pungens), and whiteveined wintergreen (Pyrola picta).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	1.0		
sedge *Carex*	CAREX	N	0	1.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	1.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
serviceberry *Amelanchier*	AMELA	N	0	1.0		
marumleaf buckwheat *Eriogonum marifolium*	ERMA4	N	0	1.0		
rubber rabbitbrush *Ericameria nauseosa ssp. nauseosa var. nauseosa*	ERNAN5	N	0	2.0		
sulphur-flower buckwheat *Eriogonum umbellatum*	ERUM	N	0	1.0		
oceanspray *Holodiscus discolor*	HODI	N	0	5.0		
granite prickly phlox *Linanthus pungens*	LIPU11	N	0	1.0		
whiteveined wintergreen *Pyrola picta*	PYPI2	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	2.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	1.0	3.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	2.0		
sugar pine *Pinus lambertiana*	PILA	N	0	2.0		
mountain hemlock *Tsuga mertensiana*	TSME	N	0	1.0		

Ecological Site Interpretations

Forest 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*	51	51	95	95	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.
Jeffrey pine	*PIJE*	76	76	63	63	44	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:
Wildlife habitat changes as the forest develops. The mature open forest provides the best shelter and habitat for wildlife as the young open stands have very little available forage or cover.

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).

The seeds of the conifer species associated with this site are valued for food by small mammals and birds. Young leaves and shoots are foraged by small mammals and deer. Standing dead trees and downed logs provide nesting cavities for small mammals and are utilized by a variety of birds.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This ecological site provides a great opportunity to view several stages of plant succession after a major disturbance.

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

The wood of Sierra lodgepole pine is used for light framing materials, interior paneling, exterior trim, posts, railroad ties, pulp and paper (Cope, 1993).

White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production hence it is a poor source of firewood compared to other conifers (Zouhar, 2001).

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:
Forest Site Productivity:

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

Conifer trees appropriate for site index measurement typically occur in community phases 1.3 and 1.4. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Moist Sandy Lake Or Stream Terraces	F022BI108CA	This is a wet lodgepole forest found around lake margins.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Tephra Over Slopes And Flats	F022BI103CA	This is a white fir-Jeffrey pine forest unaffected by avalanche debris.
Frigid Debris Flow Gentle Slopes	F022BI106CA	This site involves primary succession in the Devastated Area.

State Correlation:
This site has been correlated with the following states:

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

789124
789276
789359- site location
Chaos Jumbles- vegetation only

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	R 4
Section:	18
Datum:	NAD83
Zone:	10
Northing:	4488443
Easting:	621830
General Legal Description:	The type location is about 0.13 miles southeast of Lily Pond in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104488443621830

Relationship to Other Established Classifications:

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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra E Moseley	2/16/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/30/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Frigid Flat Outwash Terraces

Abies concolor - Pinus contorta var. murrayana / / *Achnatherum occidentale*
(white fir - Sierra lodgepole pine / / western needlegrass)

Site ID: F022BI123CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: Outwash terrace
Elevation (feet): 6,100-6,300
Slope (percent): 1-15
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, South, East
Mean annual precipitation (inches): 43-59 (1092-1499 mm)
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 to 44 degrees F (5 to 6.6 degrees C)
Restrictive Layer: Duripan occurs at 20 to 60 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra over glacial outwash from volcanic rocks
Surface Texture: Ashy Loamy coarse sand
Surface Fragments <=3" (% Cover): 10-35
Surface Fragments > 3" (% Cover): 0-5
Soil Depth (inches): 20-60
Vegetation: Presently dominated by a Sierra lodgepole pine (Pinus contorta var. murrayana) forest, with a lesser presence of white fir (Abies concolor), Jeffrey pine (Pinus jeffreyi) and quaking aspen (Populus tremuloides).
Notes: This ecological site is found on outwash terraces. This site is topographically higher in valley elevation than an adjacent Sierra lodgepole pine/aspen forest, ecological site

F022BI105CA. The understory is less productive than the Sierra lodgepole pine-quaking aspen forest found along Hat Creek.

Physiographic Features

This ecological site is found on outwash terraces between 6,100 and 6,300 feet in elevation. Slopes range from 1 to 15 percent.

Landform: (1) Outwash terrace

	Minimum	Maximum
Elevation (feet):	6100	6300
Slope (percent):	1	15
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Low
Aspect:	Southwest to southeast	

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 43 to 59 inches (1,092 to 1,499 mm) and the mean annual temperature is between 41 to 44 degrees F (5 to 6.6 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.

The climate information in the tables below is from the Manzanita Lake climate station, which is 400 feet lower in elevation and about 8 miles to the west of this site.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	43.0	61.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.21	0.3	1.37	0.56	0.16	0.0	0.0	0.0	0.0	0.0	0.04	0.0
Precip. Max.	18.54	13.68	14.05	10.78	10.23	6.09	2.52	4.57	6.36	14.76	15.45	19.42
Temp. Min.	20.2	21.0	23.1	27.6	34.6	40.9	45.5	44.1	40.3	34.0	26.7	22.1
Temp. Max.	41.0	42.7	45.0	51.2	60.5	69.9	78.9	77.6	71.6	60.5	47.2	42.0

Climate Stations: (1) 045311, Manzanita Lake, CA. Period of record 1949 - 2005

Influencing Water Features

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

Wetland Description: System Subsystem Class

Representative Soil Features

This site is associated with the Vitrixerands, low elevation soil component, which consists of moderately deep and deep, well drained soils that formed in tephra over glacial outwash from volcanic rocks. The surface texture is gravelly ashy loamy coarse sand, with sandy and sandy loam subsurface textures. There is greater than 35 percent rock fragments in most of the profile, with gravels in the upper horizons and stones and cobbles in the lower horizons. A duripan occurs at 20 to 60 inches. Permeability is rapid to moderately rapid through the upper horizons, but very slow through the duripan.

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

Map Unit / Component / Component %

138 / Vitrixerands, low elevation / 9
168 / Vitrixerands, low elevation / 90

Parent Materials:
Kind: Tephra, Outwash
Origin: Volcanic rock

Surface Texture: (1) Gravelly ashy loamy coarse sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	10	35
Surface Fragments > 3" (% Cover):	0	5
Subsurface Fragments <=3" (% Volume):	20	40

	Minimum	Maximum
Subsurface Fragments > 3" (% Volume):	0	18

Drainage Class: Well drained To Well drained
Permeability Class: Rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	60
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.27	3.69

Plant Communities

Ecological Dynamics of the Site

This ecological site is presently dominated by a Sierra lodgepole pine (Pinus contorta var. murrayana) forest, with a lesser presence of white fir (Abies concolor), Jeffrey pine (Pinus jeffreyi) and quaking aspen (Populus tremuloides). In the absence of disturbance, white fir will successionally replace or co-exist with the Sierra lodgepole pine on this site. This site is topographically higher in elevation than an adjacent Sierra lodgepole pine/aspen forest, ecological site F022BI105CA. The understory is less productive than the Sierra lodgepole pine-quaking aspen forest found along Hat Creek. Understory species include western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides), rabbitbush (Ericameria bloomeri), California stickseed (Hackelia californica), lupine (Lupinus spp.), and goosefoot violet (Viola purpurea). This area was not heavily affected by the 1915 eruption of Lassen Peak and debris material from the eruption is confined to the lower valley site F022BI105CA. The tephra deposits overlying the buried soils on this site are from the development of Chaos Crags, over 1,000 years ago.

This ecological site is on outwash terraces with a root restrictive layer at varying depths between 20 to 60 inches. The roots of Sierra lodgepole pine are generally shallow, which enable them to grow on this site. Sierra lodgepole pine produces a taproot, but it may atrophy or grow horizontally in cases of high water tables or root restrictive layers.

Sierra lodgepole pine can be long-lived; however the overstory trees cored for this site index data were between 80 to 100 years old and relatively young. Sierra lodgepole pine does not usually gain much in girth with time and older trees averaged 16 to 21 inch diameters. It grows tall and narrow with short branches and 1.2 to 2.4 inch needles in fascicles of two. Its thin bark and shallow roots make it susceptible to fire. Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds.

Sierra lodgepole pine has a complex disturbance regime that includes cyclic beetle infestations and fire. Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates for the lodgepole pine (Taylor and Solem, 1995). Sierra lodgepole pine regenerates prolifically after fire and evenly aged stands are formed. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly at a low intensity. Even the low intensity fire can cause damage to the live trees however, and fire damaged trees are more susceptible to the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine or white fir regeneration. Over time these gaps will break up the uniformity of evenly aged stands that formed after the last large fire event. This site rarely develops into an old growth forest because white fir establishes in the understory and eventually dominates the overstory.

White fir is a large long-lived tree in this area. It commonly reaches 300 to 400 years in age and heights of 120 to 140 feet. It produces single needles1.2 to 2.8 inches long that are distributed along young branches. Because the female seed cones open and fall apart while still attached to the tree, cones are not often seen on the forest floor. White fir tends to develop a shallow root system that can graft to other white fir roots and spread root rots (Zouhar, 2001). White fir is a shade tolerant conifer and is able to establish in the understory of Sierra lodgepole pine on this site. It continues to grow and reproduce in the understory and will eventually dominate the forest in the absence of disturbance. In the past the natural fire regime kept forests from developing into the later successional stages dominated by white fir or red fir (Taylor, and Solem, 2001). White fir and Sierra lodgepole pine are both relatively fire intolerant species and tend to have high mortality rates after fire.

Quaking aspen (Populus tremuloides) is a minor component in this area, but has some potential to expand after canopy disturbance. It is not included in the dynamics of this site because the site characteristics indicate that it would not dominate this area even after disturbance. Please refer to Sierra lodgepole pine/aspen ecological site F022BI105CA for more information on aspen. Although aspen doesn’t regenerate often from seed, it spreads prolifically by root sprouts called suckers. The suckers are part of a clone. The clones regenerate after sudden canopy removal caused by disturbances such as fire, disease or insect infestations. Without fire or other disturbances, aspen stands fail to produce suckers because of hormonal inhibitors. Young aspen clones and mature trees grow best in full sunlight. Aspen trees can to live to be 150 years or older, but often aspen stands tend to deteriorate after 80 to 100 years without disturbance. Sierra lodgepole pine and eventually white fir overtop and shade out aspen on this site.

The mountain pine beetle is the most significant forest pathogen affecting this site, but several other pathogens have potential to cause mortality or diminished productivity. Most of these pathogens are a natural cycle of regulation and can push the closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests.

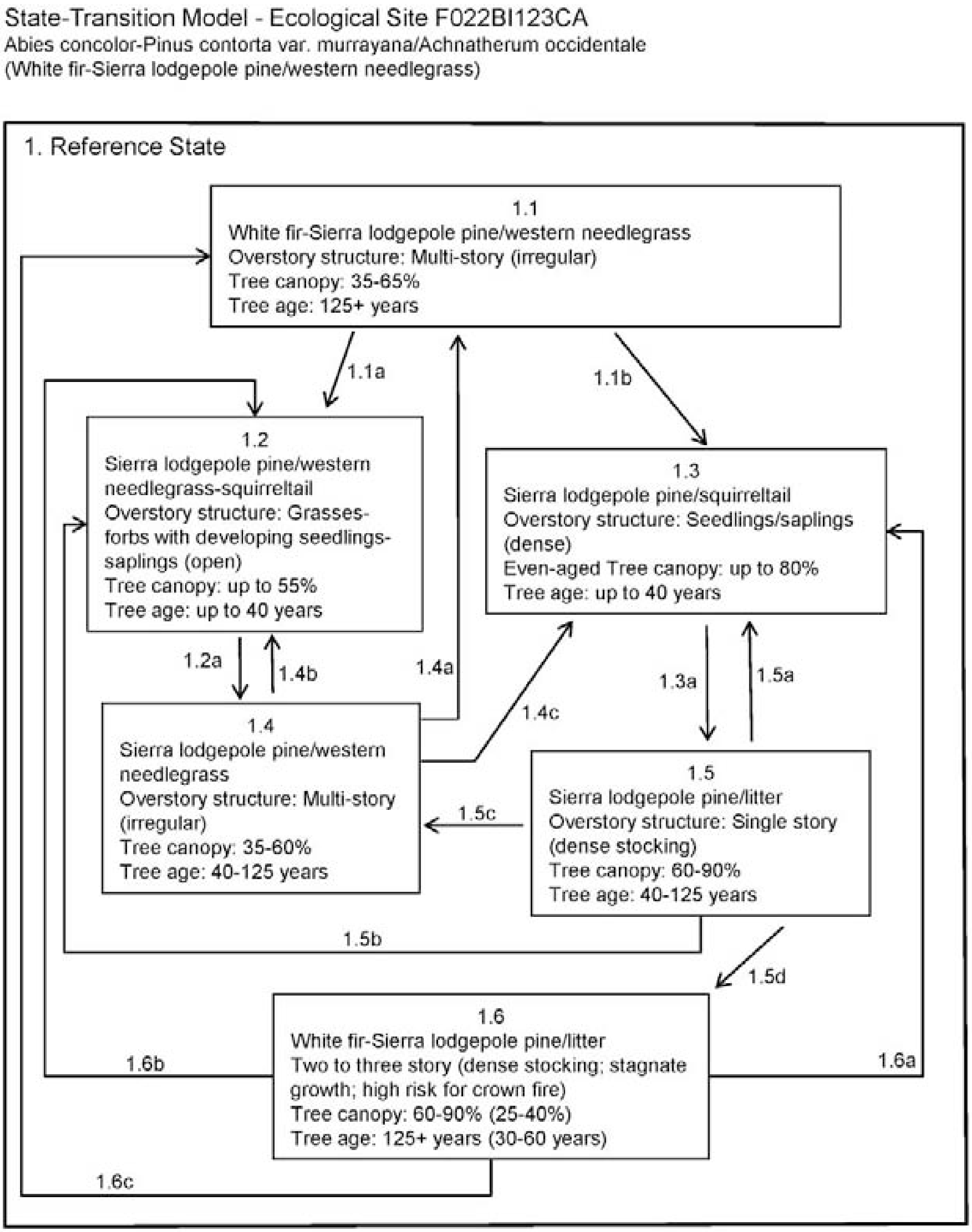
There is evidence that warming temperatures are allowing mountain pine beetles to exist farther north and into upper elevations. Warmer temperatures are altering the reproduction cycles and distribution of the mountain pine beetle. It is possible that the warmer temperatures will increase mountain pine beetle infestations for several decades. The southern mountain pine beetle may move northward due to temperature change as well (Carroll et al, 2003)

Pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), the lodgepole terminal weevil (Pissodes terminalis), the Warren's collar weevil (Hylobius warreni), the defoliating weevil (Magdalis gentiles), the pine needle scale (Chionaspis pinifoliae), the black pineleaf scale (Nuculaspis californica), the spruce spider mite (Oligonychus ununguis), the lodgepole sawfly (Neodiprion burkei), the lodgepole needle miner (Coleotechnites milleri), the sugar pine tortrix (Choristoneura lambertiana), the pine tube moth (Argyrotaenia pinatubana), and the pandora moth (Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips also can build up in windthrows. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 1990).

Pathogens that affect white fir are the dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), 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 Diagram



Reference - State 1

White fir-Sierra lodgepole pine/western needlegrass - Community Phase 1.1

This mature white fir-Sierra lodgepole pine forest develops with small scale disturbances that create gaps in the canopy. These gaps (a single tree-fall to 0.25 acres in size) provide suitable sites for Sierra lodgepole pine regeneration and, over time, create an uneven forest structure and composition characterized by varying age classes of both species. Taller overstory Sierra lodgepole pine will persist and provide a seed source for gap areas.

Data was not collected on this community phase since it has not had time to develop within this site. There is visible evidence of white fir increasing in cover throughout this area, and it will presumably continue to increase in cover and dominance over time. This community phase will benefit from occasional small scale, low intensity understory burns. These fires will kill the young understory of white fir and some of the overstory trees.

Community Phase Pathway 1.1a

This pathway is created by a high mortality fire or forest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b

This pathway is created by a high mortality fire or forest infestation, followed by relatively dense Sierra lodgepole pine seedling regeneration (Community Phase 1.3) provided there is ample presence of cones and seed and optimum germination of seeds.

Sierra lodgepole pine/western needlegrass-squirreltail - Community Phase 1.2

After a stand replacing event such as a high mortality fire or mountain pine beetle infestation, Sierra lodgepole pine will regenerate from wind dispersed seed. This community phase generally has less than 500 stems per acre and will grow into a relatively open forest. Seedlings can develop into pole-sized trees with up to 55 percent canopy cover. Grasses and forbs may increase in cover for a few years, and patches of aspen clones may resprout as well.

Community Phase Pathway 1.2a

This pathway is followed with time and growth and small scale canopy disturbances. An open multi-age lodgepole pine forest develops (Community Phase 1.4).

Sierra lodgepole pine/squirreltail - Community Phase 1.3

This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. Fires leave bare soil and disturbed duff in open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined to distinguish the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. There are many variables which influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid-October. These seeds can be stored in the soil for several years, however seedlings tend to regenerate from wind dispersed seeds after fire. Therefore, the season and timing of a burn in relation to seed crop cycles may affect seedling density. Smaller fires may produce higher seedling densities due to the proximity of available seed sources. Seasonal precipitation patterns and air temperatures during germination influence seedling survival.

As the seedlings develop they form dense thickets. As the trees grow taller, they thin their lower branches. Most trees persist even with limited sunlight on their canopy. Growth becomes stagnant when chronic competition for light, water and nutrients exists. After a certain point of stagnation Sierra lodgepole pine may not respond to competitive release from thinning, disease, or fire.

Community Phase Pathway 1.3a
With time and growth the stand remains dense and evenly aged (Dense lodgepole pine forest, Community Phase 1.5). Trees are generally healthy and few gaps are created from tree mortality in this young forest.

Sierra lodgepole pine/western needlegrass - Community Phase 1.4

Lodgepole pine forest

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. This is the common community phase at this time. The most significant forest disturbances that lead to the creation of canopy gaps are provided by Mountain pine beetle infestations. After a pest infestation, patches of the stand die and leave gaps for lodgepole pine regeneration. Fire created canopy gaps are uncommon. Because low intensity fire is often fatal to mature lodgepole pine, even a low severity fire can be a stand replacing event; however low intensity smoldering fires have been documented which spread through downed trees after mountain pine beetle infestations. Although damage to live trees was minor, those with fire scars were more susceptible to the next mountain pine beetle attack. Canopy gaps may also be created by wind throw, a susceptibility of Sierra lodgepole pine due to its shallow root system.

White fir is present in understory areas that have not experienced fire. It can regenerate in undisturbed areas, and in the shade of beetle killed lodgepole snags. White fir is multi-aged and has a patchy distribution due to stand disturbances.

Community Phase Pathway 1.4a
With time and growth and small scale disturbances, this forest continues to develop into an open White fir-Sierra lodgepole pine forest (Community Phase 1.1) with a multi-aged, complex forest structure.

Community Phase Pathway 1.4b
This pathway is triggered by a high mortality fire, which initiates open Sierra lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c
This pathway is triggered by a high mortality fire, which initiates dense lodgepole pine regeneration (Community Phase 1.3) provided there is ample presence of cones and seed and optimum germination of seeds.

Sierra lodgepole pine/western needlegrass Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**20**		
		California stickseed	HACA	*Hackelia californica*	0	3	0	1
		lupine	LUPIN	*Lupinus*	0	16	0	2
		goosefoot violet	VIPU4	*Viola purpurea*	0	1	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**190**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	150	0	30
		squirreltail	ELEL5	*Elymus elymoides*	0	40	0	10

Shrub/Vine

Annual Production in Pounds Per Acre | Foliar Cover Percent

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
0 -Shrub					**0**	**6**		
		rabbitbush	ERBL2	*Ericameria bloomeri*	0	6	0	3

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
0 -Tree (understory only)					**0**	**37**		
		white fir	ABCO	*Abies concolor*	0	10	0	4
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	15	0	3
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	2	0	1
		quaking aspen	POTR5	*Populus tremuloides*	0	10	0	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	59	190
Forb	0	8	20
Shrub/Vine	0	3	6
Tree	0	15	37
Total:	0	85	253

Forest Overstory:

Sierra lodgepole pine dominates the canopy, with a small portion of white fir and an occasional quaking aspen or Jeffrey pine in the area. Canopy cover ranges from 35 to 60 percent. The upper canopy is 90 to 100 feet above the forest floor. There are older gaps with young Sierra lodgepole pine trees and new gaps with saplings. Basal area ranges from 150 to 200 ft2/ acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	44	60

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
white fir *Abies concolor*	ABCO	N	1.0	3.0						
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	34.0	55.0						

Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	1.0
quaking aspen *Populus tremuloides*	POTR5	N	0	1.0

Forest Understory:

The understory cover is dominated by western needlegrass (Achnatherum occidentale) and squirreltail (Elymus elymoides). Other species are rabbitbush (Ericameria bloomeri), California stickseed (Hackelia californica), lupines (Lupinus spp.), and goosefoot violet (Viola purpurea).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	30.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	10.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
California stickseed *Hackelia californica*	HACA	N	0	1.0		
lupine *Lupinus*	LUPIN	N	0	2.0		
goosefoot violet *Viola purpurea*	VIPU4	N	0	1.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
rabbitbush *Ericameria bloomeri*	ERBL2	N	0	3.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	4.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	3.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	1.0		
quaking aspen *Populus tremuloides*	POTR5	N	0	5.0		

Sierra lodgepole pine/litter - Community Phase 1.5

This dense Sierra lodgepole pine forest develops after dense seedling establishment and absence of canopy disturbance. This forest is even-aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. The self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees will enable the pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

White fir establishes under the Sierra lodgepole pine overstory.

Community Phase Pathway 1.5a
This pathway is triggered by a high mortality fire with appropriate conditions for dense lodgepole pine regeneration (Community Phase 1.3) based on ample presence of cones and seed and optimum germination of seeds.

Community Phase Pathway 1.5b
This pathway is triggered by a high mortality fire with appropriate conditions for open lodgepole pine regeneration (Community Phase 1.2). Pathways 1.5a and 1.5b are common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. Such a fire return interval, if naturally operating, usually does not allow for later successional community phases (i.e. Community phases 1.1 and 1.6) to develop.

Community Phase Pathway 1.5c
This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low-mortality fires, or wind throw. The forest becomes a more open Sierra lodgepole pine forest (Community Phase 1.4) with several age classes. With continued small scale disturbances, it can eventually develop into Community Phase 1.1.

Community Phase Pathway 1.5d
With time and growth and the absence of disturbance the stand remains evenly aged and dense. White fir, which has established in the understory, becomes increasingly prevalent in the canopy and creates a dense white fir-Sierra lodgepole pine forest with little to no understory (Community Phase 1.6).

White fir-Sierra lodgepole pine/litter - Community Phase 1.6
The dense white fir-Sierra lodgepole pine forest develops with the continued exclusion of fire or other disturbances, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the white fir for some time, but eventually declines due to the lack of sunlight and natural senescence. Fuel loads are high from the trees dying in the understory. Understory vegetation is absent due to the high cover of litter and debris and the lack of sunlight on the forest floor.

Community Phase Pathway 1.6a
The occurrence of severe fire would initiate dense lodgepole pine regeneration (Community Phase 1.3) provided there is ample presence of cones and seed and optimum germination of seeds.

Community Phase Pathway 1.6b
The occurrence of severe fire would initiate open lodgepole pine regeneration (Community Phase 1.2) provided seed amounts are moderate.

Community Phase Pathway 1.6c
This pathway is created in time with a high incidence of small scale disturbances, which break up the uniformity and density of this forest. With continued disturbances the open multi-aged white fir-Sierra lodgepole pine forest (Community Phase 1.1) may develop. However, the natural event of a moderate or surface fire in this forest is unlikely due to the high fuels and low fire tolerance of the dominant tree species. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with small scale disturbances over time.

Ecological Site Interpretations

Forest 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*	49	49	88	88	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*	79	79	86	86	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*	86	86	79	79	40	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:
Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. Thirty-one mammals and almost fifty bird species have been documented to use Sierra lodgepole pine forests. Snags and down logs are important for cavity-nesting birds and mammals. Other animals feed on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area is suitable for trails and camping.

Wood Products:
Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light and straight grained with consistent texture (Cope 1993).

Other Products:

Other Information:

SITE INDEX DOCUMENTATION:

Schumacher (1926), Alexander (1966) and Meyer (1961) were used to determine forest site productivity for white fir, lodgepole pine and Jeffrey pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phase 1.4 and older stands in 1.2 and 1.3. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Loam Debris Flow On Stream Terraces	F022BI105CA	This site is found in lower positions closer to the stream channel and has more aspen.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Coarse Glaciolacustrine Gentle Slopes	F022BI117CA	This is a similar site found at higher elevations with red fir in place of white fir.
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This is a mixed white fir-Sierra lodgepole pine site found in wetter conditions.
Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	F022BI125CA	This is a Sierra lodgepole pine forest found in cold air drainages and basins.
Cold Frigid Tephra Over Moraine Slopes	F022BI126CA	This is a Sierra lodgepole pine forest that is replaced by Jeffrey pine and ponderosa pine over time without disturbance.

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
The following NRCS vegetation plots were used to describe this ecological site.

789228
789332
789334
789367- Site location for ecological site.

Type Locality:

State:	CA
County:	Lassen
Township:	
Range:	
Section:	
Datum:	NAD83
Zone:	10
Northing:	4490409
Easting:	631429
General Legal Description:	The type location is west of Hat Creek near the northern boundary of Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104490409631429

Relationship to Other Established Classifications:
Forest Alliance = Abies concolor - White fir forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/30/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Upper Cryic Slopes

Tsuga mertensiana - Pinus albicaulis / *Holodiscus discolor* / *Lupinus obtusilobus - Polygonum davisiae*
(mountain hemlock - whitebark pine / oceanspray / bluntlobe lupine - Davis' knotweed)

Site ID: F022BI124CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Volcanic dome, (2) Mountain slope, (3) Roche moutonnée
Elevation (feet): 6,710- 9,000
Slope (percent): 15-60
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, East, West
Mean annual precipitation (inches): 71.0-125.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 38 to 41 degrees F (3.3 to 5 degrees C)
Restrictive Layer: Bedrock at 40-60 inches
Temperature Regime: Cryic
Moisture Regime: Xeric
Parent Materials: Tephra over colluvium and residuum
Surface Texture: Very gravelly ashy sandy loam
Surface Fragments <=3" (% Cover): 20-30
Surface Fragments > 3" (% Cover): 40-75
Soil Depth (inches): 40-60
Vegetation: The alpine forest is composed of whitebark pine (Pinus albicaulis) and mountain hemlock (Tsuga mertensiana). Although the cover of bluntlobe lupine (Lupinus obtusilobus) is often very high, it is absent in other areas.
Notes: This ecological site is found on convex back slopes on high mountains and ridges.

Treeline varies due to climatic conditions and exposure, but generally stays consistent at approximately 9,000 feet.

Physiographic Features

This ecological site is found on convex back slopes on high mountains and ridges at approximately 6,710 to 9,000 feet in elevation. This site is correlated to map units that extend up Lassen Peak to 10,457 feet, but the site itself does not extend above treeline. Treeline varies due to climatic conditions and exposure, but generally stays consistent at approximately 9,000 feet. Although slopes on this ecological site are generally between 15 and 60 percent, they are correlated with map units that range from 5 to 95 percent.

Landform:	(1) Volcanic dome
	(2) Mountain slope
	(3) Roche moutonnée

	Minimum	Maximum
Elevation (feet):	6710	9000
Slope (percent):	15	60
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	Medium
Aspect:	North East West	

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 71 to 125 inches (1,803 to 3,175 mm) and the mean annual temperature is between 38 and 41 degrees F (3.3 and 5 degrees C).The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 70 to 185 days.

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

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	70	185
Mean annual precipitation (inches):	71.0	125.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

The Readingpeak soil series associated with this site consists of deep well drained soils that formed in tephra over colluvium and residuum. Surface textures are very gravelly ashy sandy loam, with sandy subsurface textures. Most of the soil profile contains greater than 35 percent rock fragments, with gravels in the upper horizons and cobbles and stones prominent in the lower horizons. Bedrock occurs between 40 and 60 inches. There is very low to low AWC (available water capacity) in the upper 60 inches of soil. Permeability is moderately rapid to rapid in the upper horizons but the bedrock is impermeable.

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

Map Unit Component /Component percent
114 Readingpeak /20
149 Readingpeak /3
167 Readingpeak /20
174 Readingpeak /20

Parent Materials:
Kind: Tephra, Colluvium, Residuum
Origin: Volcanic rock

Surface Texture: (1)Very gravelly ashy sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	20	30
Surface Fragments > 3" (% Cover):	40	75
Subsurface Fragments <=3" (% Volume):	20	65
Subsurface Fragments > 3" (% Volume):	5	65

Drainage Class: Well drained To Well drained
Permeability Class: Rapid To Impermeable

	Minimum	Maximum
Depth (inches):	40	60
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.22	2.62

Plant Communities

Ecological Dynamics of the Site

This alpine forest is composed of whitebark pine (Pinus albicaulis) and mountain hemlock (Tsuga mertensiana). Total canopy cover is about 25 percent. In some areas trees grow as single upright stems and reach approximately 45 feet in height, while in other areas they are multi-stemmed and shrub-like (Krummholz). Although the cover of bluntlobe lupine (Lupinus obtusilobus) is often very high, it is absent in other areas. Bare soil and gravels cover most of the surface, with 1 to 3 percent vegetative ground cover other than lupine. Common plants in addition to lupine are western needlegrass (Achnatherum occidentale), pioneer rockcress (Arabis platysperma), squirreltail (Elymus elymoides), marumleaf buckwheat (Eriogonum marifolium), oceanspray (Holodiscus discolor), and Davis' knotweed (Polygonum davisiae).

The whitebark pine-mountain hemlock forest is found near treeline in Lassen Volcanic National Park, but may be found in other similar elevations in the Southern Cascade Mountains. The trees at this elevation are very slow growing. Older trees may be 500 years old while younger trees appear to be 75 to 200 years old. On the steep slopes, this forest develops on bedrock controlled ridges. The depth to bedrock is 40 to 60 inches. The bedrock provides a solid anchor for the tree roots. The surrounding colluvial soils have a low cover of forbs and grasses, with very few trees.

Trees may be inhibited in the nearby areas because of cold air that drains down the mountain to lower positions, where it pools in basins. These areas are more prone to summer frost, which can kill young mountain hemlock and whitebark pine seedlings. On steep southern slopes, whitebark pine may be inhibited by excessively warm temperatures.

The high elevations are buried with deep snow from November to June and remain cool for most of the year. Several physiological adaptations allow mountain hemlock and white bark pine to survive in this cold environment. They have maximum photosynthetic rates at colder temperatures than lower elevation trees, and close stomata to reduce water loss during dormant periods. The tips of mountain hemlock are very flexible, an attribute that reduces snow build-up and stem breakage. Snow burial can be helpful in protecting trees from strong winter winds, desiccation from warm winter winds and sunny winter days, extreme cold, and repeated freezing and thawing (Arno and Hammerly, 1984). Snow burial can, however, be detrimental as well. In some areas, those portions of the trees exposed above the snow can die back, leaving short multi-stemmed trees. Snow creep can create pistol-butted trees, and avalanches can destroy swaths of forest.

Timberline trees are able to withstand extremely cold winter conditions when they are dormant but need at least a 2 to 3-month frost free growing period in the summer. During this short growing season, usually in July and August, new mountain hemlock and whitebark pine growth is susceptible to frost. The new shoots are soft and succulent and need time to "ripen" (Arno and Hammerly, 1984). The duration of the growing season is crucial for seedling establishment. As elevations increase, temperatures drop and the growing season is shortened. Growing season length is one of the limiting factors to determine treeline. Another is wind. Wind induced treelines can be caused by drought conditions, due to increased evapotranspiration (Tomback, et al. 2001).

Whitebark pine is a long-lived timberline tree species that grows 40 to 60 feet tall in favorable conditions. At upper treeline limits and on exposed ridges it is reduced to its Krummholz or low shrub form. In its upright form it develops multiple branches along the upper stem and creates a broad canopy, rather than the tapered canopy of many conifers. Needles are formed in bundles of 5 that vary in length from 1.5 to 7 inches. The female cones are 1.6 to 3 inches in length. The cones are indehiscent, meaning they do not open at maturity. They heavily rely on the Clark’s Nutcracker (Howard, 2002) as these birds often cache the seeds in open areas that are suitable for young seedlings. If the seeds are not completely consumed, they give rise to dense clusters of genetically similar whitebark pine. These clusters appear to be one tree with many stems but are actually individual trees (Arno and Raymond 1990, Tomback et al. 2001).

White bark pine germination and seedling survival is best in canopy openings, such as those created by small fires. This is especially important in areas where whitebark pine develops dense canopies, as in the northern Cascades and the Rocky Mountains (Arno and Raymond, 1990, Howard, Janet L. 2002, Tomback et al. 2001). In Lassen Volcanic National Park, whitebark pine is usually found on exposed ridges and mountain slopes near timberline. It grows naturally into an open canopy with low levels of litter and woody debris accumulations. The understory is primarily bare soil, composed of loose single-grain gravels or coarse sand. Lightning is the primary cause of natural fires in this area, but the discontinuity of forest fuels will usually not allow it to spread far or burn very hot (Arno and Raymond, 1990, Howard, Janet L. 2002).

Whitebark pine forests are diminishing rapidly across the western United States. This is caused by fire exclusion and climate change, as well as impacts by the introduction of white pine blister rust (Cronartium ribicola) and from the native mountain pine beetle (Dendroctonus ponderosae) (Cox, 2000, Howard, Janet L. 2002, Tomback et al. 2001). In 2005, the National Park Service surveyed for white pine blister rust infestation in Lassen Volcanic National Park. There was a 2 percent infection rate in 1 of the 2 plots within the whitebark pine forest (personal communication, LVNP). The sites have not been resurveyed since. Conditions for the white pine blister rust require sufficient moisture during early summer to allow an alternate host to be infected, usually local currents and gooseberries (Ribes ssp.), and continuing moisture throughout summer to maintain the leaf moisture (Arno and Raymond, 1990). Alternate hosts are often found in lower elevation forests and wind can carry the fragile spores short distances up slope.

Predictions about climate change due to global warming suggest that the whitebark pine communities may be threatened by rising temperatures and precipitation changes. These changes may cause lower elevation tree species to extend their elevation range and encroach into the whitebark pine community (Cox, 2000). These invading trees, which may include California red fir (Abies magnifica), mountain hemlock (Tsuga mertensiana) and Sierra lodgepole pine (Pinus contorta var. murrayana) could over-top the whitebark pine and replace it successionally (Cox, 2000).

The fire return intervals for whitebark pine and mountain hemlock forests in this area are poorly documented. Fire occurrence for mountain hemlock may range from 400 to 800 years (Tesky, 1992); for white bark pine, the range is from 50 to over 300 years (Tomback et al. 2001). There were 9 fires documented in the mountain hemlock zone of Lassen Volcanic National Park between 1933 and 1977, resulting in a single tree being burned (Taylor, 1995). Lightning strikes are very common in this area, but the fuel loads and their capacity to carry fire is low. Even if fire started to spread, these forests are often dissected by unvegetated slopes, wind exposed ridges and rock outcrops.

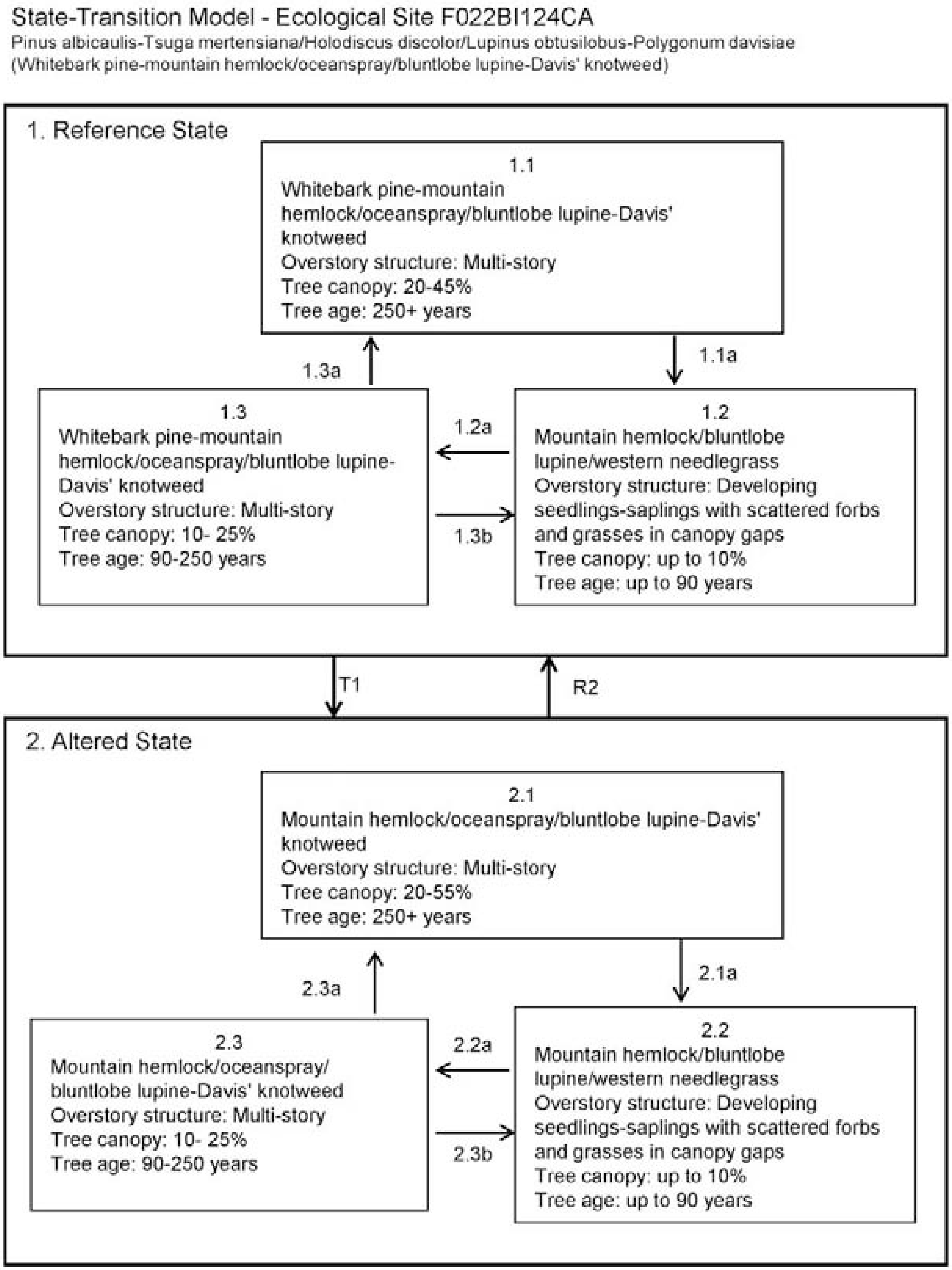
Mountain hemlock is a slow-growing native conifer. On this site it is generally less than 45 feet tall with branches covering the entire stem. Low-lying branches may root by layering. Trees produce single needles that tightly overlap all surface area of the twigs. The needles generally curve upward. The species exhibit shallow wide-spreading root systems. It is shade tolerant and will reproduce in the understory (Tesky, 1992). Reestablishment of mountain hemlock after a fire or other disturbance is often slow, and in some areas growth never regains its tree-like stature (Arno and Hammerly, 1984).

Mountain hemlock is not generally as susceptible to forest pathogens as the lower elevation conifers, but trees over 80 years old are very susceptible to laminated root rot (Phellinus weirii). Laminated root rot can rapidly spread by root contact and kill acres of forests (Tesky, 1992). Other common fungal and parasitic pests of mountain hemlock include several heart rots, of which Indian paint fungus (Echinodontium tinctorum) is the most common and damaging, various needle diseases, snow mold (Herpotrichia nigra), and dwarf-mistletoe (Arceuthobium tsugense) (Tesky, 1992).

Other pests that affect whitebark pine include aphids (Essigella gillettei), mealybugs (Puto cupressi and P. pricei), lodgepole needletier (Argyrotaenia tabulana), Monterey pine Ips (Ips mexicanus), other bark beetles (Pityogenes carinulatus and P. fossifrons), and ponderosa pine cone beetle (Conophthorus ponderosae). Other diseases that infect whitebark pine include stem infections from (Atropellis pinicola), (A. piniphila), (Lachnellula pini), (Dasyscypha pini) and (Gremmeniella abietina), all of which form cankers. Wood rots are caused by (Phellinus pini), (Heterobasidion annosum), (Phaeolus schweinitzii), and (Poria subacida). Needle cast fungi include (Lophodermium nitens), (L. pinastri), (Bifusella linearis), and (B. saccata). The snow mold (Neopeckia coulteri) occasionally forms on leaves when they are buried by snow for long periods. Several species of dwarf mistletoes (Arceuthobium spp.) can infest whitebark pine and cause localized mortality. The limber pine dwarf mistletoe (A. cyanocarpum), lodgepole pine dwarf mistletoe (A. americanum), and hemlock dwarf mistletoe (A. tsugense) can damage whitebark pine.

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 Diagram



Reference - State 1

Whitebark pine-mountain hemlock/oceanspray/bluntlobe lupine-Davis knotweed - Community Phase 1.1

Mountain hemlock-whitebark pine forest

This timberline forest is composed of whitebark pine and mountain hemlock. It is patchy in distribution because of its exposure to high wind, avalanche, and intense solar radiation. Whitebark pine is almost solely dominant along a thin band at the upper elevations of this site, the mountain hemlock increasing in cover as elevation decreases. Within the areas suitable for forest development, small canopy gaps are crucial for continual regeneration of white bark pine. This forest has evolved with small-scale disturbances that cause mortality ranging from a single to several trees. Lightning is the most common agent for natural canopy disturbance in this area. Older trees can become stressed from climatic factors which render them more susceptible to death from pests and drought.

The presence of mountain hemlock will increase in some areas because it is shade tolerant and will continue to reproduce in the understory. It is long-lived and after extended periods without disturbance (>400 years), mountain hemlock may slowly replace whitebark pine. There are locations, however, where this site is too extreme for mountain hemlock and whitebark pine will persist.

Community Phase Pathway 1.1a

Natural disturbances such as fire, disease, avalanche, or rock fall create the small and moderate-sized canopy openings needed for white bark pine regeneration (Community Phase 1.2).

Transition - T1

Transition to State 2 is triggered by a high mortality of white bark pine from white pine blister rust. White bark pine die slowly from white pine blister rust. The upper branches where cones are produced often succumb first; therefore regeneration is reduced long before the trees actually die. Trees weakened by white pine blister rust are more susceptible to mountain pine beetle infestations, and mortality may be high. Climate change may intensify this situation if precipitation and temperature increase. This transition may not be an immediate threat in this area, but whitebark pine has declined in much of its range due to a combination of white pine blister rust, mountain pine beetle infestations and fire suppression.

Whitebark pine-mountain hemlock/oceanspray/bluntlobe lupine-Davis knotweed Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**161**		
		pioneer rockcress	ARPL	*Arabis platysperma*	0	1	0	1
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	0	156	0	12
		Davis' knotweed	PODA	*Polygonum davisiae*	0	4	0	4

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**0**	**22**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	10	0	2
		squirreltail	ELEL5	*Elymus elymoides*	0	12	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**0**	**128**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	0	3	0	1
		marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	0	5	0	4
		oceanspray	HODI	*Holodiscus discolor*	0	120	0	8

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**3**	**24**		
		whitebark pine	PIAL	*Pinus albicaulis*	3	9	1	3
		mountain hemlock	TSME	*Tsuga mertensiana*	0	15	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	11	22
Forb	0	90	161
Shrub/Vine	0	65	128
Tree	3	16	24
Total:	3	182	335

Forest Overstory:

Whitebark pine is dominant or equal in cover to mountain hemlock. Total canopy cover ranges from 20 to 45 percent. Trees are generally less than 35 feet tall and often multi-stemmed. Trees are multi-stemmed due to continual regeneration and long lifespan. Regeneration is evident.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	20	20	45

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
whitebark pine *Pinus albicaulis*	PIAL	N	15.0	35.0						
mountain hemlock *Tsuga mertensiana*	TSME	N	5.0	10.0						

Forest Understory:

The understory is generally sparse, but the cover of bluntlobe lupine (Lupinus obtusilobus) can be high in some areas. Other common plants are western needlegrass (Achnatherum occidentale), pioneer rockcress (Arabis platysperma), squirreltail (Elymus elymoides), marumleaf buckwheat (Eriogonum marifolium), oceanspray (Holodiscus discolor), and Davis' knotweed (Polygonum davisiae).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	0	2.0		
squirreltail *Elymus elymoides*	ELEL5	N	0	2.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pioneer rockcress *Arabis platysperma*	ARPL	N	0	1.0		
bluntlobe lupine *Lupinus obtusilobus*	LUOB	N	0	12.0		
Davis' knotweed *Polygonum davisiae*	PODA	N	0	4.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
pinemat manzanita *Arctostaphylos nevadensis*	ARNE	N	0	1.0		
marumleaf buckwheat *Eriogonum marifolium*	ERMA4	N	0	4.0		
oceanspray *Holodiscus discolor*	HODI	N	0	8.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
whitebark pine *Pinus albicaulis*	PIAL	N	1.0	3.0		
mountain hemlock *Tsuga mertensiana*	TSME	N	0	3.0		

Mountain hemlock/bluntlobe lupine/western needlegrass - Community Phase 1.2

The cones of whitebark pine are indehiscent and rely heavily on the Clark’s nutcracker (a bird) to release and cache the heavy wingless seeds into the soil. The birds prefer to cache the seeds on open slopes created after fire. The seeds that are not consumed will eventually germinate. The birds will continue to cache seeds from nearby trees for decades, as long as the site remains open. Whitebark pine seed have a delayed germination and need suitable conditions for survival. It may be several years before a good seedling establishment. Young seedlings do well in partial shade to open sunlight. They quickly develop deep roots. Stem growth is slower and may take several decades to reach 10 feet in height. Mountain hemlock will germinate from winged wind-dispersed seeds after fire, but seedling survival is best under shade. Seedlings that survive grow slowly.

Community Phase Pathway 1.2a
With time, growth, and small scale disturbances, a multi-aged whitebark pine-mountain hemlock forest develops (Community Phase 1.3).

Whitebark pine-mountain hemlock/oceanspray/bluntlobe lupine-Davis knotweed - Community Phase 1.3
This forest slowly develops over time with occasional small scale disturbances. It is a relatively young patch of forest dominated by whitebark pine. Mountain hemlock establishes slowly in the understory and at the lower elevations of this site.

Community Phase Pathway 1.3a
With time and growth, the mature whitebark pine-mountain hemlock forest develops (Community Phase 1.1).

Community Phase Pathway 1.3b
This pathway is created after canopy disturbances, which allow for regeneration (Community Phase 1.2).

Altered - State 2

Mountain hemlock/oceanspray/bluntlobe lupine-Davis knotweed - Community Phase 2.1
This forest is dominated by mountain hemlock (Tsuga mertensiana). There may be 1 to 2 percent cover of blister rust-resistant whitebark pine. This forest can maintain for centuries without major disturbance, however it benefits from small scale disturbances. A mature forest may be from 200 to 400 years old but trees can live for 800 years. Mountain hemlock will regenerate in shady understories and in small canopy openings. Growth and development is slow.

Community Phase Pathway 2.1a
Fire, disease, windthrow, avalanche, and/or winter desiccation create small canopy gaps for regeneration (Community Phase 2.2).

Transition - R2
Restoration efforts need to be focused on re-introducing blister rust-resistant white bark pine. Seeds may need to be collected from other areas or from resistant trees nearby. Canopy openings will be needed to eliminate shade and competition from mountain hemlock.

Mountain hemlock/bluntlobe lupine/western needlegrass - Community Phase 2.2
Small-scale disturbances from windthrow, disease, single tree mortalities from lightning strikes, snow creep, and small avalanches are possible in this ecological site. Mountain hemlock has a shallow root system and is susceptible to windthrow. These disturbances create small gaps which reduce competition and enhance mountain hemlock regeneration.

Canopy fires are uncommon in this mountain hemlock community phase but may occur if there are sufficient fuels and the right climatic conditions for fire to spread.

Mountain hemlock is able to reproduce by layering and by seed. Trees that reproduce by layering create a circle of young trees around the original tree. Mountain hemlock seedlings prefer partial shade. Seeds are winged and wind dispersed. Trees produce cones in 3-year intervals with almost no cone production between intervals. For the seeds to establish, a good seed crop is needed with favorable temperature and moisture conditions. Mountain hemlock establishes well during years of lower than normal April snowpack depths, which provides a longer snow-free growing season (Taylor, 1995). Adequate summer moisture is also important.

Growth of the seedlings is very slow at first. In a study of mountain hemlock recruitment in Lassen Volcanic Park, 30 cm tall seedlings were 29 years old (Taylor, 1995).

Lupines, grasses, and other forbs are present.

Community Phase Pathway 2.2a
With time and growth, mountain hemlock increases in basal area, height and cover.

Mountain hemlock/oceanspray/ bluntlobe lupine-Davis knotweed - Community Phase 2.3
Even under favorable conditions this community may require over 100 years for the slow growing hemlocks to slowly regain a forest structure. In one study of mountain hemlock after a laminated root rot die-off, the regrowth of the forest was very slow. Due to the slow and continual recruitment of mountain hemlock, an unevenly aged forest will develop (Boone et. al. 1988).

If disturbances such as fire, clear-cutting or disease create large canopy openings, the trees may have difficulty reestablishing as a forest site. The lack of a nearby seed source, exposure to severe winds, or the lack of protective shade may reduce a formerly forested site to a more open Krummholz statured forest.

Community Phase Pathway 2.3a
With time and growth, mountain hemlock increases in basal area, height and cover.

Community Phase Pathway 2.3b
Fire, disease, windthrow, avalanche, and/or winter desiccation create small canopy gaps for regeneration.

Ecological Site Interpretations

Animal Community:
The seeds of whitebark pine are a nutritional food source for bears, rodents and birds. Whitebark pine and mountain hemlock provide cover and nesting sites for wildlife species. Bears have been reported to raid squirrel middens for whitebark seeds. Northern flickers and mountain bluebirds are cavity nesters that use whitebark pine trees (Howard, 2002). Various other birds eat mountain hemlock seeds. In some areas the understory provides decent forage (Tesky, 1992).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This site is located on or near alpine peaks and ridges. The area is often steep but provides scenic views. Trails may need special planning to avoid erosion.

Wood Products:
Whitebark pine and mountain hemlock are rarely harvested for commercial uses because of inaccessibility. If harvested, mountain hemlock is usually sold with western hemlock. The wood is moderately strong and used as small lumber, pulp, interior finish, cabinetry, crates, flooring and ceilings (Tesky, 1992).

Whitebark pine is not generally harvested, and trees on this site are generally twisted and gnarled, making them unsuitable for most timber uses.

Other Products:
Mountain hemlock is sometimes planted as an ornamental tree.

Other Information:
Re-vegetation/Restoration of white pine blister rust infected areas to prevent transition to State 2:

The following restoration procedures are outlined in the U.S. Forest Service Fire Effects Information System:

1. Assess the local extent, successional status, and vigor of whitebark pine to determine if cone crops will dwindle in the future.

2. Inventory stands to document tree age, stand structure, cone production potential, and projected time of successional replacement.

3. Apply and evaluate management-ignited and wild-land for resource benefit fires designed to kill late-successional species and favor whitebark pine.

4. Conduct seed trials with white pine blister rust-resistant stock in areas where natural whitebark pine seed sources have disappeared.

Information and data for forest site productivity was not collected for tree species on this site.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Cirque Floor	R022BI205CA	Forbs dominate this range site that is situated in cirque floors.
Alpine Slopes	R022BI207CA	This sparsely vegetated alpine range site is found on slopes among the forest site.

Similar Sites:

Site Name	Site ID	Site Narrative

Cryic Coarse Loamy Colluvial Slopes F022BI104CA	This mountain hemlock forest has more forest structure with taller trees and higher cover.

State Correlation:
This site has been correlated with the following states:

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

789173-type location
789292

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	4 E
Section:	11
Datum:	NAD83
Zone:	10
Northing:	4481351
Easting:	626356
General Legal Description:	The type locality is about 0.2 miles west-southwest from the southernmost corner of the Lassen Peak Trail parking lot.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104481351626356

Relationship to Other Established Classifications:
Forest Alliance = Pinus albicaulis - Whitebark pine forest; Association = Pinus albicaulis-Tsuga mertensiana. (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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/24/2008	Kendra E Moseley	2/16/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	11/30/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Cold Frigid Tephra Over Outwash Plains Or Lake Terraces

Pinus contorta var. murrayana / / *Elymus elymoides*
(Sierra lodgepole pine / / squirreltail)

Site ID: F022BI125CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: (1) Outwash plain, (2) Lake terrace
Elevation (feet): 5,850-6,360
Slope (percent): 0-15
Water Table Depth (inches): 19 to greater than 60
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: Non-influencing
Mean annual precipitation (inches): 23.0-49.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 42 and 44 degrees F (5.5 and 6.6 degrees C)
Restrictive Layer: Silica-cemented duripan occurs at depths between 20 to 60 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Mixed tephra and outwash over outwash from volcanic rocks
Surface Texture: (1) Very bouldery medial loamy coarse sand, (2) Ashy coarse sand
Surface Fragments <=3" (% Cover): 5-70
Surface Fragments > 3" (% Cover): 0-20
Soil Depth (inches): 20-60
Vegetation: Although the heavy dominance of lodgepole pine here is partly in response to high fire frequency, the root restrictive layer and cold air drainage may exclude other conifers from establishing on this site.
Notes: This ecological site occurs on glacial outwash plains and lake terraces.

Physiographic Features

This ecological site occurs on glacial outwash plains and lake terraces at 5,850 to 6,360 feet in elevation. Slopes range from 0 to 15 percent.

This site has a seasonal water table associated with the Humic Haploxerands, moist lake terrace component. The water table fluctuates from 19 to 30 inches during the wetter months then drops to below 60 inches from July to November.

Landform:	(1) Outwash plain
	(2) Lake terrace

	Minimum	Maximum
Elevation (feet):	5850	6360
Slope (percent):	0	15
Water Table Depth (inches):	19	
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Very high
Aspect:		

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 and 49 inches (594 mm to 1,245 mm) and the mean annual temperature is between 42 and 44 degrees F (5.5 and 6.6 degrees C). The frost free (>32F) season is 60 to 85 days. The freeze free (>28F) season is 75 to 190 days.

There are no representative climate stations for this site. The nearest one is Manzanita Lake.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	23.0	49.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System Subsystem Class

Representative Soil Features

This site is associated with the Badgerwash and Humic Haploxerands, moist lake terrace soil components.

The Badgerwash soils are moderately deep, well-drained soils that formed in mixed tephra and outwash over outwash from volcanic rocks. The surface texture is very bouldery medial loamy coarse sand, with extremely stony medial sandy loam textures in the lower horizons. There are greater than 35 percent rock fragments throughout the soil depth and a silica-cemented duripan is encountered at 20 to 40 inches. The Badgerwash soils are classified as Ashy-skeletal, mixed, frigid Humic Vitrixerands.

Humic Haploxerands, moist lake terrace soils are moderately deep to deep, moderately well-drained soils that formed in tephra over glaciolacustrine deposits from volcanic rocks. The tephra deposits are blackish in color and are approximately 7 inches deep. The tephra has developed an A/C horizon sequence over the buried soil. The A horizon has an ashy coarse sand, with a gravelly ashy coarse sand texture just below. The buried horizon has a very stony medial sandy loam texture over a very stony medial fine sandy loam. A silica-cemented duripan occurs at depths between 20 to 60 inches.

These soils have very low AWC (available water capacity) in the upper 60 inches of soil. Permeability is moderately rapid to rapid in the upper horizon, and slow to very slow through the duripan.

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

Map Unit Component /Component %
101 Badgerwash /8
101 Humic Haploxerands, moist lake terrace /2
108 Humic Haploxerands, moist lake terrace /3
117 Humic Haploxerands, moist lake terrace /90
117 Badgerwash /2
172 Badgerwash /2
173 Badgerwash /90

Parent Materials:
Kind: Tephra, Outwash, Glaciolacustrine deposits
Origin: Volcanic rock
Surface Texture: (1)Very bouldery medial loamy coarse sand
(2)Ashy coarse sand
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	5	70
Surface Fragments > 3" (% Cover):	0	20
Subsurface Fragments <=3" (% Volume):	2	95
Subsurface Fragments > 3" (% Volume):	0	85

Drainage Class: Moderately well drained To Well drained
Permeability Class: Very rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	60
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.5	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.43	3.52

Plant Communities

Ecological Dynamics of the Site

This ecological site is on outwash with a root restrictive layer at varying depths between 20 to 60 inches. Although the heavy dominance of lodgepole pine here is partly in response to high fire frequency, the root restrictive layer and cold air drainage may exclude other conifers from establishing on this site.

In 2009, this ecological site within Lassen Volcanic National Park, is mainly dominated by a Sierra lodgepole pine (Pinus contorta var. murrayana) forest; however, outside the park it may be expressed by any of the plant communities described within the state and transition model. The canopy is relatively open due to frequent fires of varying intensity. A recent canopy fire has left some areas almost completely bare. Nothing remains; the standing dead and downed trees have been mostly consumed. There is very little regeneration in these areas. In other areas it appears that the understory burned at a low intensity, and a large portion of the overstory Sierra lodgepole pine will survive, leaving gap openings from the dead trees. The understory is dominated with grasses and forbs, including western needlegrass (Achnatherum occidentale), Ross' sedge (Carex rossii), squirreltail (Elymus elymoides), goldenbush (Ericameria spp.), narrowleaf lupine (Lupinus angustifolius), and lettuce wirelettuce (Stephanomeria lactucina).

Sierra lodgepole pine can be long-lived exceeding 150 years old. The overstory trees cored to obtain representative site index data were between 80 to 100 years old and relatively young. Sierra lodgepole pine does not usually gain much in girth with time and older trees averaged 16 to 21 inch diameters. Trees grow tall and narrow with short branches and 1.2 to 2.4 inch needles in fascicles of two. Its thin bark and shallow roots make it susceptible to fire. Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow, which enables it to grow on this site. Sierra lodgepole pine produces a taproot that may atrophy or grow horizontally in cases of high water tables or root restrictive layers.

Sierra lodgepole pine has a complex disturbance regime that includes cyclic beetle infestations and fire. Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates for the lodgepole pine (Taylor and Solem, 1995). Sierra lodgepole pine regenerates prolifically after fire and evenly aged stands are formed. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly and at a low intensity. As noted, even low intensity fire can cause damage to live trees, and fire damaged trees are rendered more susceptible to the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine or white fir regeneration. Over time these gaps will break up the uniformity of evenly aged stands that formed after the last large fire event.

White fir is presently not common on this site. This area has been burned repeatedly in the last century, which may have reduced its presence. The root restrictive layer and/or the cold air drainage may also keep white fir from firmly establishing. There are however sufficient white fir present in the understory to indicate that, without fire and with appropriate climate conditions, white fir could establish here. White fir is a large long-lived tree in this area. It commonly reaches 300 to 400 years in age and heights of 120 to 140 feet. It produces single needles1.2 to 2.8 inches long that are distributed along young branches. Because the female seed cones open and fall apart while still attached to the tree, cones are not often seen on the forest floor. White fir tends to develop a shallow root system that can graft to other white fir roots and spread root rots (Zouhar, 2001). White fir is a shade-tolerant conifer and is able to establish in the understory of the Sierra lodgepole pine on this site. If it continues to grow and reproduce in the understory in the absence of disturbance, it will eventually dominate the forest. In the past, the natural fire regime kept these forests from developing into the later successional stages dominated by white or red fir (Taylor, and Solem, 2001). White fir and Sierra lodgepole pine are both relatively fire intolerant species and tend to have high mortality rates after fire.

The mountain pine beetle is the most significant forest pathogen to affect this site, but several other pathogens have the potential to cause mortality or diminish productivity. Most of these pathogens represent natural cycles of regulation and can push the closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests.

There is evidence that warming temperatures are allowing mountain pine beetles to exist farther north and into upper elevations. Warmer temperatures are altering the reproductive cycles and distribution of the mountain pine beetle. It is possible that the warmer temperatures will increase mountain pine beetle infestations for several decades. The southern mountain pine beetle may move northward due to temperature change as well (Carroll et al, 2003)

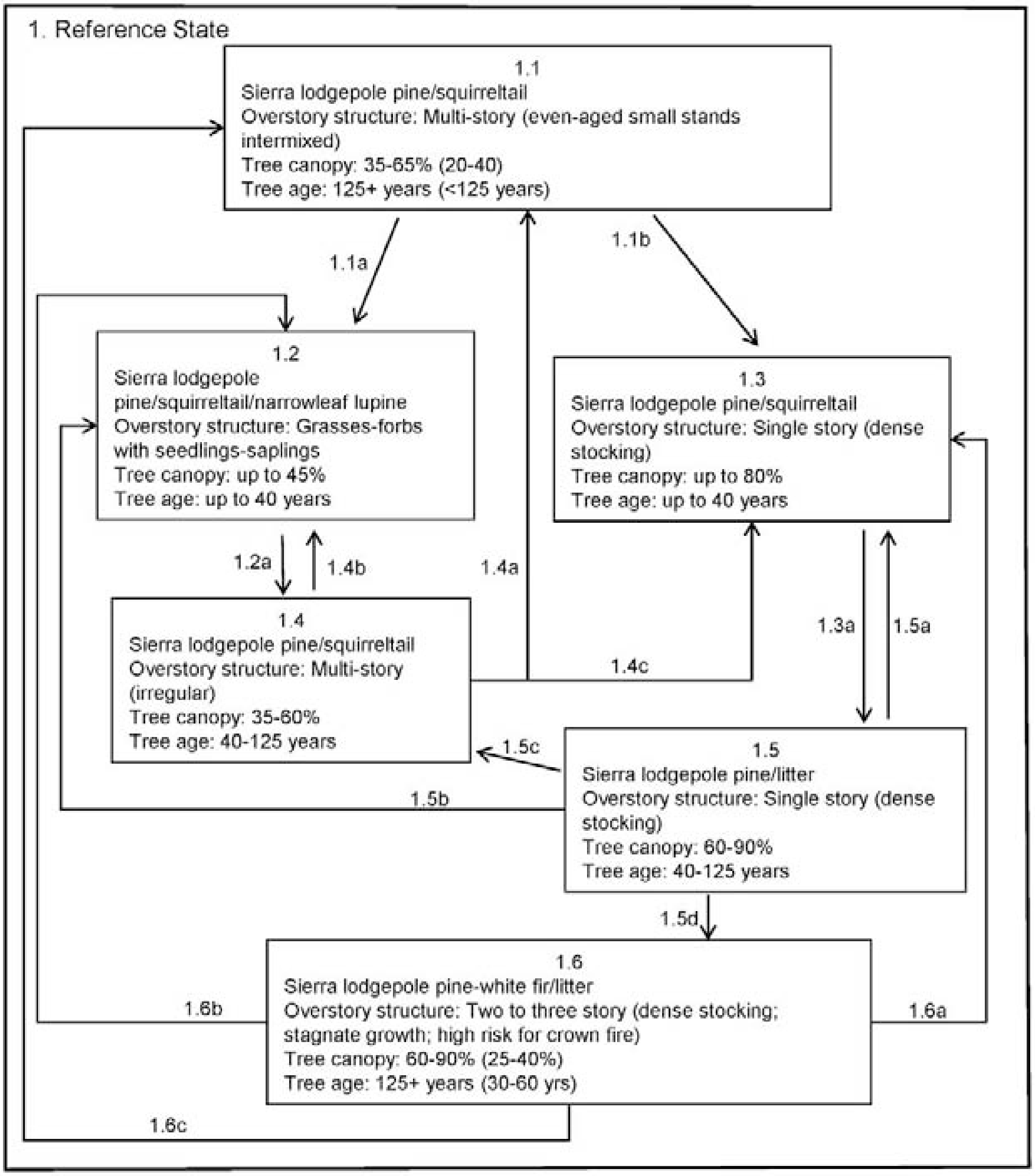
Pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), the weevil (Magdalis gentiles), the lodgepole terminal weevil (Pissodes terminalis), the Warren's collar weevil (Hylobius warreni), the pine needle scale (Chionaspis pinifoliae), the black pineleaf scale (Nuculaspis californica), the spruce spider mite (Oligonychus ununguis), the lodgepole sawfly (Neodiprion burkei), the lodgepole needle miner (Coleotechnites milleri), the sugar pine tortrix (Choristoneura lambertiana), the pine tube moth (Argyrotaenia pinatubana), and the pandora moth (Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips also can build up in windthrows. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 1990).

Pathogens that affect white fir are the dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), 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 Diagram

State-Transition Model - Ecological Site F022BI125CA
Pinus contorta var. *murrayana*/*Elymus elymoides*
(Sierra lodgepole pine/squirreltail)



Reference - State 1

Sierra lodgepole pine/squirreltail - Community Phase 1.1

Sierra lodgepole pine forest

This mature Sierra lodgepole pine forest develops with continual small scale disturbances that create gaps in the canopy. These gaps (single tree fall to .25 acres in size) provide suitable sites for Sierra lodgepole pine regeneration and, over time, will create an uneven forest structure and composition. Several age classes of Sierra lodgepole pine are present.

Community Phase Pathway 1.1a

This pathway is created by a high mortality fire or forest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b

This pathway is created by a high mortality fire or forest infestation, followed by relatively dense Sierra lodgepole pine seedling regeneration (Community Phase 1.3) from an ample supply of cones and seeds and favorable conditions for seed germination.

Sierra lodgepole pine/squirreltail Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**0**	**61**		
		goldenbush	ERICA2	*Ericameria*	0	12	0	2
		narrowleaf lupine	LUAN4	*Lupinus angustifolius*	0	48	0	15
		lettuce wirelettuce	STLA	*Stephanomeria lactucina*	0	1	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**14**	**71**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	6	24	2	6
		Ross' sedge	CARO5	*Carex rossii*	0	15	0	5
		squirreltail	ELEL5	*Elymus elymoides*	8	32	2	8

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**3**	**15**		
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	3	15	1	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	14	38	71
Forb	0	30	61
Tree	3	9	15
Total:	17	77	147

Forest Overstory:

The Sierra lodgepole pine canopy cover ranges from 35 to 60 percent. Mature overstory trees are 140 to 180 years old and 60 to 80 feet tall. Dbh (diameter at breast height) ranges from 12 to 17 inches. There are older trees in the stand that were not measured. Basal area ranges from 100 to 210 ft2/ acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	38	60

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	35.0	60.0	50.0	80.0	12.0	17.0	100.0	210.0

Forest Understory:

The cover of grasses and forbs is moderate due to recent fire, which has opened the canopy and removed litter and fuels from the forest floor. Common plants are western needlegrass (Achnatherum occidentale), Ross' sedge (Carex rossii), squirreltail (Elymus elymoides), goldenbush (Ericameria spp.), narrowleaf lupine (Lupinus angustifolius), and lettuce wirelettuce (Stephanomeria lactucina).

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	2.0	6.0		
Ross' sedge *Carex rossii*	CARO5	N	0	5.0		
squirreltail *Elymus elymoides*	ELEL5	N	2.0	8.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
goldenbush *Ericameria*	ERICA2	N	0	2.0		
narrowleaf lupine *Lupinus angustifolius*	LUAN4	N	0	15.0		
lettuce wirelettuce *Stephanomeria lactucina*	STLA	N	0	1.0		

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	1.0	5.0		

Sierra lodgepole pine/squirreltail/narrowleaf lupine - Community Phase 1.2
After a stand replacing event such as a high mortality fire or mountain pine beetle infestation, Sierra lodgepole pine will regenerate from wind dispersed seed. This site generally has less than 500 stems per acre and will grow into a relatively open forest. Seedlings can develop into pole-sized trees with up to 55 percent canopy cover. Grasses and forbs may increase in cover for a several years.

Community Phase Pathway 1.2a
This pathway is followed with time and growth and small scale canopy disturbances. An open multi-age lodgepole pine forest develops (Community Phase 1.4).

Sierra lodgepole pine/squirreltail - Community Phase 1.3
This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. Fires leave bare soil and disturbed duff in open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined to distinguish the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. There are many variables to influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid-October. These seeds can be stored in the soil for several years, however seedlings tend to regenerate from wind dispersed seeds after fire. Therefore, the season and timing of a burn in relation to seed crop cycles may affect seedling density. Smaller fires may produce higher seedling densities due to the proximity of available seed sources. Seasonal precipitation patterns and air temperatures during germination influence seedling survival.

As the seedlings develop they form dense thickets. As the trees grow taller, they thin their lower branches. Most trees persist even with limited sunlight on their canopies. Growth becomes stagnant when chronic competition for light, water and nutrients exists. After a certain point of stagnation Sierra lodgepole pine may not respond to competitive release from thinning, disease, or fire.

Community Phase Pathway 1.3a
With time and growth the stand remains dense and evenly aged (Dense lodgepole forest, Community Phase 1.5). Trees are generally healthy and few gaps are created from tree mortality in this young forest.

Sierra lodgepole pine/squirreltail - Community Phase 1.4
This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. The two most significant forest disturbances to create canopy gaps are provided by mountain pine beetle infestations and fire. After a pest infestation, patches of a stand die and leave gaps for lodgepole pine regeneration. Because low intensity fire is often fatal to mature lodgepole pine, even a low severity fire can be a stand replacing event; however low intensity smoldering fires have been documented which spread through downed trees after mountain pine beetle infestations. Although damage to live trees was minor, those with fire scars were rendered

more susceptible to the next mountain pine beetle attack. Canopy gaps may also be created by wind throw, a susceptibility of Sierra lodgepole pine due to its shallow root system.

Community Phase Pathway 1.4a
With time and growth and small scale disturbances, this forest continues to develop into an open Sierra lodgepole pine forest (Community Phase 1.1) with a multi-aged complex forest structure.

Community Phase Pathway 1.4b
This pathway is triggered by a high mortality fire, which initiates open Sierra lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c
This pathway is triggered by a high mortality fire, which initiates dense lodgepole pine regeneration (Community Phase 1.3) assuming an ample supply of cones and seeds and favorable conditions for seed germination.

Sierra lodgepole pine/litter - Community Phase 1.5
This dense Sierra lodgepole pine forest develops after dense seedling establishment in the absence of canopy disturbances. This forest is even-aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. This self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees enables pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

White fir establishes in some areas under the Sierra lodgepole pine overstory in the absence of fire.

Community Phase Pathway 1.5a
This pathway is triggered by a high mortality fire, creating appropriate conditions for dense lodgepole pine regeneration (Community Phase 1.3) based on an ample supply of cones and seeds and favorable conditions for seed germination.

Community Phase Pathway 1.5b
This pathway is triggered by a high mortality fire, creating appropriate conditions for open lodgepole pine regeneration (Community Phase 1.2). Pathways 1.5a and 1.5b are common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. Such a fire return interval would not allow for later succession communities (Community Phases 1.1 and 1.6) to develop.

Community Phase Pathway 1.5c
This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low mortality fires, or wind throw. A more open Sierra lodgepole pine forest

(Community Phase 1.4) develops with several age classes. With continued small scale disturbances, it can eventually develop into Community Phase 1.1.

Community Phase Pathway 1.5d
With time and growth and the absence of disturbance the stand remains evenly aged and dense. White fir, which has established in the understory, becomes increasingly prevalent in the canopy and creates a dense Sierra lodgepole pine-white fir forest (Community Phase 1.6).

Sierra lodgepole pine-white fir/litter - Community Phase 1.6
The dense Sierra lodgepole pine-white fir forest develops with the continued exclusion of fire or other disturbances, allowing tree density to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the white fir for some time, but eventually declines due to the lack of sunlight and natural senescence. Fuel loads are high from the trees dying in the understory. Understory vegetation is absent due to the high cover of litter and debris and the lack of sunlight on the forest floor.

Community Phase Pathway 1.6a
A severe fire would initiate dense lodgepole pine regeneration (Community Phase 1.3) assuming ample cone and seed and favorable conditions for seed germination.

Community Phase Pathway 1.6b
A severe fire would initiate open lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.6c
This pathway is created in time with a high incidence of small scale disturbances, which break up the uniformity and density of this forest. With continued disturbances the open multi-aged Sierra lodgepole pine forest (Community Phase 1.1) may develop. The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels and low fire tolerance of the dominant tree species. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with small scale disturbances over time.

Ecological Site Interpretations

Forest 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
Sierra lodgepole pine	*PICOM*	68	89	66	102	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.

Animal Community:
Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. There are 31 mammals and almost 50 bird species documented in Sierra lodgepole pine forests. Snags and downed logs are important for cavity-nesting birds and mammals. Other animals feed on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area is suitable for trails and camping.

Wood Products:
Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light and straight grained with consistent texture (Cope 1993).

Other Products:

Other Information:
Alexander (1966) was used to determine forest site productivity for lodgepole pine. 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 phase 1.4 and older stands in 1.2 and 1.3. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Moist Sandy Lake Or Stream Terraces	F022BI108CA	This is a wet lodgepole site found on lake and stream terraces.
Cold Frigid Tephra Over Moraine Slopes	F022BI126CA	This site is found on the moraines interspersed around the outwash and has more Jeffrey pine.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Loam Debris Flow On Stream Terraces	F022BI105CA	This is a Sierra lodgepole pine-quaking aspen site.

Frigid Coarse Glaciolacustrine Gentle Slopes	F022BI117CA	This is a California red fir-Sierra lodgepole pine site found at higher elevations.
Frigid Flat Outwash Terraces	F022BI123CA	This is a white fir-Sierra lodgepole pine site with some aspen.
Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	F022BI125CA	This is a white fir-Sierra lodgepole pine site found in wetter conditions.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789110
789369- Type location
789397

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	5 E
Section:	10
Datum:	NAD83
Zone:	10
Northing:	4490710
Easting:	634578
General Legal Description:	The type location is about 1.6 miles west northwest from the western edge of Soap Lake in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104490710634578

Relationship to Other Established Classifications:

Forest Alliance = Pinus contorta ssp. murrayana – Lodgepole pine forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	6/12/2008	Kendra E Moseley	2/16/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	12/6/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Forestland

Site Name: Cold Frigid Tephra Over Moraine Slopes

Pinus jeffreyi - Pinus contorta var. murrayana / / *Monardella odoratissima*
(Jeffrey pine - Sierra lodgepole pine / / mountain monardella)

Site ID: F022BI126CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site concept:
Landform: Ground moraine
Elevation (feet): 6,100-6,900
Slope (percent): 1-30
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 39.0-57.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 and 44 degrees F (5 and 6.6 degrees C)
Restrictive Layer: Dense till is encountered between 20 to 40 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra over till from volcanic rocks
Surface Texture: Very gravelly ashy sandy loam
Surface Fragments <=3" (% Cover): 35-65
Surface Fragments > 3" (% Cover): 3-30
Soil Depth (inches): 20-40
Vegetation: The heavy dominance of lodgepole pine here is mostly in response to a high fire frequency. The root restrictive layer and cold air drainage may slow the establishment of other conifers, but does not exclude them.
Notes: This site contains approximately 7 inches of tephra over glacial till. The tephra deposits are from the eruption of the Chaos Crags, over 1,000 years ago. A root restrictive layer of dense till is present 20 to 40 inches below the surface.

Physiographic Features

This ecological site occurs on ground moraines between 6,100 feet to 6,900 feet in elevation. Slopes range from 1 to 30 percent.

Landform: (1) Ground moraine

	Minimum	Maximum
Elevation (feet):	6100	6900
Slope (percent):	1	30
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	Medium
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation during the winter months in the form of snow. The mean annual precipitation ranges from 39 to 57 inches (991 to 1,448 mm) and the mean annual temperature is between 41 and 44 degrees F (5 and 6.6 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. The nearest one is Manzanita Lake.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	39.0	57.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System Subsystem Class

Representative Soil Features

This ecological site is associated with the Badgerflat soil series. Moderately deep and well-drained, these soils formed in tephra over till from volcanic rocks. Surface textures are a very gravelly ashy sandy loam, with sandy subsurface textures containing greater than 35 percent rock fragments. Dense till is encountered between 20 to 40 inches. Permeability is moderately rapid to rapid through the upper horizons, and slow to very slow through the dense till.

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

Map Unit Component/ Component %
100 Badgerflat/ 2
145 Badgerflat/ 2
172 Badgerflat/ 90
173 Badgerflat/ 2

Parent Materials:
Kind: Tephra, Till
Origin: Volcanic rock
Surface Texture: (1)Very gravelly ashy sandy loam
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	35	65
Surface Fragments > 3" (% Cover):	3	30
Subsurface Fragments <=3" (% Volume):	20	50
Subsurface Fragments > 3" (% Volume):	0	55

Drainage Class: Well drained To Well drained
Permeability Class: Rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	40

Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.1	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.9	2.05

Plant Communities

Ecological Dynamics of the Site

This site contains approximately 7 inches of tephra over glacial till. The tephra deposits are from the eruption of the Chaos Crags, over 1,000 years ago. A root restrictive layer of dense till is present 20 to 40 inches below the surface. The heavy dominance of lodgepole pine here is mostly in response to a high fire frequency. The root restrictive layer and cold air drainage may slow the establishment of other conifers, but does not exclude them.

In 2009, this ecological site is mainly dominated by a Sierra lodgepole pine (Pinus contorta var. murrayana) forest, with scattered cover from large Jeffrey pine (Pinus jeffreyi) and ponderosa pine (Pinus ponderosa). Western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides), narrowleaf lupine (Lupinus angustifolius), mountain monardella (Monardella odoratissima), and woolly mule-ears (Wyethia mollis) are common in the understory.

Sierra lodgepole pine can be long-lived exceeding 150 years old. The overstory trees cored to obtain representative site index data were between 100 to 130 years old. Sierra lodgepole pine does not usually gain much in girth with time and, at this site, older trees averaged 20 to 24 inch diameters. It grows tall and narrow with short branches and 1.2 to 2.4 inch needles in fascicles of two. Its thin bark and shallow roots make it susceptible to fire; it is the only non-serotinous lodgepole pine however, and does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow. Taproots are known to atrophy or grow horizontally in cases of high water tables or root restrictive layers, which enable them to grown on this site.

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. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007) that are intolerant of wet conditions. Trees look similar to ponderosa pine but have a vanilla-like odor in the bark, which is not as yellow as the ponderosa pine. Ponderosa pine will grow on this site, but with limited distribution and cover. Jeffrey pine is shade-intolerant and can be replaced over time by white fir if fire is excluded from the system. Mature Jeffrey pines are somewhat adapted to fire because their thicker bark can offer protection from moderate intensity flames. Additionally, the branches of Jeffrey pine tend to thin along lower portions of the tree trunk, leaving the crown 65 to 100 feet above the forest floor.

White fir is a large long-lived tree in this area. It commonly reaches 300 to 400 years in age and heights of 120 to 140 feet. It produces single needles 1.2 to 2.8 inches long that are distributed along young branches. Because the female seed cones open and fall apart while still attached to the tree, cones are not often seen on the forest floor. White fir tends to develop a shallow root system that can graft to other white fir roots and spread root rots (Zouhar, 2001). White fir is a shade-tolerant conifer and is able to establish in the understory of Sierra lodgepole pine on this site. If it continues to grow and reproduce in the understory in the absence of disturbance, it will gradually dominate the forest. In the past, the natural fire regime kept forests from developing into the later successional stages dominated by white or red fir (Taylor, and Solem, 2001). White fir and Sierra lodgepole pine are both relatively fire intolerant species that tend to have high mortality rates after fire.

Sierra lodgepole pine has a complex disturbance regime that includes cyclic beetle infestations and fire. Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires result in high mortality rates for the lodgepole pine (Taylor and Solem, 1995). Sierra lodgepole pine regenerates prolifically after fire, forming evenly aged stands. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly and at a low intensity. The low intensity fire causes damage to the live trees however, making them more susceptible to the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine, Jeffrey pine or ponderosa pine regeneration. Over time these gaps will break up the uniformity of evenly aged stands that formed after the last large fire event.

Fire regime studies, using tree rings and fire scars, report historic median fire return intervals in Jeffrey pine-white fir forests of 14, 18.8, and 70 years (Bekker and Taylor; Skinner and Chang; Taylor and Solem, respectively). Beaty and Taylor report that fire frequency and intensity is additionally associated with slope position, aspect, and climatic fluctuations. Fire return intervals are longer on north facing slopes than on south facing slopes. Stand replacing fire is more common on upper slopes, while low to moderate intensity fires occur only along lower slopes. This is probably due to the tendency of fire to burn upslope, preheating the fuels as it goes (Beaty and Taylor, 2001). In July and August, thunderstorms are common in Lassen Volcanic National Park and the 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). Prior to fire suppression, this ecological site would not have developed as often into the later successional stages dominated by white fir, and therefore the Sierra lodgepole pine forest may have been more extensive (Taylor, and Solem, 2001).

The mountain pine beetle is the most significant forest pathogen affecting this site, but several other pathogens have potential to cause mortality or diminish productivity. Most of these pathogens are natural cycles of regulation that push closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests.

There is evidence that warming temperatures are allowing mountain pine beetles to exist farther north and into upper elevations. Warmer temperatures are altering the reproductive cycles and distribution of the mountain pine beetle. It is possible that the warmer temperatures will increase mountain pine beetle infestations for several decades. The southern mountain pine beetle may move northward due to temperature change as well (Carroll et al, 2003)

Pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), the weevil (Magdalis gentiles), the lodgepole terminal weevil (Pissodes terminalis), the Warren's collar weevil (Hylobius warreni), the pine needle scale (Chionaspis pinifoliae), the black pineleaf scale (Nuculaspis californica), the spruce spider mite (Oligonychus ununguis), the lodgepole sawfly (Neodiprion burkei), the lodgepole needle miner (Coleotechnites milleri), the sugar pine tortrix (Choristoneura lambertiana), the pine tube moth (Argyrotaenia pinatubana), and the pandora moth (Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips also can build up in windthrows. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (Arceuthobium americanum) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 1990).

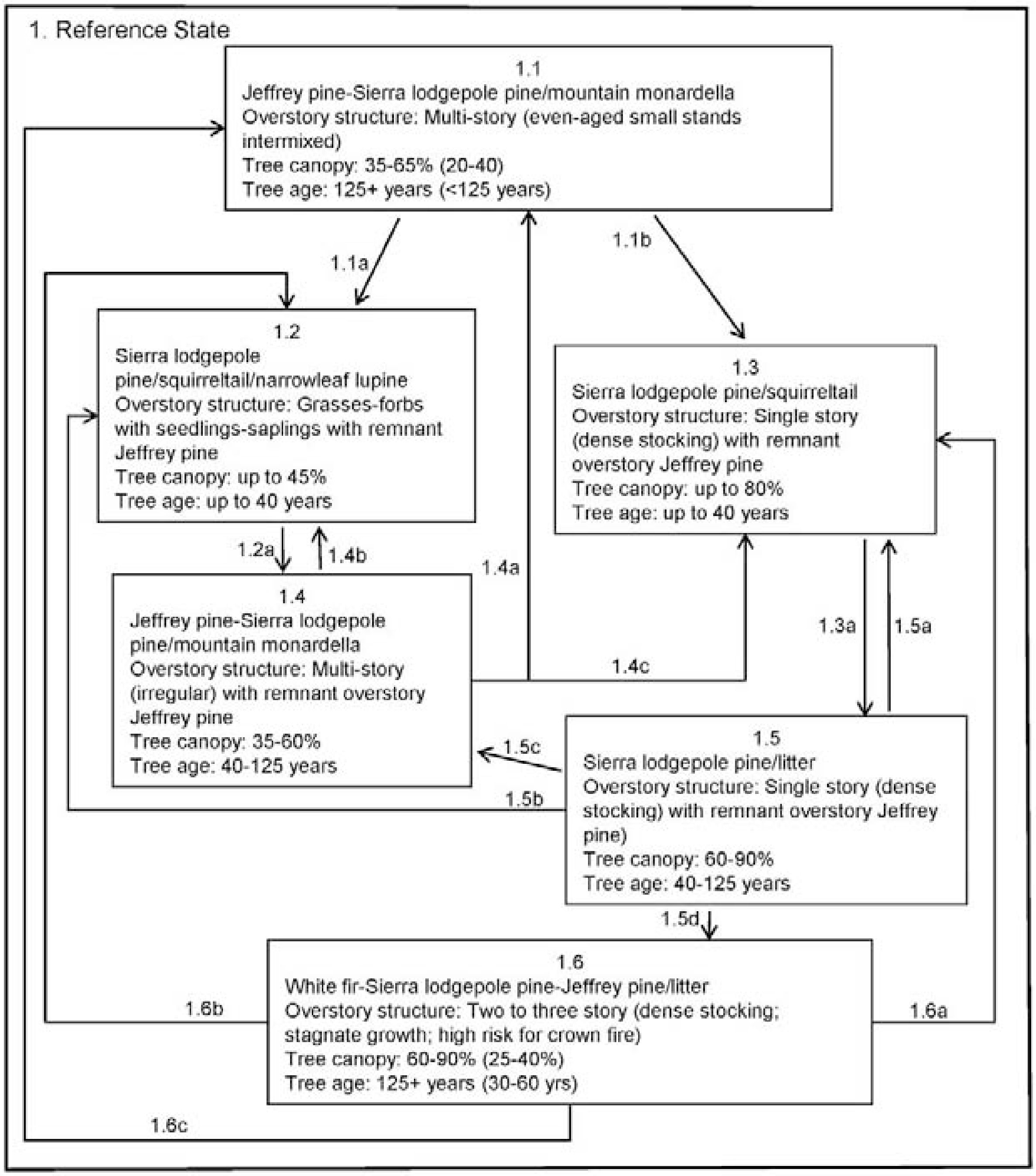
Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. Pathogens that affect Jeffrey pine in this area are dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle, (Dendroctonus 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 the dwarf mistletoe (Arceuthobium abietinum f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), 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 Diagram

State-Transition Model - Ecological Site F022BI126CA
Pinus jeffreyi-Pinus contorta var. murrayana/Monardella odoratissima
(Jeffrey pine-Sierra lodgepole pine/mountain monardella)



Reference - State 1

Jeffrey pine-Sierra lodgepole pine/mountain monardella - Community Phase 1.1
This mature Jeffrey pine-Sierra lodgepole pine forest develops with small scale disturbances that create gaps in the canopy. These gaps (single tree-fall to 0.25 acres in size) provide suitable sites for Sierra lodgepole pine, Jeffrey pine and ponderosa pine regeneration. Over time with continual disturbances, an uneven forest structure with varying age classes of pines develops. Taller overstory Sierra lodgepole pine that persist provide a seed source for gap areas.

Low intensity understory burns cause high mortality in the understory trees and portions of the overstory lodgepole pine, opening the canopy.

Community Phase Pathway 1.1a
This pathway is created by a high mortality fire or forest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community Phase 1.2).

Community Phase Pathway 1.1b
This pathway is created by a high mortality fire or forest infestation, followed by relatively dense Sierra lodgepole pine seedling regeneration (Community Phase 1.3) provided by ample cones and seed and favorable seed germination.

Sierra lodgepole pine/squirreltail/narrowleaf lupine - Community Phase 1.2
After a stand replacing event such as a high mortality fire or mountain pine beetle infestation, Sierra lodgepole pine will regenerate from wind dispersed seed. Depending upon fire severity, a portion of the Jeffrey pine and ponderosa pine will survive and provide an important seed source for regeneration. This site generally has less than 500 stems per acre and will grow into a relatively open forest. Seedlings can develop into pole-sized trees with up to 55 percent canopy cover. Grasses and forbs will increase in cover for several years.

Community Phase Pathway 1.2a
This pathway is followed with time and growth and small scale canopy disturbances. An open multi-age lodgepole pine forest develops (Community Phase 1.4).

Sierra lodgepole pine/squirreltail - Community Phase 1.3
This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. It seems to be the least common path for this ecological site. Depending upon fire severity, a portion of Jeffrey pine and ponderosa pine survive the fire. They provide an important seed source for regeneration. Fires leave bare soil and disturbed duff in open sunlight, which are ideal conditions for Sierra lodgepole pine, Jeffrey pine and ponderosa pine seed germination. Sierra lodgepole pine tends to reproduce more prolifically just after fire than either Jeffrey pine or ponderosa pine. It can form dense, almost impenetrable stands. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined to distinguish between the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. Many variables influence seedling density. Sierra lodgepole pine will produce good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid-October. These seeds can be stored

in the soil for several years, however seedlings tend to regenerate from wind dispersed seeds after fire. Therefore, the season and timing of a burn in relation to seed crop cycles may affect seedling density. Smaller fires may produce higher seedling densities, due to the proximity of available seed sources. Seasonal precipitation patterns and air temperatures during germination influence seedling survival.

Dense thickets are formed as the seedlings develop. As the trees grow taller they thin their lower branches. Most trees persist even with limited sunlight on their canopies. Growth becomes stagnant when chronic competition for light, water and nutrients exists. After a certain point of stagnation, Sierra lodgepole pine may not respond to competitive release from thinning, disease, or fire.

Community Phase Pathway 1.3a
With time and growth, the stand remains dense and evenly aged (Dense lodgepole pine forest, Community Phase 1.5). Trees are generally healthy and few gaps are created from tree mortality in this young forest.

Jeffrey pine-Sierra lodgepole pine/mountain monardella - Community Phase 1.4


lodgepole pine forest

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. In 2009, this is the common community phase. There are scattered large Jeffrey pine trees, which survived the last fire. The relatively open Sierra lodgepole pine canopy is 20 to 30 feet below the Jeffrey pine. Sierra lodgepole pine, Jeffrey pine and ponderosa pine seedlings are present in open areas. There may be an occasional white fir in the understory.

The two most significant forest disturbances leading to the creation of canopy gaps are provided by mountain pine beetle infestations and fire. After a pest infestation, patches of a stand die and leave gaps for lodgepole pine regeneration. Low intensity fire is often fatal to mature lodgepole pine and even a low severity fire can be a stand replacing event; however low intensity smoldering fires have been documented that had spread through downed trees after mountain pine beetle infestations. Although damage to live trees appeared minor, those with fire scars were rendered more susceptible to the next mountain pine beetle attack. Canopy gaps may also be created by wind throw, a susceptibility of Sierra lodgepole pine due to its shallow root system.

Community Phase Pathway 1.4a

With time and growth and small scale disturbances, this forest continues to develop into a Jeffrey pine-Sierra lodgepole pine forest (Community Phase 1.1) with a multi-aged, complex forest structure.

Community Phase Pathway 1.4b

This pathway is triggered by a high mortality fire, which initiates open Sierra lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.4c

This pathway is triggered by a high mortality fire, which initiates dense lodgepole pine regeneration (Community Phase 1.3) provided by ample cones and seeds and favorable seed germination.

Jeffrey pine-Sierra lodgepole pine/mountain monardella Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Forb					**17**	**222**		
		spreading groundsmoke	GADI2	*Gayophytum diffusum*	0	1	0	1
		California stickseed	HACA	*Hackelia californica*	0	25	0	5
		narrowleaf lupine	LUAN4	*Lupinus angustifolius*	10	80	1	8
		silverleaf phacelia	PHHA	*Phacelia hastata*	0	3	0	2
		lettuce wirelettuce	STLA	*Stephanomeria lactucina*	0	9	0	6
		goosefoot violet	VIPU4	*Viola purpurea*	0	1	0	1
		woolly mule-ears	WYMO	*Wyethia mollis*	7	103	1	15

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Grass/Grasslike					**3**	**84**		

		western needlegrass	ACOC3	*Achnatherum occidentale*	3	12	1	4
		smooth brome	BRIN2	*Bromus inermis*	0	5	0	2
		sedge	CAREX	*Carex*	0	3	0	2
		Ross' sedge	CARO5	*Carex rossii*	0	4	0	2
		squirreltail	ELEL5	*Elymus elymoides*	10	60	2	10

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Shrub					**10**	**226**		
		rubber rabbitbrush	ERNAS2	*Ericameria nauseosa ssp. nauseosa var. speciosa*	0	14	0	2
		sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0	2	0	2
		mountain monardella	MOOD	*Monardella odoratissima*	10	200	2	20
		wax currant	RICE	*Ribes cereum*	0	10	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
0 -Tree (understory only)					**0**	**53**		
		white fir	ABCO	*Abies concolor*	0	3	0	1
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	35	0	7
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	10	0	2
		ponderosa pine	PIPO	*Pinus ponderosa*	0	5	0	1

Annual Production by Plant Type:

	Annual Production (lbs/AC)		
Plant Type	Low	Representative Value	High
Grass/Grasslike	3	41	84
Forb	17	117	222
Shrub/Vine	10	37	226
Tree	0	33	53
Total:	30	228	585

Structure and Cover:

Ground Cover

Vegetative Cover	**Minimum**	**Maximum**
Grass / Grasslike	3%	20%
Forb	4%	45%
Shrub/ Vine	0%	2%
Tree	35%	65%
Non-Vascular Plants		
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	50%	90%
Surface Fragments > 0.25" and <= 3"	35%	65%
Surface Fragments > 3"	3%	30%
Bedrock	0%	0%
Water	0%	0%
Bare Ground	2%	8%

Forest Overstory:

Total tree canopy cover ranges from 35 to 60 percent, dominated by Sierra lodgepole pine. Large Jeffrey pines provide 2 to 10 percent cover. The older Jeffrey pines are probably over 200 years old. The younger strata of Sierra lodgepole pine from the area of this photo are 110 to 120 years old and 100 to 120 feet tall. The data represents an advanced stage within this community. Basal areas range from 65 to 150 ft2/acre.

Forest Overstory Characterization Summary (tree, tree fern and vine species > 13 feet in height)

	Low Canopy Cover %	RV Canopy Cover %	High Canopy Cover %
Forest Canopy (all species > 13' height)	35	44	60

Overstory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top	Tree Diameter Low	Tree Diameter High	Basal Area Low	Basal Area High
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	32.0	45.0						
Jeffrey pine *Pinus jeffreyi*	PIJE	N	2.0	10.0						
ponderosa pine *Pinus ponderosa*	PIPO	N	1.0	5.0						

Forest Understory:

The understory is diverse with a fair amount of cover and production. Recent fires and other disturbances have kept the canopy open and removed litter from the forest floor, allowing forbs and grasses to develop. Common plants are western needlegrass (Achnatherum occidentale), smooth brome (Bromus inermis), carex (Carex spp.), Ross' sedge (Carex rossii), squirreltail (Elymus elymoides), rubber rabbitbrush (Ericameria nauseosa ssp. nauseosa var. speciosa), sulphur-flower buckwheat (Eriogonum umbellatum), spreading groundsmoke (Gayophytum diffusum), California stickseed (Hackelia californica), narrowleaf lupine (Lupinus angustifolius), mountain monardella (Monardella odoratissima), silverleaf phacelia (Phacelia hastata), wax currant (Ribes cereum), lettuce wirelettuce (Stephanomeria lactucina), goosefoot violet (Viola purpurea) and woolly mule-ears (Wyethia mollis).

There is approximately 3 percent cover from Sierra lodgepole pine saplings.

Forest Understory Canopy Cover Summary (all species < 13 feet in height)

Understory - Plant Type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
western needlegrass *Achnatherum occidentale*	ACOC3	N	1.0	4.0		
smooth brome *Bromus inermis*	BRIN2	N	0	2.0		
sedge *Carex*	CAREX	N	0	2.0		
Ross' sedge *Carex rossii*	CARO5	N	0	2.0		
squirreltail *Elymus elymoides*	ELEL5	N	2.0	10.0		

Understory - Plant Type: Forb/Herb

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
spreading groundsmoke *Gayophytum diffusum*	GADI2	N	0	1.0		
California stickseed *Hackelia californica*	HACA	N	0	5.0		
narrowleaf lupine *Lupinus angustifolius*	LUAN4	N	1.0	8.0		
silverleaf phacelia *Phacelia hastata*	PHHA	N	0	2.0		
lettuce wirelettuce *Stephanomeria lactucina*	STLA	N	0	6.0		
goosefoot violet *Viola purpurea*	VIPU4	N	0	1.0		
woolly mule-ears *Wyethia mollis*	WYMO	N	1.0	15.0		

Understory - Plant Type: Shrub/Subshrub

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
rubber rabbitbrush *Ericameria nauseosa ssp. nauseosa var. speciosa*	ERNAS2	N	0	2.0		
sulphur-flower buckwheat *Eriogonum umbellatum*	ERUM	N	0	2.0		
mountain monardella *Monardella odoratissima*	MOOD	N	2.0	20.0		

wax currant *Ribes cereum*	RICE	N	0	2.0

Understory - Plant Type: Tree

Name	Symbol	Nativity	Cover Low %	Cover High %	Canopy Height Bottom	Canopy Height Top
white fir *Abies concolor*	ABCO	N	0	1.0		
Sierra lodgepole pine *Pinus contorta var. murrayana*	PICOM	N	0	7.0		
Jeffrey pine *Pinus jeffreyi*	PIJE	N	0	2.0		
ponderosa pine *Pinus ponderosa*	PIPO	N	0	1.0		

Sierra lodgepole pine/litter - Community Phase 1.5

This dense Sierra lodgepole pine forest develops after dense seedling establishment and absence of canopy disturbance. This forest is even-aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. The self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees enables pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

Mature Jeffrey pine and ponderosa pine that survived the last fire stand above the dense Sierra lodgepole pine canopy. A lower cover of younger Jeffrey pine and ponderosa pine may exist among the Sierra lodgepole pine canopy. White fir establishes in the understory.

Community Phase Pathway 1.5a

This pathway is triggered by a high mortality fire with appropriate conditions for dense lodgepole pine regeneration (Community Phase 1.3), i.e. ample cones and seeds and favorable seed germination.

Community Phase Pathway 1.5b

This pathway is triggered by a high mortality fire with appropriate conditions for open lodgepole pine regeneration (Community Phase 1.2). Pathways 1.5a and 1.5b are common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. Such a fire return interval does not allow for later successional community phases (Community Phases 1.1 and 1.6) to develop.

Community Phase Pathway 1.5c

This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low-mortality fires, or wind throw. The forest becomes a more open Sierra lodgepole pine forest (Community Phase 1.4) with several age classes. With continued small scale disturbances, it can eventually develop into Community Phase 1.1.

Community Phase Pathway 1.5d
With time and growth and the absence of disturbance the stand remains evenly aged and dense. White fir, which has established in the understory, becomes increasingly prevalent in the canopy and creates a white fir-mixed conifer forest (Community Phase 1.6).

White fir-Sierra lodgepole pine-Jeffrey pine/litter - Community Phase 1.6
The white fir-mixed conifer forest develops with the continued exclusion of fire or other disturbances. Shade-tolerant white fir has continued to regenerate under the Sierra lodgepole pine canopy. Jeffrey pine and ponderosa pine remain present in the upper canopy and, to some extent, in the lower Sierra lodgepole pine canopy. Without canopy disturbances, the lodgepole pine remains evenly aged and dense, limiting regeneration of the shade-intolerant pines. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the white fir for some time, but eventually declines due to the lack of sunlight and natural senescence. Fuel loads are high from the trees dying in the understory. Understory vegetation is absent due to the high cover of litter and debris and the lack of sunlight on the forest floor.

Community Phase Pathway 1.6a
A severe fire would initiate dense lodgepole pine regeneration (Community Phase 1.3) provided there are ample cones and seed and favorable seed germination.

Community Phase Pathway 1.6b
A severe fire would initiate open lodgepole pine regeneration (Community Phase 1.2).

Community Phase Pathway 1.6c
This pathway is created in time with a high incidence of small scale disturbances, which break up the uniformity and density of this forest. With continued disturbances the open multi-aged Jeffrey pine-Sierra lodgepole pine forest (Community Phase 1.1) may develop. The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels and low fire tolerance of the dominant tree species. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with small scale disturbances over time.

Ecological Site Interpretations

Forest 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
Sierra lodgepole pine	*PICOM*	85	85	96	96	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*	69	69	54	54	51	600	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Animal Community:
Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. There are 31 mammals and almost 50 bird species documented in Sierra lodgepole pine forests. Snags and downed logs are important for cavity-nesting birds and mammals. Other animals feed on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

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).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area is suitable for trails and camping.

Wood Products:
Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light and straight grained with consistent texture (Cope 1993).

Ponderosa pine wood is used for dimensional lumber, molding, mill work, cabinents, doors and window (Habeck, 1992).

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:

SITE INDEX DOCUMENTATION:

Alexander (1966) and Meyer (1961) were used to determine forest site productivity for lodgepole pine and Jeffrey pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phase 1.4 and 1.5. They are selected according to guidance listed in the site index publications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Moderately Deep Slopes	F022BI107CA	This is a red fir-white fir forest found at higher elevations.
Frigid Moist Sandy Lake Or Stream Terraces	F022BI108CA	This is a wet lodgepole site found on lake and stream terraces.
Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	F022BI125CA	This lodgepole forest is found on outwash without Jeffrey pine.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Loam Debris Flow On Stream Terraces	F022BI105CA	This is a Sierra lodgepole pine-quaking aspen site.
Frigid Coarse Glaciolacustrine Gentle Slopes	F022BI117CA	This is a California red fir-Sierra lodgepole pine site found at higher elevations.
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This is a white fir-Sierra lodgepole pine site found in wetter conditions.
Frigid Flat Outwash Terraces	F022BI123CA	This is a white fir- Sierra lodgepole pine site, with some aspen.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789353-type location
789354
789368
789393
789394

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	5 E
Section:	10
Datum:	NAD83
Zone:	10

Northing:	4490982
Easting:	635029
General Legal Description:	The type location is about 1.3 miles west northwest from the western edge of Soap Lake in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104490982635029

Relationship to Other Established Classifications:

Forest Alliance = Pinus jeffreyi - Jeffrey pine forest; Association = (no matching 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.)

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	10/27/2008	Kendra E Moseley	2/16/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Lyn Townsend	12/6/2010	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Talus Slope

Pinus jeffreyi / *Holodiscus discolor* - *Chrysolepis sempervirens* / *Ageratina occidentalis* - *Hieracium horridum*
(Jeffrey pine / oceanspray - bush chinquapin / western snakeroot - prickly hawkweed)

Site ID: R022BI200CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 20 to 65 percent
Landform: Scoured glacial-valley walls.
Soils: Very deep excessively drained soils that formed in tephra over colluvium from volcanic rock that has broken loose from glacially scoured bedrock outcrops.
Temp regime: Frigid
MAT: 25 to 45 inches (635 to 1,143 mm).
MAP: 42 to 44 degrees F (5.5 to 7 degrees C).
Soil texture: Extremely cobbly ashy loamy coarse sand
Surface fragments: 80-90 (minimum of 25 percent rock fragments is not common) percent rock fragments, with a representative composition of: 10 percent angular fine gravel, 5 percent angular medium and coarse gravel, 40 percent angular cobbles, 10 percent angular stones and 10 percent angular boulders.
Vegetation: Patchy cover of oceanspray (Holodiscus discolor) and bush chinquapin (Chrysolepis sempervirens) and other vegetation among the rocks. There are a few scattered Jeffrey pines (Pinus jeffreyi) across the slopes.

Physiographic Features

This ecological site is situated on glacial valley walls between 5,980 and 7,600 feet in elevation. Slopes are between 20 and 65 percent.

Landform: (1) Mountain slope

	Minimum	Maximum
Elevation (feet):	5980	7600
Slope (percent):	20	65
Water Table Depth (inches):	60	
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Low
Aspect:	South SouthEast SouthWest	

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 25 to 45 inches (635 to 1,143 mm) and the mean annual temperature ranges from 42 to 44 degrees F (5.5 to 7 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. The nearest one is at Manzanita Lake, which receives substantially more precipitation than this area.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	23.0	45.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is not influenced by water features.

Wetland Description: System Subsystem Class

Representative Soil Features

The Talved series consists of very deep excessively drained soils that formed in tephra over colluvium from volcanic rock that has broken loose from glacially scoured bedrock outcrops. The surface texture is extremely cobbly ashy loamy coarse sand, with coarse subsurface textures intermixed with 20 percent gravel and 60 to 70 percent stones, cobbles, and boulders. Available water capacity (AWC) ranges from 0.0 (very low) to 4.34 (low), with an RV of 0.6 (very low).

This ecological site has been correlated with the following map units within the Lassen Volcanic National Park Soil Survey (CA789):

Map Unit Component Percent
100 Talved 1
120 Talved 10

Parent Materials:
Kind: Colluvium
Origin: Volcanic rock

Surface Texture: (1)Extremely cobbly ashy loamy coarse sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	10	30
Surface Fragments > 3" (% Cover):	15	60
Subsurface Fragments <=3" (% Volume):	10	75
Subsurface Fragments > 3" (% Volume):	20	45

Drainage Class: Excessively drained To Excessively drained
Permeability Class: Moderately rapid To Moderately rapid

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.5	7.3

Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.0	4.34

Plant Communities

Ecological Dynamics of the Site

This ecological site is found on talus slopes that exhibit a patchy cover of shrubs and Jeffrey pine (Pinus jeffreyi). Oceanspray (Holodiscus discolor) and bush chinquapin (Chrysolepis sempervirens) are common among the talus. Due to the relatively slow tree growth on this site the forest will remain open, providing opportunity for shrubs, grasses, and forbs to grow in open sun.

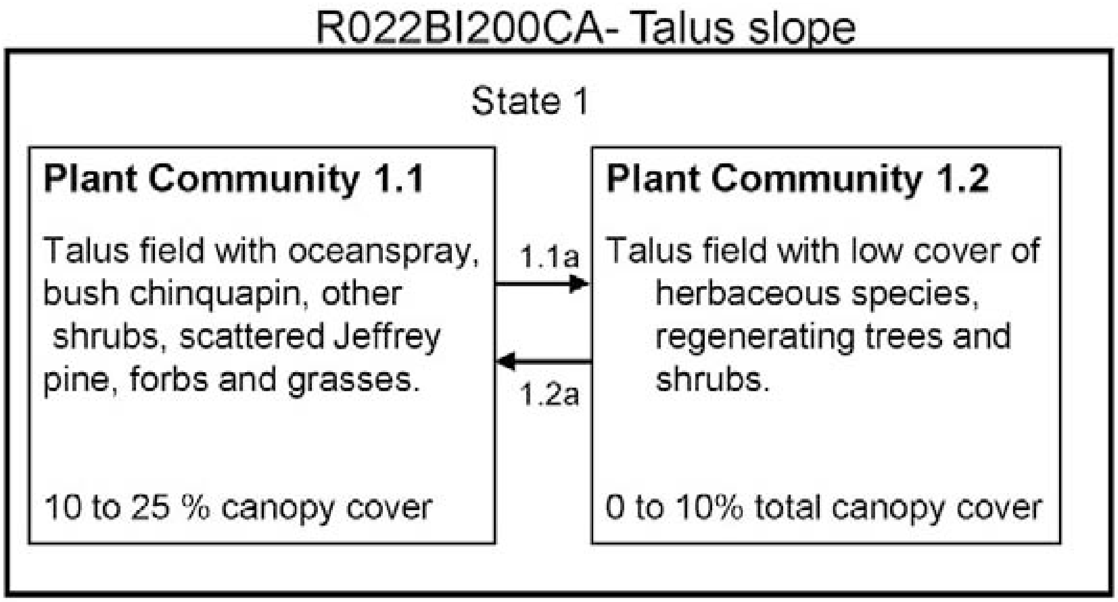
Vegetation on this ecological site will remain sparse throughout the successional process and Jeffrey pine represents the dominate tree species in this setting. The limited resources and relative harshness of the site will not allow for Jeffrey pine to be replaced by a later seral stage species. Recruitment of Jeffrey pine seedlings is in part inhibited by competition from shrubs for available soil moisture in the upper sections of the soil profile (Rose, 2003).

Oceanspray has been used as an indicator of climax conditions on rocky sites in both forested and non-forested communities throughout its range (McMurray, 1987). The plant assemblages associated with a climax oceanspray community change as it moves throughout its range. In this case oceanspray is associated with bush chinquapin, which is also considered to be a climax species on shallow rocky soils (Howard, 1992).

The soils associated with this site are very deep, but have 80 to 90 percent rock fragments. There is very little soil on the surface suitable for seedling development and survival. Plants must establish in soil pockets among the cobbles, boulders and stones. The soils have very low available water holding capacity, so any moisture drains out quickly. The plants on this site have a short growing period during and after snow melt, before the soils dry out. The stones and boulders provide small nooks with shade, which slow the rate of snow melt and water loss through evaporation, thereby creating pockets of soil that remain moist for longer into the summer months. Jeffrey pine is able to survive on sites like these by developing extensive root systems that can reach into fractured bedrock in order to extract moisture. This technique of removing water from deeper and deeper within the profile as the summer progresses allows Jeffrey pine to persist on this site (Meyer, 2007).

Plant- water relations vary by species. A thin leaved deciduous species like oceanspray experiences greatly decreased water potential during times of moisture stress. The root system of oceanspray does not extend into the lower soil profile and is limited to extracting water from the upper portion of the soil profile, which is severely depleted in late summer. However due to its high leaf area index (which increases the removal of soil- water) and its’ shallow rooting habit, it is very competitive in the upper soil profile (Conard, 1970). Thicker leaved evergreen shrubs, like bush chinquapin will maintain a relatively high conductance even under stressful environmental conditions.

State and Transition Diagram



Talus slope - State 1

This state represents the natural conditions for this ecological site.

Talus slope shrubland with scattered trees, forbs, and grasses - Community Phase 1.1


Talus Slope

Plant community 1.1 is the climax community associated with this ecological site.

Dominant shrubs include oceanspray (Holodiscus discolor) and bush chinquapin (Chrysolepis sempervirens). These are common climax species on harsh rocky sites. Total shrub cover will remain low, growing in patches.

Jeffrey pine (Pinus jeffreyi) is present, growing and regenerating at a very slow rate; total canopy cover will remain below 25% in the late seral sages. Jeffrey pine can be a climax species, especially on harsh sites (Gucker, 2007) where they will not be crowded out by more shade tolerant species.

Grasses and forbs are a minor component of this plant community and include western snakeroot (Ageratina occidentalis), prickly hawkweed (Hieracium horridum), scabland penstemon

(Penstemon deustus), whiteveined wintergreen (Pyrola picta), western needlegrass (Achnatherum occidentale) and squirreltail (Elymus elymoides). The limiting resources on this site prevent most of these species from reaching their maximum productivity potential.

Community Phase Pathway 1.1a

1.1a – A disturbance such as a lighting strike or rockfall that removes part of the vegetation will move the plant community toward a new phase (1.2).

Talus slope shrubland with scattered trees, forbs, and grasses Plant Species Composition:

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -native grasses/grass likes					**7**	**35**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	5	20	1	5
		sedge	CAREX	*Carex*	0	5	0	2
		squirreltail	ELEL5	*Elymus elymoides*	2	10	0	3

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
2 -native forbs					**20**	**48**		
		western snakeroot	AGOC2	*Ageratina occidentalis*	10	20	0	4
		prickly hawkweed	HIHO	*Hieracium horridum*	10	20	0	2
		scabland penstemon	PEDE4	*Penstemon deustus*	0	6	0	2
		whiteveined wintergreen	PYPI2	*Pyrola picta*	0	2	0	1

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
3 -native trees					**0**	**20**		
		white fir	ABCO	*Abies concolor*	0	5	0	1
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	15	0	8

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
4 -native shrubs					**55**	**530**		
		bush chinquapin	CHSE11	*Chrysolepis*	5	75	1	15

		sempervirens				
oceanspray	HODI	*Holodiscus discolor*	50	400	3	20
bitter cherry	PREM	*Prunus emarginata*	0	30	0	2
Sierra gooseberry	RIRO	*Ribes roezlii*	0	25	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	7	23	35
Forb	20	35	48
Shrub/Vine	55	210	530
Tree	0	10	20
Total:	82	278	633

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	1%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	1%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	2%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	2%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	3%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	10%	25%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	10%	30%		**Tree Snags** per Acre**			
Surface Fragments > 3"	15%	60%		Hard Snags***			
Bedrock	0%	1%		Soft Snags***			
Water	0%	0%					
Bare Ground	3%	12%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	5%	0%	1%				
> 0.5 - < 1 feet	0%	5%	0%	1%				
> 1 - <= 2 feet	2%	5%	2%	10%	0%	5%		
> 2 - < 4.5 feet					5%	15%		
> 4.5 - <= 13 feet					0%	5%		
> 13 - < 40 feet								
< 40 - >= 80 feet							5%	10%
> 80 - < 120 feet							2%	8%
>= 120 feet								

Overstory:
There is 2-10 percent cover of Jeffrey pine. The distribution of the trees is patchy and the trees present are very slow growing. Two trees were aged at 260 and 300+ years old. They were 90 and 74 feet tall respectively.

Understory:
Total ground cover is between 15-30% and made up mostly of oceanspray (Holodiscus discolor) and Sierra chinquapin. Various other shrubs, as well as some grass and forb species, make up the rest of the understory composition.

Talus slope with low herbaceous cover and regenerating shrubs and trees - Community Phase 1.2
A small or large scale disturbance such as a rock slide or fire would remove patches of vegetation. These disturbed areas create openings for regeneration of grasses, forbs, shrubs and, later, trees. It is unlikely that a crown fire would carry across this site, but it would be possible if the vegetative and climatic conditions were ideal. It is more probable that fire would originate from a lightning strike and be relatively small, creating patchiness on the landscape. The grasses and forbs would be the first foliage to come back, followed by the shrubs. Later, seedlings and saplings would begin to reappear on the site, most likely establishing from an off-site seed source. Much of this propagation on this site will result from animal and/or wind dispersed seed.

Squirreltail (Elymus elymoides) is generally tolerant of disturbance and can be present in early, mid- or late seral stages, depending on the habitat type (Simonin, 2001). Squirreltail would be a pioneering species after a fire due to its ability to regenerate from the remaining root crown and the abundance of off-site seed sources (Simonin, 2001). Squirreltail will be a persistent species throughout the successional process on this ecological site.

Bush chinquapin (Chrysolepis sempervirens) frequently sprouts from the roots, root crown and stump following a fire (Howard, 1992). This adaptation to begin sprouting relatively soon after a fire, would allow bush chinquapin to be one of the earliest species to reappear on this site following a fire of any size.

After disturbance, it is most likely that oceanspray (Holodiscus discolor) will reproduce naturally through wind dispersed seed. Currently there are no reports that establish the ability of oceanspray to resprout from existing plants after a fire, but it has been documented as a dominate species in the shrub layer in the years immediately following a fire (McMurray, 1987).

Community Phase Pathway 1.2a
1.2a- This pathway is followed with time and growth of the shrubs and trees, moving towards plant community 1.1.

Overstory:
A small scale disturbance may leave a few residual mature Jeffrey pine (Pinus jeffreyi), equaling 0-5% of the overstory canopy cover. A larger disturbance could remove all the forest overstory and most of the understory vegetation.

Understory:
The small herbaceous component is made up of mostly grass species like squirreltail, with a trace amount of forbs. Shrubs in various stages of growth and regeneration are scattered across the site comprising 0-10% of the total canopy cover. Cover and production data was not collected on this community phase.

Ecological Site Interpretations

Animal Community:
Grazing pressure on this site is relatively low. Wild ungulates are present throughout this area of Lassen Volcanic National Park however the majority of plants growing here are not choice forage species. There is no permitted livestock grazing within the park.

The palatability of oceanspray (Holodiscus discolor) is generally considered to be low (McMurray, 1987), therefore reducing its importance as a forage species for wildlife and livestock. Sierra chinquapin (Chrysolepis sempervirens) is considered useless for wildlife and livestock but is a staple diet item for small rodents and various birds (Howard, 1992).

Squirreltail (Elymus elymoides) is considered to be moderately palatable, however it would be basically unaffected by grazing pressure on this site due to its relative scarcity.

Plant Preference by Animal Kind:

Hydrology 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 difficult to walk across due to the high percentage of boulders and stones on the surface. It may provide for nice views because trees do not establish well on this site.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Moderately Deep Slopes	F022BI107CA	This is a red fir- white fir forest site.
Low Precip Frigid Sandy Moraine Slopes	F022BI119CA	This is a white fir- Jeffrey pine forest which often surrounds the rocky outcrops.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
There is one NRCS soil pit for this site with vegetation data: Soils 232 No 106.

Type Locality:

State:	CA
County:	Lassen
Township:	
Range:	
Section:	
Datum:	NAD83
Zone:	10
Northing:	4492599
Easting:	644461
General Legal Description:	Located north-northeast of Butte Lake in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	

Latitude Decimal:

Longitude Degrees:

Longitude Minutes:

Longitude Seconds:

Longitude Decimal:

Universal Transverse Mercator (UTM) system: NAD83104492599644461

Relationship to Other Established Classifications:

Other References:

Conard, Susan G., Steven R. Sparks and Jon C. Regelbrugge. Comparative plant water relations and soil water depletion patterns of three seral shrub species on forest sites in southern Oregon. Forest Science 43(3) 1997.

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Rose, K. L., R. C. Graham and D. R. Parker. Water source utilization by Pinus jeffreyi and Arctostaphylos patula on thin soils over bedrock. Oecologica 134:46-54 (2003).

Simonin, Kevin A. 2001. Elymus elymoides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2008, October 29].

Site Description Approval:

Author	Date	Approval	Date
Erin Hourihan, Marchel Munnecke	6/26/2006	Kendra E Moseley	2/17/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Marchel Munnecke	1/1/2011	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Bedded Tephra Deposits

/ *Eriogonum marifolium* - *Eriogonum polyanthum* /
(/ marumleaf buckwheat - sulphur-flower buckwheat /)

Site ID: R022BI201CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: Range from 2 to 50 percent.
Landform: Tepra covered lava flow.
Soils: Shallow to very deep, formed in tephra or scoria from Cinder Cone.
Temp regime: frigid.
MAAT: 43 to 44 degrees F (6.1 to 6.6 degrees C).
MAP: 31 to 35 inches (787 to 889 mm).
Soil texture: Gravelly ashy coarse sand or ashy loamy sand.
Surface fragments: 65 to 95 percent gravel.
Vegetation: Very sparse cover of sulphur-flowered buckwheat (Eriogonum polyanthum), marumleaf buckwheat (Eriogonum marifolium), and naked buckwheat (Eriogonum nudum) and a few other species.

Physiographic Features

This ecological site is associated with the Painted Dunes, which developed from lava flows and tephra deposits from the eruption of Cinder Cone around 1650 (Clynne et al, 2000). Although this area is commonly called Painted Dunes, a more appropriate term for this area is knolls on lava flows. It is situated between 6,155 feet and 6,532 feet in elevation. Slopes are generally between 5 to 30 percent, with absolute ranges between 2 to 50 percent.

Landform: (1) Lava flow

	Minimum	Maximum
Elevation (feet):	6155	6532
Slope (percent):	2	50
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Negligible	Very low
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 31 to 35 inches (787 to 889 mm). The mean annual temperature ranges from 43 to 44 degrees F (6.1 to 6.6 degrees C). The frost free (>32 degrees F) season is 70 to 90 days, and the freeze free (>28 degrees F) season is 90 to 200 days (MZL).

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	70	90
Freeze-free period (days):	90	200
Mean annual precipitation (inches):	31.0	35.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

The soil components associated with the Painted Dunes are Typic Xerorthents-welded and Typic Xerorthent-tephra. The Typic Xerorthents-welded soils are shallow and well drained with a welded layer between 10 to 20 inches. The Typic Xerorthents-tephra soils are very deep and excessively drained. Both soils formed in tephra or scoria from Cinder Cone. The surface textures are gravelly ashy coarse sand or ashy loamy sand, with very gravelly coarse sand or ashy sand subsurface textures. The Typic Xerorthents-welded are basically barren of vegetation, most likely because of the welded layer and a tendency for the surface to create a platey crust.

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

Map Unit Component/ Comp %
202 Typic Xerorthents-tephra /85
202 Typic Xerorthents-welded /10

Parent Materials:
Kind: Tephra
Origin: Volcanic rock

Surface Texture: (1)Very gravelly ashy coarse sand
(2)Ashy loamy sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	65	95
Surface Fragments > 3" (% Cover):	0	7
Subsurface Fragments <=3" (% Volume):	18	90
Subsurface Fragments > 3" (% Volume):	0	10

Drainage Class: Excessively drained To Excessively drained
Permeability Class: Rapid To Rapid

	Minimum	Maximum
Depth (inches):	10	60+
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.6	8.4

Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.1	2.8

Plant Communities

Ecological Dynamics of the Site

This ecological site is located in the north-east corner of Lassen National Volcanic Park, near Butte Lake. Called the Painted Dunes, it gets its name from the mosaic of black, tan, and red soils that appear on the landscape. The generally recognized theory that explains the different soil colors goes back to the sixteenth or seventeeth century when Cinder Cone erupted. Ash fell on the lava flow while it was still hot, creating the brightly oxidized colors. These black, tan, and red soils have slightly different expression of species but collectively make up one plant community. Most vegetation is growing on the tan soil and where slopes meet the darker black troughs. The most common species include western needlegrass (Achnatherum occidentale), sulphur-flowered buckwheat (Eriogonum polyanthum), marumleaf buckwheat (Eriogonum marifolium), and naked buckwheat (Eriogonum nudum). The red soils located at the top of the knolls are basically void of vegetation.

This ecological site consists of relatively stable knolls sparsely vegetated with a minute buckwheat plant community and scattered trees. The community maintains a reasonably steady state since, short of an eruption of Cinder Cone, which is unlikely, there is very little disturbance that can affect it. The areas surrounding this ecological site were covered by the tephra deposits from Cinder Cone, and have developed Jeffrey pine forests of different successional stages. This area is developing much slower, possibly due a distant conifer seed source, or inherent soil characteristics such as the bedded tephra layers. Soil development and organic matter accumulation is proceeding at such a slow rate that it may take several centuries for this site to be suitable for a Jeffrey pine forest to develop.

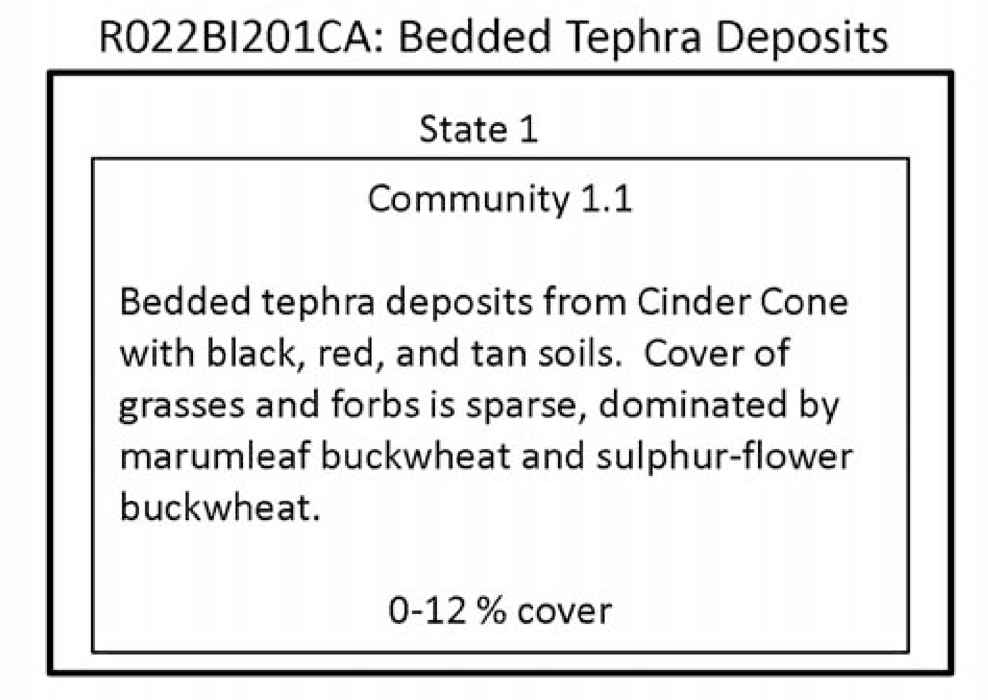
The initial colonization of plants on newly exposed parent material initiates a wide range of processes. Nitrogen fixation is commonly one of the first processes initiated by pioneering plant species and microorganisms. This process converts atmospheric nitrogen gas into ammonia (NH_4^+) through chemical and biological reactions. The resulting ammonia is converted to nitrate (NO_3^-) by microorganisms through a process called nitrification. Plants assimilate inorganic nitrogen in the form ammonia and nitrate. As plants continue to establish on the new substrate, they absorb CO_2 from the atmosphere and convert it to plant carbon through the process of photosynthesis. The carbon is sequestered in either above-ground or below-ground biomass, or as soil carbon. Soil organisms are responsible for the decomposition of plant material. When soil organisms die and decompose, nutrients are processed back into the soil. Plant material and dead soil organisms provide the bulk of organic matter in soil. The process of CO_2 production and the accumulation of organic matter begin to transform freshly exposed parent material by providing nutrients and creating better water availability for plants and microorganisms, affecting pH and weathering minerals. Over time, as these organisms eat, grow and move through the soil, they transform it into a more vibrant biologic substrate. Most of these processes are concentrated in the upper portion of the soil.

The living and dead material of plants stabilize the soil surface by physically buffering raindrop impact and impeding surface runoff. Within the soil, plants, animals and microbes bind the soil together as aggregates with roots, hyphae, fecal pellets and decomposed organic matter. The micro-structure formed by the combined processes of buffering and binding increases soil stability, porosity, water infiltration and water holding capacity (NRCS, 2009).

Trees and burrowing animal activity produce larger pores and mix soil at a greater scale. Ants and gophers transport soil material by depositing subsoil on the surface as they build tunnels and nests. Dead tree roots produce macropores that often accumulate surface material and incorporate organic matter deeper down in the profile (NRCS, 2009).

The soils here are bedded with coarse and fine, sands and gravels. The roots are dense in the fine layers of the profile. These layers may be affecting the biological processes discussed above.

State and Transition Diagram



Bedded Tephra Deposits - State 1

Scattered forbs and grasses - Community Phase 1.1

Bedded tephra deposits ecological site

Plant community 1.1 represents a very slowly developing pioneer plant community. Under the present conditions this plant community can exist for an extended period of time.

This landscape is almost barren with a few low lying subshrubs, forbs, and grasses. Although not visible from a distance, there is 0-6% total canopy cover of western needlegrass (Achnatherum occidentale), sulphur-flower buckwheat (Eriogonum polyanthum), marumleaf buckwheat (Eriogonum marifolium), naked buckwheat (Eriogonum nudum), Douglas' dustymaiden (Chaenactis douglasii), silverleaf phacelia (Phacelia hastate), and Lemmon's rockcress (Arabis lemmonii).

There is less than 5 percent canopy cover from Jeffrey pine (Pinus jeffreyi), western white pine (Pinus monticola), and Sierra lodgepole pine (Pinus contorta var. murrayana). Trees may be 5 to 30 feet tall.

The most common vegetation growing here are various species of buckwheat (Eriogonum spp.). Eriogonums are one of the most widespread genera of plants in North America. They are found in a variety of environmental conditions, including the dry sandy soil found here (Reveal, 1973).

Eriogonum species can facilitate succession by accumulating seeds and providing more favorable conditions for germination and establishment of other species (Day and Wright, 1989). Litter and organic matter accumulate in the prostrate canopy of buckwheat plants, which may increase the nutrient levels of the soil (Day and Wright, 1989).

There are few disturbances or ecological processes that would drive the current plant community into a new state or phase. It has been found that disturbance by animal burrowing can enhance plant growth and biodiversity (Vilies et al., 2008) in areas similar to this. A fire on this site is extremely unlikely due to the lack of fuels.

Studies have shown Eriogonum species to be tolerant of stressful nutrient and water situations, making it an ideal plant for this ecological site. Eriogonum seedlings are able to withstand the coarse textured and nutrient deficient soil found in this area. Eriogonum species have lower osmotic potentials, greater fine root biomass and lower reductions in growth under drought conditions (Chapin and Bliss, 1989) than other species growing in similar environments.

Jeffrey pine (Pinus jeffreyi) is frequently considered to be tolerant of early-seral conditions (Gucker, 2007). Jeffrey pine generally only persists to the late-seral stages on extremely harsh sites, like this ecological site, due to its shade intolerance. Although Jeffrey pine commonly grows on rocky and infertile soils, the extreme lack of resources limits its productivity. Sierra lodgepole pine (Pinus contorta var. murrayana) is a pioneer species that is tolerant of xeric and infertile soil. Total canopy cover will remain low for both of these species for a hundred years or more. It is not uncommon for environments like this to lack late successional species over long periods of time (Gomez-Romero et al., 2006).

Scattered forbs and grasses Plant Species Composition:

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre		Foliar Cover Percent	
					Low	High	Low	High
1 -native trees					**0**	**6**		
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	2	0	1
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	2	0	1
		western white pine	PIMO3	*Pinus monticola*	0	2	0	1

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre		Foliar Cover Percent	
					Low	High	Low	High
2 -native forbs					**0**	**19**		
		Lemmon's rockcress	ARLE	*Arabis lemmonii*	0	3	0	1
		Douglas' dustymaiden	CHDO	*Chaenactis douglasii*	0	2	0	1
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	2	0	1

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
		sulphur-flower buckwheat	ERPO16	*Eriogonum polyanthum*	0	5	0	2
		sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0	5	0	2
		silverleaf phacelia	PHHA	*Phacelia hastata*	0	2	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
3 -native grass					**0**	**5**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	3	0	1

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	3	5
Forb	0	12	19
Tree	0	3	6
Total:	0	18	30

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	1%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	3%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	1%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	2%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	1%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	0%	1%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	90%	95%		**Tree Snags** per Acre**			
Surface Fragments > 3"	0%	3%		Hard Snags***			
Bedrock	0%	0%		Soft Snags***			
Water	0%	0%					

Bare Ground	0%	0%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet			0%	3%				
> 0.5 - < 1 feet			0%	3%				
> 1 - <= 2 feet								
> 2 - < 4.5 feet								
> 4.5 - <= 13 feet							0%	2%
> 13 - < 40 feet							0%	3%
< 40 - >= 80 feet								
> 80 - < 120 feet								
>= 120 feet								

Ecological Site Interpretations

Animal Community:
This site has very little vegetation cover. Grazing opportunities are extremely limited and there is minimal protection or shelter available. Very few animals use this site on regular basis.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
Due to the sensitivity of the landscape there are limited recreation opportunities. Hiking is allowed, but it is restricted to designated trails to prevent leaving tracks that remain visible for many years. This area provides many photographic opportunities.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Low Precip Frigid Sandy Tephra Gentle Slopes	F022BI100CA	This is a Jeffrey pine forest that surrounds the Painted Dunes.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:
This site has been correlated with the following states:

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

789190
789191
789233
789234

Type Locality:

Relationship to Other Established Classifications:

Other References:

Chapin, David M. and L.C. Bliss. Seedling growth, Physiology, and Survivorship in a subalpine, Volcanic Environment. Ecology. 70(5).1989.

Clynne, Michael A., Duane E. Champion, Deborah A. Trimble, James W. Hendley II, and Peter H. Stauffer. 2000. How old is “Cinder Cone”? - Solving a mystery in Lassen Volcanic National Park, California. USGS Fact Sheet -023-00. 2000. [Available online: http://www.nps.gov/lavo]

Day, T.A. and R.G. Wright. 1989. Positive plant spatial associated with Eriogonum ovalifolium in primary succession on cinder cones: seed-trapping nurse plants. Vegetation 80: 37-45, 1989. [Available online: http://www.springerlink.com/content]

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Gucker, Corey L. 2007. Pinus jeffreyi. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences

Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, August 21].

United States Department of Agriculture, Natural Resources Conservation Service. 2010. Soil survey of Lassen Volcanic National Park, California. (Accessible online at: http://soils.usda.gov/survey/printed_surveys/).

Viles, H.A., L.A. Naylor, N.E.A. Carter, and D. Chaput. 2008. Biogeomorphical disturbance regimes: progress in linking ecological and geomorphical systems. Earth Surf. Process. Landforms 33: 1419-1435(2008). [Available online: http://www.interscience.wiley.com]

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	6/26/2006	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
		Kendra Moseley	11/3/2010

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Frigid Alluvial Flat

/ *Salix lemmonii* - *Alnus incana ssp. tenuifolia* / *Carex nebrascensis* - *Carex simulata*
(/ Lemmon's willow - mountain alder / Nebraska sedge - analogue sedge)

Site ID: R022BI202CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by multiple springs, flows, and seasonal snow melt.
Slopes: Generally 1 to 3 percent but can have up to 5 percent slopes.
Landform: stream terrace.
Soils: Very deep alluvium, with varying depths of organic horizons.
Temp regime: Frigid.
MAAT: 5.5 to 6.1 degrees C. (42 to 43 degrees F.).
MAP: 1,295 to 1,753 mm (51 to 69 inches).
Soil texture: muck to gravelly ashy fine sandy loam.
Surface fragments: 0 to 10 percent gravel
Commonly Associated with: R022BI211CA Spring Complex and R022BI210CA Frigid Loamy Flood Plain Floodplain
Vegetation: several montane meadow plant communities dominated by graminoid species with some willow and mountain alder.

Physiographic Features

This ecological site is presently mapped between 5,440 and 5,790 feet in elevation, but the elevation range may be extended if found outside the park. This site is on stream terraces. Slopes are generally 1 to 3 percent but may be up to 5 percent.

Landform: (1) Stream terrace

	Minimum	Maximum
Elevation (feet):	5440	5790
Slope (percent):	1	5
Water Table Depth (inches):	0	60
Flooding:		
Frequency:	Rare	Frequent
Duration:	Extremely brief	Long
Ponding:		
Depth (inches):		
Frequency:	Occasional	Frequent
Duration:	Brief	Very long
Runoff Class:	Very high	Very high
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 51 to 69 inches (1,295 to 1,753 mm). The mean annual temperature ranges from 42 to 43 degrees F (5.5 to 6.1 degrees C). The frost free (>32 degrees F) season is 70 to 90 days. The freeze free (> 28 degrees F) season is approximately 80 to 200 days.

	Minimum	Maximum
Frost-free period (days):	70	90
Freeze-free period (days):	80	200
Mean annual precipitation (inches):	51.0	69.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site has wetland and non-wetland features; further delineation would be needed to locate the wetland boundaries. The drier portions of this meadow complex are seasonally saturated for short durations after the spring snowmelt. The wettest areas are saturated to the surface throughout the entire year, due to continual input of water from springs that emerge just upslope from the meadow.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Palustrine	N/A	Emergent Wetland

Representative Soil Features

The soil components associated with this meadow ecological site are Terric Haplohemists, Histic Humaquepts, Aquandic Humaquepts, and Aquandic Endoaquepts. These are all very deep, very poorly to somewhat poorly drained soils that formed in alluvium.

The wettest part of this meadow fits the criteria for a fen because it has at least 40 cm of organic soil within the upper 80 cm of soil, supports hydrophytic vegetation, and its soil is saturated to the surface for a least one month each year (Cooper and Evan, 2006). Incised ditches and the removal of Lemmon’s willow (Salix lemmonii) and other shrubs have altered the vegetation, threatening the characteristics of the fen. The soil in this part of the meadow are Terric Haplohemists, which has 20 inches of organic muck over a 10 inch ashy silty clay loam textured horizon. The lower horizons have ashy silty loam and ashy silty clay loam textures. The water table fluctuates from 0 to 24 inches during the dry season. The vegetation is dominated by analogue sedge (Carex simulata), Northwest Territory sedge (Carex utriculata), and Nebraska sedge (Carex nebrascensis), along with other hydrophytic vegetation (PCC1b).

The Nebraska sedge (Carex nebrascensis) community (PCC2b) is found in slightly drier locations surrounding the fen and is associated with the Histic Humaquepts soil component. These soils have 9 inches of organic material over 19 inches of ashy loam textured A and B horizons. The C horizons have extremely cobbly ashy sandy clay loam and very cobbly ashy coarse sandy loam textures. The water table is at the surface in early summer then fluctuates from 10 to 60 inches during the dry season.

A mixed sedge and grassland community (PCC3b) is found throughout the meadow and is associated with the Aquandic Humaquepts soil component. These soils have 4 inches of ashy mucky peat over an ashy very fine sandy loam textured horizon. The subsurface textures are very gravelly, extremely gravelly, and gravelly ashy sandy loams. The water table is near the surface in early summer and fluctuates from 10 to 60 inches in the dry season. Common plants include widefruit sedge (Carex angustata), tufted hairgrass (Deschampsia cespitosa), Kentucky bluegrass (Poa pratensis), and timothy (Phleum pretense).

The driest part of the meadow is associated with the Aquandic Endoaquepts soil component. These soils formed in bar deposits. They do not have an organic horizon, due to the aerobic conditions created by these soils as water flows through them. This creates oxygenated conditions for most of the year that allow organic matter to decompose rather than form peat. The surface texture is a gravelly ashy fine sandy loam surface texture. Subsurface textures include ashy very fine sandy loams, ashy loamy fine sand, and ashy loam coarse sand, and gravelly ashy loam coarse sand. This soil has a high percentage of surface gravels and bare ground, compared to the rest of the meadow. Sedges (Carex spp.) and mountain rush (Juncus arcticus ssp. littoralis) provide about 70 percent cover of the vegetation cover (PCC4b).

This ecological site has been correlated with the following map units and soil components in the Lassen Volcanic National Park Soil Survey (CA789):

Map Unit Component /Component percent
165 Aquandic Humaquepts / 35
165 Histic Humaquepts / 25
165 Aquandic Endoaquepts / 20
165 Terric Haplohemists / 15

Parent Materials:
Kind: Alluvium
Origin: Volcanic rock

Surface Texture:
(1) Ashy muck peat
(2) Herbaceous peat
(3) Gravelly ashy fine sandy loam

Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	10
Surface Fragments > 3" (% Cover):	0	0
Subsurface Fragments <=3" (% Volume):	0	75
Subsurface Fragments > 3" (% Volume):	0	40

Drainage Class: Very poorly drained To Somewhat poorly drained
Permeability Class: Moderately slow To Moderate

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	3.8	9.4

Plant Communities

Ecological Dynamics of the Site

This ecological site is a montane meadow-fen complex. One representative location of this ecological site is the Drakesbad Meadow in Lassen Volcanic National Park. The following description is based on data and research from Drakesbad Meadow, however this site may be found and mapped elsewhere within the MLRA.

This ecological site complex has an assemblage of plant communities and soil types dependent upon dependent upon stream deposit characteristic, micro-topography, hydrologic characteristics, and human-influenced alterations. An extensive study of the hydrology of the lower part of Drakesbad Meadow, by Lindsay Patterson, determined that 99 percent of the hydrologic input during the summer months comes from the associated spring complex ecological site, R022BI211CA located almost 200 feet above the meadow. These spring complexes can be created by groundwater seeping out at a contact between an older andesite flow and a more recent dacite flow, which is the case in Lassen Volcanic National Park. These springs are from a regional aquifer that is recharged by a high winter snowfall. The spring flow reaches the meadow by surface flow and creates a flow- through system in the meadow (Patterson, 2005). There is also a small tributary to Little Hot Springs Creek bisects Drakesbad Meadow. It effectively intercepts the spring flow before it reaches the upper portion of the meadow, where fen characteristics have not developed. The riparian ecological site: Frigid Loamy Flood plains R022BI210CA, is often associated with this ecological site. An example of this site in Lassen Volcanic National Park would be Hot Springs Creek, which is on the lower, south side of this valley. This site may or may not be supplying hydrologic support to this ecological site, and in Lassen Volcanic National Park. Hot Springs Creek stays mainly in its channel and does not regularly overflow into the meadow, and is thus of secondary hydrologic importance.

There is little known about the use of these meadows by the Native Americans. The Mountain or Northeastern Maidu were seasonal inhabitants in the Warner Valley prior to European settlers and it is likely they harvested plant materials for consumption and for weaving material. They hunted game, although their impact was probably minimal.

The recent history of Drakesbad Meadow in particular has been well documented in several papers, with nice photo pairs showing the changes over time. Edward Drake arrived in Warner Valley around 1875 and was the first documented settler in the area. In 1894 he finally purchased or had a government patent for the upper Warner Valley, including Drakesbad Meadow. By this time he had improved the dirt road from Chester, built a house and a barn, and fenced and planted his pasture with timothy grass. As many as 100 horses may have been passing through Drakesbad Meadow at one time (Hoke, et al., 2005; Bozeman). The Sifford family bought the ranch from Edward Drake in 1900. The Siffords began a campground and guest house for tourists visiting the nearby hot springs. They spent many long and arduous days removing willows and alders from the meadow west of the lodge. They also dug ditches to drain the wettest areas there, and tried to divert the water to drier areas (Hoke, et al. 2005). Between 1942 and 1951, the Siffords ran about 100 head of cattle as many as 30 horses passing through Drakesbad Meadow at any one time. During the cattle ranching period, fencing was expanded and timothy seed was spread in the pastures. Drakesbad Meadow and the surrounding areas became part of Lassen National Volcanic Park in 1958 and cattle grazing ceased, although horses are still corralled near the meadow.

The hydrology, soil development and history of this site and Drakesbad Meadow in particular, play important roles in the distribution and composition of the plant communities present. The constant flow of water and the subsequent prolonged saturated soil conditions has allowed peat to develop from sedge roots by creating anaerobic conditions that inhibit organic matter decomposition. Peat accumulation is a slow process with accumulation rates of approximately 20 cm per thousand years, as cited in Patterson’s report (Patterson 2005, and Chimner and Cooper, 2003). Peat from the southeast portion of Drakesbad Meadow has been dated from 4200 years BP (White, et. al 2001). Once peat dries out it can decompose quickly. Presently only the wettest areas of the meadow have deep organic soils. The drier areas of the meadow have mineral soils and support a larger composition of upland plant species.

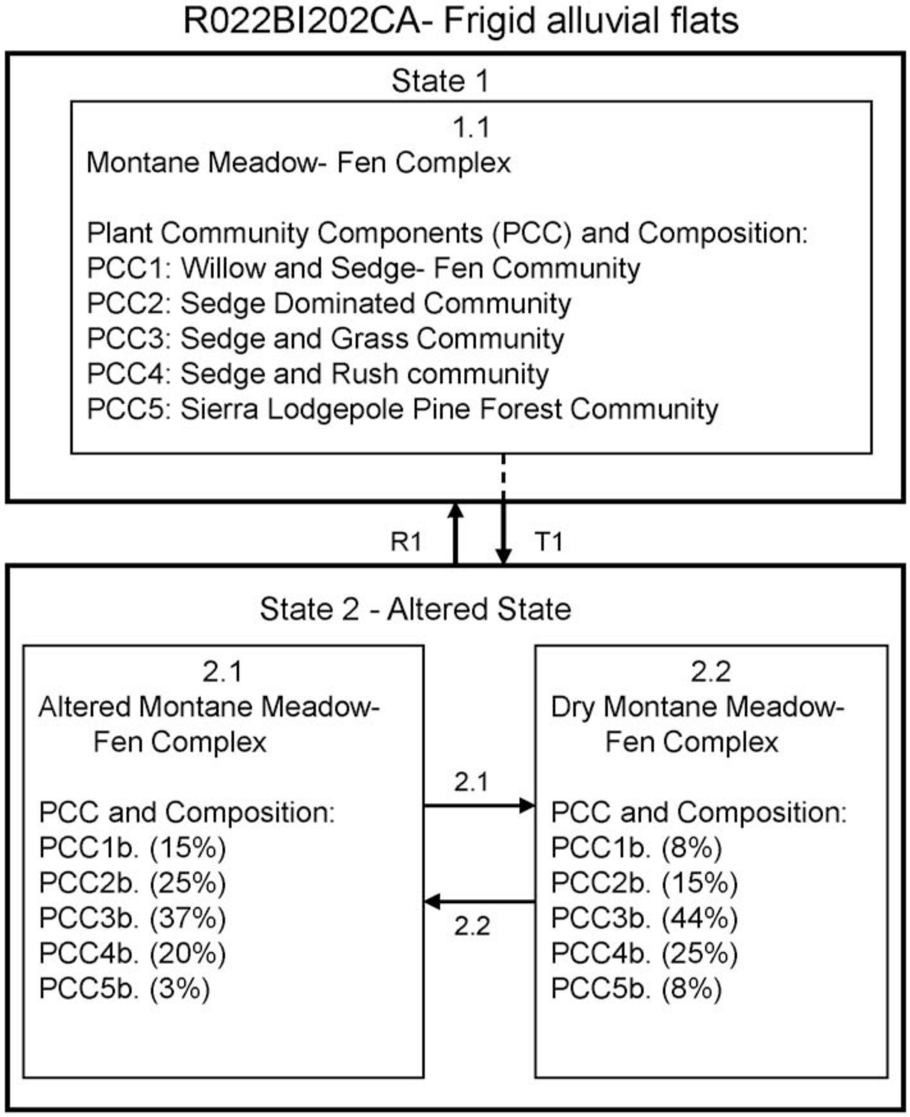
This ecological site is a complex of plant communities which are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community component composition as a result of disturbance or change in the water table, rather than focusing on the succession of one plant community.

Fire is not included in the successional dynamics for this ecological site. Under natural conditions this meadow would be too wet to burn. The drier upper meadow could burn, but the native perennial grasses would resprout and recover quickly.

There is a potential serious threat from fire in State 2, if the peat dries out. It could burn and restoration of the fen would be nearly impossible.

Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram



State 1 - State 1

This state represents the natural conditions for this meadow complex. It is based on historical accounts and photos of the meadow from the early 1900's (Hoke, et al, 2005, Bozeman, and Patterson, 2005).

Montane Meadow- Fen Complex 1.1 - Community Phase 1.1

The native plant communities that were present in this meadow before human alterations may have been somewhat similar to the respective plant communities described in State 2. Historical photos indicate that PCC1 and PCC2 had a large component of shrubs, most likely Lemmon's willow and mountain alder. The shrubs may have been in areas with oxygenated surface flow or elevated patches of peat. Patterson reported a 96 percent decrease in shrubs from 1952 and 2003 (determined by photo interpretation). This actually includes about a 3 percent increase in shrubs since the meadow became part of the national park (Patterson, 2005).

The presence and distribution of the plant communities are related to water table depth and duration of soil saturation. The wettest portions of this meadow have developed with a constant, steady flow of water from the springs upslope and seasonal snow melt. This system is relatively stable with few natural disturbances to change the distribution and proportion of the plant communities within the meadow. The plant community borders, however, may shift if the site gets drier or wetter due to drought, flood, or a change in drainage patterns (i.e. sedge roots build up, block a channel and the channel changes course). The following community components are associated with this state of the montane meadow-fen complex, described from wettest to driest:

PCC1:
A relict of this plant community is still present today in the wettest part of the fen. It has peat-forming sedges such as analogue sedge (Carex simulata), Northwest Territory sedge (Carex utriculata), Nebraska sedge (Carex nebrascensis), and other wetland species. Historical photos show this area was dominated by shrubs, most likely Lemmon's willow (Salix lemmonii) and/or thinleaf alder (Alnus incana ssp. tenuifolia). Literature and photos indicate that this community was once more extensive in the lower part of Drakesbad Meadow.

PCC2:
The Nebraska sedge (Carex nebrascensis) community borders the wettest area of the meadow. Historical photos indicate high shrub cover where this community is present today. Lemmon's willow (Salix lemmonii) may have been more prevalent in the open meadow, where water drainage is slower. Thinleaf alder would tend to prefer areas with more water movement, such as near channels or concentrated surface flow. Seed bank studies indicate that this community may have been less extensive when water tables were higher, prior to hydrologic alterations (Patterson, 2005).

PCC3:
This community existed in the upper portion of the meadow, which does not receive direct spring flow. Native plants such as tufted hairgrass (Deschampsia cespitosa), widefruit sedge (Carex angustata), other mixed sedges (Carex spp.) and mountain rush (Juncus arcticus ssp. littoralis) are still present today. Native species that tend to increase with surface disturbance are meadow barley (Hordeum brachyantherum), Chamisso arnica (Arnica chamissonis), longstalk clover (Trifolium longipes), cinquefoil (Potentilla spp.), and Rydberg's penstemon (Penstemon rydbergii). Non-native grasses, primarily timothy (Phleum pretense) and Kentucky bluegrass (Poa pratensis), are a significant component of this plant community today.

PCC4:
This is the driest plant community. It is associated with the topographically higher bar deposits within the meadow, that were a result of past flooding dynamics of the associated Frigid Loamy Floodplains ecological site. There is less vegetative cover and a higher percentage of surface gravels compared to the rest of the meadow. Because of its convex mound topography and course textures, this area drains water rapidly. The lack of an organic horizon indicates that this area does not experience the prolonged saturated conditions suitable for peat development. This area is presently dominated by mixed sedges (Carex spp.), mountain rush (Juncus arcticus ssp.

littoralis), and Columbia needlegrass (Achnatherum nelsonii). It is difficult to determine species composition changes in this plant community since the early 1900’s. Because this area is drier than the rest of the meadow it may have been heavily used in the past.

PCC5:
This is a Sierra lodgepole pine (Pinus contorta var. murrayana) forest found along the edge of the meadow. White fir (Abies concolor) and Jeffrey pine (Pinus jeffreyi) may be present. This forest is open with a grassy understory. Native understory species present in the bordering forest today are Columbia needlegrass (Achnatherum nelsonii), California brome (Bromus carinatus), blue wildrye (Elymus glaucus), common yarrow (Achillea millefolium), strawberry (Fragaria sp.), and Ross' sedge (Carex rossii).

Natural fluctuations which raise the water table would favor PCC1 and PCC2, while a lower water table would favor Community Types PCC3, PCC4, and PCC5.

Transition - 1
Using Drakesbad Meadow as the example illustrating the transitions that can occur in this ecological site, the transition was initiated in the early 1900’s when the meadow hydrology was altered and shrubs were manually removed. Non-native grasses were seeded to improve forage for livestock. A threshold was crossed when the hydrology of the site was altered, and non-native plant species established. Spring flow was diverted down a road, away from the meadow. Ditches were created in the meadow to drain the wet areas and redirect flow to drier areas. The ditches captured surface water flow, subsequently causing the water table to drop in the surrounding areas. The lower water tables allowed other plant communities to establish on the recently dried fen habitat. Additional drainage channels may have formed when the dominant vegetation shifted from sedges, which form dense stable root mats, to grasses, which offer less protection against soil erosion. In low slope meadows dominated by sedge, surface flow generally sheets across the surface and infiltrates as subsurface flow without true channels, but in areas where grasses are dominant and the soil is less tightly bound, the surface flow can scour channels. Shrub removal has left the meadow dominated by graminoid species and now lacks the valuable wildlife habitat provided by shrub cover. Willows have not reestablished their former cover in the meadow. The physical impact from grazing horses and cattle is not documented, but it’s conceivable they may have altered species composition due to selective herbivory and/or soil compaction. Introduced grasses have created plant communities that did not exist prior to European settlement. It is possible for fen soils to dry to a sufficient depth and duration to allow for the decomposition of the organic material in the upper soil horizons. This is a real concern, but soils here do not indicate that this process is occurring at this time. As stated earlier, the development of organic fen soils takes thousands of years, but they can decompose in a decade when dried out. When the organic material decomposes the fibrous peat disintegrates and becomes amorphous. This causes the peat to shrink, reducing hydraulic conductivity and increasing bulk density (Patterson, 2005). The process of decay is a combination of complex chemical and biological processes. Many of these processes are inhibited in anaerobic conditions (lack of oxygen). When water tables drop in fen habitats, peat is exposed to oxygen and begins to decay. The exposure of the peat to air can increases carbon mineralization, which creates a loss of carbon into the atmosphere in the form of carbon dioxide (CO_2). The process of nitrogen mineralization (decay) is also affected by changes in the water table, but the process seems to be

complex and dependent upon the depth of the water table and other variables. Nitrogen mineralization (decay) creates ammonium ions (NH4+) that attach to the negatively charged clay particles. The ammonium can be utilized by plants or processed further to form nitrate via nitrification. Nitrification requires oxygen and creates negatively charged nitrate ions (NO3-) that are leached out of the soil, leaving positively charged hydrogen ions (H+) which, in turn, decrease the pH of the soil. The extent of the impact from these processes in the areas where the peat has been drained for almost 100 years is unclear and could use more study.

Altered state - State 2

This state represents the existing altered condition and the potentially severely degraded phase for this ecological site. It is based on literature review, and recent soil and vegetation data collected by NRCS from 2006 to 2008.

Altered Montane Meadow- Fen complex - Community Phase 2.1

Frigid Alluvial Flat

This community phase has some similar plant community components as the undisturbed state, but the willow component has been reduced, and the hydrology has been altered due to incised ditches. Non-native plants have become established. The incised ditches have lowered the water table in some areas, which alters the distribution of the plant community components.

PCC1b:
This community is dominated by peat-forming sedges such as Northwest Territory sedge (Carex utriculata), analogue sedge (Carex simulata) and Nebraska sedge (Carex nebrascensis), with an occasional Lemmon's willow (Salix lemmonii) and thinleaf alder (Alnus incana ssp. tenuifolia). This community is found in areas that are saturated to the surface for several months during the growing season and water tables don't drop below 6 inches. The sedges form a tightly woven organic surface with their extensive root systems. The root mats do not decay in these saturated conditions, so dead roots, rhizomes, and stolons develop into a thick organic peat layer. These plants have several adaptations which enable them to survive these anoxic saturated conditions, such as aerenchyma tissue in the roots and stems. This tissue has well-developed air spaces between the cells which allow for gas exchange.

PCC2b:
This community is dominated by Nebraska sedge (Carex nebrascensis). It is found adjacent to the fen community, but does not always have the depth of organic soil required to meet the fen criteria (40cm with in the upper 80cm). Nebraska sedge is a heavily rhizomatous wetland plant that can form almost monotypic stands. It can survive total inundation for 3 months (Hoag, 1998.). It is not generally found in areas where the water table drops to more than 1 meter below the surface late in the growing season (Hoag, et al. 2007). This community may be expanding into the fen community in those areas where the water table has dropped below the surface.

PCC3b:
This community is dominated by native sedges and non-native grasses. The dominant sedge appears to be widefruit sedge (Carex angustata). Tufted hairgrass (Deschampsia cespitosa) is the dominant native grass. Non-native grasses are Kentucky bluegrass (Poa pratensis) and timothy (Phleum pretense). There is high cover of mountain rush (Juncus arcticus ssp. littoralis), Chamisso arnica (Arnica chamissonis), and longstalk clover (Trifolium longipes). Other plants include meadow barley (Hordeum brachyantherum), fringed willowherb (Epilobium ciliatum), three-petal bedstraw (Galium trifidum), California false hellebore (Veratrum californicum var. californicum), cinquefoil (Potentilla sp.), Rydberg's penstemon (Penstemon rydbergii), Lemmon's yampah (Perideridia lemmonii), longstalk starwort (Stellaria longipes) and other sedges (Carex spp.).

PCC4b:
This is the droughtiest plant community which is found on bar deposits within the meadow, as described above in State 1, PCC4. Mixed sedges (Carex spp.) and mountain rush (Juncus arcticus ssp. littoralis) dominate with lesser amounts of Columbia needlegrass (Achnatherum nelsonii), Bolander's bluegrass (Poa bolanderi), spreading groundsmoke (Gayophytum diffusum), longstalk clover (Trifolium longipes), aster (Aster sp.), clover (Trifolium sp.), slender cinquefoil (Potentilla gracilis), and common dandelion (Taraxacum officinale).

PCC5b:
This is a Sierra lodgepole pine forest found along the driest portions of the meadow. Sierra lodgepole pine creates an open forest with a grassy understory. Data was not collected for this community component, but it was collected on a nearby drier site where species include California brome (Bromus carinatus), Columbia needlegrass (Achnatherum nelsonii), blue

wildrye (Elymus glaucus), timothy (Phleum pretense), Kentucky bluegrass (Poa pratensis), common yarrow (Achillea millefolium), strawberry (Fragaria sp.), and Ross' sedge (Carex rossii).

The percent composition for the community components during this phase are approximately:

PCC1b: 15%
PCC2b: 25%
PCC3b: 37%
PCC4b: 20%
PCC5b: 3%

The production values in the tables below, for groups 1 and 4, represent ocular estimates which were calibrated based on actual clipped production from plots nearby.

Community Phase Pathway 1
This community pathway is created if water tables continue to lower.

Altered Montane Meadow- Fen complex Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -native forbs					**60**	**260**		
		Douglas' thistle	CIDO2	*Cirsium douglasii*	10	30	0	1
		Scouler's St. Johnswort	HYSCS2	*Hypericum scouleri ssp. scouleri*	30	80	2	4
		longstalk starwort	STLO2	*Stellaria longipes*	10	50	1	3
		longstalk clover	TRLO	*Trifolium longipes*	10	100	1	5

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -grass/grasslike					**1400**	**2795**		
		bentgrass	AGROS2	*Agrostis*	35	70	1	2
		California brome	BRCA5	*Bromus carinatus*	35	70	1	2
		Nebraska sedge	CANE2	*Carex nebrascensis*	285	700	15	25
		analogue sedge	CASI2	*Carex simulata*	250	500	10	20
		Northwest Territory sedge	CAUT	*Carex utriculata*	540	800	20	30
		spikerush	ELEOC	*Eleocharis*	210	315	10	15
		Bolander's bluegrass	POBO	*Poa bolanderi*	36	90	2	5
		panicled bulrush	SCMI2	*Scirpus microcarpus*	160	250	8	12

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -shrubs					**0**	**100**		
		thinleaf alder	ALINT	*Alnus incana ssp. tenuifolia*	0	75	0	1
		alpine laurel	KAMI	*Kalmia microphylla*	0	20	0	2
		Lemmon's willow	SALE	*Salix lemmonii*	0	50	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
2 -grass/grasslike					**1520**	**2620**		
		Nebraska sedge	CANE2	*Carex nebrascensis*	1500	2500	80	95
		tufted hairgrass	DECE	*Deschampsia cespitosa*	0	10	0	1
		meadow barley	HOBR2	*Hordeum brachyantherum*	0	10	0	1
		mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	20	100	5	28

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
2 -native forbs					**0**	**26**		
		rose thistle	CIAN	*Cirsium andersonii*	0	1	0	1
		slender phlox	MIGRG4	*Microsteris gracilis var. gracilis*	0	10	0	1
		Rydberg's penstemon	PERY	*Penstemon rydbergii*	0	12	0	1
		knotweed	POLYG4	*Polygonum*	0	1	0	1
		longstalk clover	TRLO	*Trifolium longipes*	0	1	0	1
		violet	VIOLA	*Viola*	0	1	0	1
3 -native forbs					**301**	**762**		
		Chamisso arnica	ARCH3	*Arnica chamissonis*	300	660	25	55
		fringed willowherb	EPCI	*Epilobium ciliatum*	0	1	0	1
		threepetal bedstraw	GATR2	*Galium trifidum*	0	10	0	5
		Rydberg's penstemon	PERY	*Penstemon rydbergii*	1	60	0	5
		cinquefoil	POTEN	*Potentilla*	0	10	0	3

		longleaf starwort	STLO	Stellaria longifolia	0	1	0	1
		California false hellebore	VECAC2	Veratrum californicum var. californicum	0	20	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
3 -grass/grasslike					**1750**	**3110**		
		widefruit sedge	CAAN15	Carex angustata	1200	2200	50	70
		tufted hairgrass	DECE	Deschampsia cespitosa	50	200	5	15
		meadow barley	HOBR2	Hordeum brachyantherum	0	10	0	1
		mountain rush	JUARL	Juncus arcticus ssp. littoralis	500	700	65	75
4 -grass/grasslike					**1066**	**1615**		
		Columbia needlegrass	ACNE9	Achnatherum nelsonii	30	90	1	3
		sedge	CAREX	Carex	600	800	30	40
		mountain rush	JUARL	Juncus arcticus ssp. littoralis	400	600	50	70
		Bolander's bluegrass	POBO	Poa bolanderi	36	125	2	7

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
4 -native forbs					**2**	**55**		
		aster	ASTER	Aster	1	10	0	2
		spreading groundsmoke	GADI2	Gayophytum diffusum	1	30	1	5
		slender cinquefoil	POGR9	Potentilla gracilis	0	5	0	1
		longstalk clover	TRLO	Trifolium longipes	0	10	0	2

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
20 -non-native grasses CT3					**233**	**450**		
		timothy	PHPR3	Phleum pratense	1	100	1	10
		Kentucky bluegrass	POPR	Poa pratensis	232	350	8	12

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
30 -non-native forbs CT1					**0**	**60**		
		bull thistle	CIVU	*Cirsium vulgare*	0	30	0	1
		common dandelion	TAOF	*Taraxacum officinale*	0	30	0	1

Dry Montane Meadow-Fen Complex - Community Phase 2.2

This community phase has the same community components as describe in Community Phase 2.1, but the composition of the plant communities may change if water tables continue to drop. PCC1b and PCC2b are most at risk if the water table drops and the fen community could disappear, permitting the more upland communities to dominate. It is unclear if Drakesbad Meadow has developed into this community or if it remains a potential phase for the future. Should water be diverted from this site and ditches continue to incise, water tables will drop. Prolonged drought can exacerbate this situation.

The percent composition for the community components during this phase are approximately:

PCC1b: 8%
PCC2b: 15%
PCC3b: 44%
PCC4b: 25%
PCC5b: 8%

Community Phase Pathway 2

This pathway may be created by raising the level of the water table by natural or artificial means.

Restoration Pathway - 1

Several restoration practices were implemented during the summer of 2003. The dirt road that leads to the water tank dissects and diverts spring flow, so culverts were placed across this road at 21 points to allow the springs to cross at their natural course. Shortly after, the largest ditch in the meadow was blocked with 5 sheet- metal dams. The restoration of the road increased the water table in the meadow, but the placement of the sheet dams seemed to have had a more significant impact by raising the water table over a larger area of the meadow. One year after treatment, there was a significant increase in the fen-forming sedges (Carex spp.), and a reduction in the drier type grasses. This was considered a pilot study, with positive results, and further similar treatments are recommended. Shrub seeds were absent in the seed bank, so the shrubs may need to be reintroduced. Lemmon's willow (Salix lemmonii) can be reintroduced from seed or from cuttings from nearby shrubs. Thinleaf alder (Alnus incana ssp. tenuifolia) may also have been present in some of this area (Patterson, Lindsay S. 2005). Removing the non-native grasses and invasive plant species from the meadow will require an ongoing commitment by physically removing the undesired plants and reseeding or encouraging the native species. Complete removal of non-native grasses in the upper meadow is probably not practical.

Ecological Site Interpretations

Animal Community:
This site provides valuable wildlife resources, such as water, forage, and cover. The leaves, stems, and seeds of Nebraska sedge, tufted hairgrass, and other grasses and sedges provide forage for wildlife and livestock. The sedges and bunchgrasses provide nesting habitat for waterfowl and cover for small mammals.

Songbird mist-netting studies have been conducted in Drakesbad for the last 10 years. The results indicate above average songbird productivity. A complete list of netted songbirds can be viewed on their report (Lassen Volcanic National Park, 2006).

Plant Preference by Animal Kind:

Hydrology Functions:
The hydrologic function of this meadow is to provide a catchment for water, sediments, and nutrients. The meadow allows sediments from spring snow melt to settle out and traps nutrients in surface and subsurface flows. The meadow provides water storage that slowly releases down the drainage throughout the year. This meadow also provides a broad abandoned flood plain which may take on overflow from Hot Springs Creek in the event of a very large flood event. Access to this flood plain would reduce erosion downstream and allow for sediment deposition.

Recreational Uses:
This meadow provides open space for wildlife viewing, photographic opportunities, historical features, access to hot springs, and easy level nature trails. Trails should be constructed in appropriate areas to avoid water diversion or soil compaction.

Wood Products:

Other Products:
Mountain rush was and may still be used for basketry and food by native Americans.

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This white fir- Sierra lodgepole pine forest surrounds the meadow.
Spring Complex	R022BI211CA	This site is a spring complex which provides water to the meadow.

Similar Sites:

Site Name	Site ID	Site Narrative
Cryic Lacustrine Flat	R022BI206CA	This meadow site is found at higher elevations, and is associated with

		small meandering streams.
Frigid Loamy Flood Plains	R022BI210CA	This riparian site is associated with Hot Springs Creek.
Frigid Lacustrine Flat	R022BI217CA	This meadow site is associated with relic glacial lakes and alluvial terraces, without major spring influences.

State Correlation:
This site has been correlated with the following states:

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

789168- Aquandic Humaquepts (CT3)
789204- Histic Humaquepts (CT2)
789286- Aquandic Endoaquents (CT4)
789348- Terric Haplohemist (CT1)

Type Locality:

Relationship to Other Established Classifications:

Other References:
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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	6/26/2007	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Moderately Deep Fragmental Slopes

Abies magnifica / / Wyethia mollis - Balsamorhiza sagittata
(California red fir / / woolly mule-ears - arrowleaf balsamroot)

Site ID: R022BI203CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 10 to 80 percent, but generally 10 to 50 percent
Landform: Mountain slope
Soils: moderately deep, well drained soils that formed in tephra and colluvium over residuum from hydrothermally altered rock. A Cr horizon begins at 15 inches and indurated bedrock is encountered at 20-40 inches.
Temp regime: Frigid
MAT: 38 to 42 degrees F (3.3 to 5.5 degrees C).
MAP: 63 to 119 inches (2,515 to 2,870 mm).
Soil texture: Gravelly ashy loam
Surface fragments: 40 to 65 percent gravel and cobbles.
Vegetation: High cover of woolly mule-ears (Wyethia mollis) and/or arrowleaf balsamroot (Balsamorhiza sagittata) with other forbs and grasses.
Note: The soils formed from the hydrothermally altered parent material are higher in clay content and have lower pH than other soils in Lassen Volcanic National Park.

Physiographic Features

This ecological site is found on convex mountain side slopes in hydro-thermally altered areas within Brokeoff Volcano at elevations between 5,680 and 8,570 feet. Slopes range from 10 to 80 percent, but are usually between 10 to 50 percent.

Landform: (1) Mountain slope

	Minimum	Maximum
Elevation (feet):	5680	8570
Slope (percent):	10	80
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	South East West	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 63 to 119 inches (2,515 to 2,870 mm). The mean annual temperature ranges from 38 to 42 degrees F (3.3 to 5.5 degrees C). The frost free (>32 degrees F) season is 60 to 85 days. The freeze free (>28 degrees F) season is 80 to 195 days.

There are no representative climate stations for this ecological site.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	80	195
Mean annual precipitation (inches):	63.0	119.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This ecological site is not associated with wetland or riparian water features.

Wetland Description: System	Subsystem	Class

Representative Soil Features

The Brokeoff series associated with this site consists of moderately deep, well drained soils that formed in tephra and colluvium over residuum from hydro-thermally altered volcanic rock. Acidic steam and water of various temperatures and pH have altered the mineralogy of the rock to produce minerals that have weathered into soils with significantly higher amounts of clay and a lower pH than those soils in the rest of the Park. The pH was sampled in the field at 4.8 at depths from 0 to 2 inches, and 5.0 to 5.2 in the lower horizons. A lab pit from deeper soils with similar chemistry had pH ranges from 4.7 to 5.1. These soils are very strongly acidic to neutral, and may have high levels of aluminum and manganese. Aluminum +++ becomes soluble in acidic soils, and impairs root growth, reducing the plants ability to access water. Plants may show symptoms of Phosphorus (P), calcium (Ca), and magnesium (Mg), deficiencies due to the high pH. Manganese toxicity is also associated with acidic soils. The symptoms of manganese toxicity are reduced shoot growth, discoloring and chlorosis of leaves.

The surface texture is a gravelly ashy loam with 18 percent clay and 30 percent gravel. Subsurface textures are gravelly ashy loam, very gravelly clay loam, and extremely gravelly loam. Percent gravel ranges from 30 to 40 and percent cobbles ranges from 2 to 20 increasing with depth. At 15 to 37 inches in depth is a Cr horizon of cobbles with 98 percent rock fragments that include gravels, cobbles and stones. Indurated bedrock is encountered at 37 inches in the modal pit and ranges from 20 to 40 inches. This soil is fragmental with a high percentage of gravels and cobbles.

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

Map Unit Component / Component %
118 Brokeoff / 5
119 Brokeoff / 25

Parent Materials:
Kind: Tepra and colluvium over residuum
Origin: Hydrothermally altered volcanic rock
Surface Texture: (1) Gravelly ashy loam
Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	34	45
Surface Fragments > 3" (% Cover):	6	20

Subsurface Fragments <=3" (% Volume):	25	48
Subsurface Fragments > 3" (% Volume):	0	5

Drainage Class: Well drained To Well drained
Permeability Class: Impermeable To Impermeable

	Minimum	Maximum
Depth (inches):	20	40
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.8	6.7
Soil Reaction (0.01M $CaCl_2$):		
Available Water Capacity (inches):	0.78	2.33

Plant Communities

Ecological Dynamics of the Site

This ecological site is heavily dominated by woolly mule-ears (Wyethia mollis), although it may be replaced by arrowleaf balsamroot (Balsamorhiza sagittata) in some areas. Other common plants include bluntlobe lupine (Lupinus obtusilobus), mountain monardella (Monardella odoratissima), squirreltail (Elymus elymoides) and blue wildrye (Elymus glaucus). There are very few trees on this site.

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. Deposition can sometimes be seen as a yellow coating on the snow, which can affect surface pH and mineralogy. Hydrogen sulfide (H_2S), Carbon dioxide (CO_2), hydrogen gas (H_2), nitrogen (N), and helium (He) are some of the chemicals found in the thermal springs, which react with oxygen and other elements to form a variety of chemicals which may be found in the steam deposits.

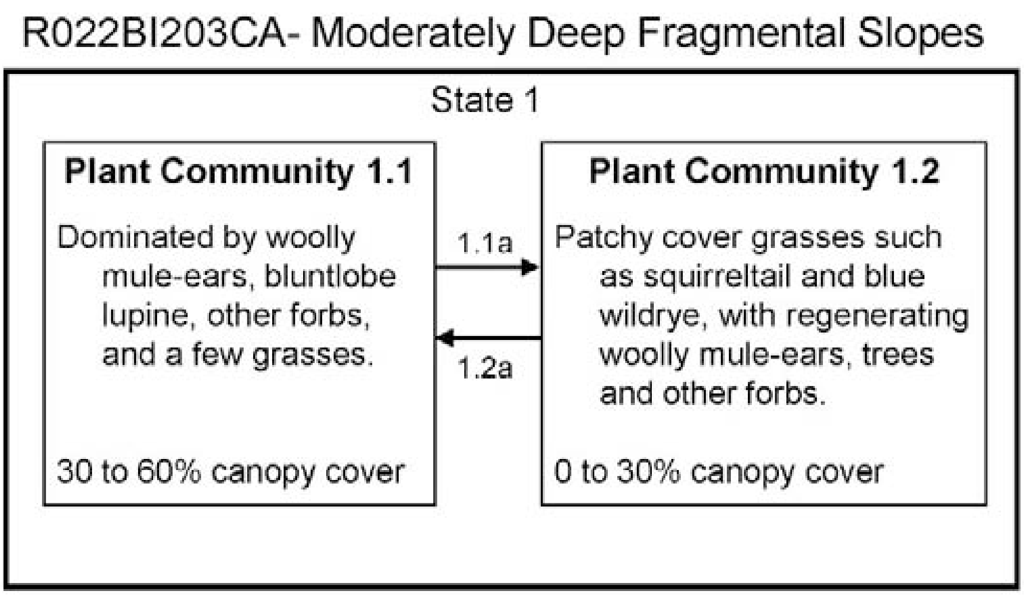
The soil chemistry alone does not inhibit tree growth however, as trees are growing in similar conditions nearby. The trees nearby are not growing in a normal forest-like structure. They tend to stay open with multiple age classes, possibly indicating some response to low pHs, aluminum or manganese toxicity. Another factor may be the droughtiness of the Brokeoff soils. The Cr layer begins at 15 inches, with 98 percent rock fragments and indurated bedrock occurring between 20 to 40 inches. Even with its finer textures this soil has a limited available water holding capacity. It is this low available water capacity, due to high rock fragments and moderately deep soils over indurated bedrock, which inhibits tree growth. Additionally, woolly mule-ears can interfere with conifer establishment through competition for water and/or allelopathy.

Woolly mule-ears (Wyethia mollis) can grow in a variety of soils but tend to be most aggressive in heavy clay soils, making it well adapted to this site. It does well on the moderate to steep slopes characterizing this site (Matthews 1993). Woolly mule-ears (Wyethia mollis) and arrowleaf balsamroot (Balsamorhiza sagittata) are tolerant of drought conditions and both can be found throughout the successional process.

There is a strong possibility that fire will create a disturbance in this landscape. In late summer and fall, when woolly mule-ears (Wyethia mollis) and arrowleaf balsamroot (Balsamorhiza sagittata) dry out, there is an abundance of available fuel, which increases the chance of fire. When woolly mule-ears (Wyethia mollis) cures it is covered with a resin that makes it rather flammable (Matthews 1993), further increasing the likelihood of fire. Arrowleaf balsamroot has a “high fire resistance rating” and following a fire it will sprout from the caudex, but growth increases slowly until seed production (McWilliams 2002). There is some indication that woolly mule-ears (Wyethia mollis) will resprout after a fire (Matthews 1993).

In the short term, a fire on this site will create a patchy pattern on the landscape by decreasing the amount of large forbs like woolly mule-ears and arrowleaf balsamroot, and increasing the amount of grasses.

State and Transition Diagram



Natural State - State 1

This state represents the natural condition for this ecological site.

Robust forbs, scattered trees, and a few grasses - Community Phase 1.1

Moderately Deep Fragmental Slopes

Plant community 1.1 is the reference plant community for this site and is chiefly made up of vigorous forbs like woolly mule-ears (Wyethia mollis), arrowleaf balsamroot (Balsamorhiza sagittata) and bluntlobe lupine (Lupinus obtusilobus). Total canopy cover ranges from 30% and 50%, depending on the location.

Community Phase Pathway 1.1a

1.1a- A low intensity ground fire could easily burn across this site, removing existing vegetation and leaving opportunity for regeneration. Grasses would be the first to return, dominating the site until shrubs and forbs become more abundant. The majority of species growing here, including less abundant species, are well adapted to and even more vigorous after fire.

Robust forbs, scattered trees, and a few grasses Plant Species Composition:

Grass/Grasslike					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
1 -native grasses					1	55		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	10	0	4

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
		California brome	BRCA5	*Bromus carinatus*	0	12	0	3
		squirreltail	ELEL5	*Elymus elymoides*	1	18	1	6
		blue wildrye	ELGL	*Elymus glaucus*	0	15	0	5

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
2 -native forbs					**350**	**980**		
		arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	10	150	2	15
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	7	0	3
		Brewer's aster	EUBR12	*Eucephalus breweri*	0	8	0	2
		California stickseed	HACA	*Hackelia californica*	0	16	0	5
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	0	120	0	12
		mountain tarweed	MAGL2	*Madia glomerata*	0	6	0	2
		mountain monardella	MOOD	*Monardella odoratissima*	5	32	2	8
		sweetcicely	OSBE	*Osmorhiza berteroi*	0	9	0	3
		silverleaf phacelia	PHHA	*Phacelia hastata*	0	8	0	2
		hairy brackenfern	PTAQP2	*Pteridium aquilinum var. pubescens*	0	12	0	5
		woolly mule-ears	WYMO	*Wyethia mollis*	150	600	15	60

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
3 -native trees					**3**	**47**		
		California red fir	ABMA	*Abies magnifica*	3	45	5	15
		western white pine	PIMO3	*Pinus monticola*	0	2	0	1

Annual Production by Plant Type:

Plant Type	Annual Production (lbs/AC) Low	Representative Value	High
Grass/Grasslike	1	24	55
Forb	350	627	980
Tree	3	30	47
Total:	354	681	1082

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	2%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	5%	10%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	0%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	1%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	0%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	40%	55%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	34%	45%		**Tree Snags** per Acre**			
Surface Fragments > 3"	6%	20%		Hard Snags***			
Bedrock	0%	0%		Soft Snags***			
Water	0%	0%					
Bare Ground	22%	50%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	5%	10%	10%	20%				
> 0.5 - < 1 feet	0%	8%	20%	40%				
> 1 - <= 2 feet			5%	15%			0%	1%
> 2 - < 4.5 feet							1%	8%
> 4.5 - <= 13 feet							1%	6%
> 13 - < 40 feet							0%	1%

< 40 - >= 80 feet							2%	6%
> 80 - < 120 feet							2%	5%
>= 120 feet								

Overstory:
The overstory canopy includes western white pine (Pinus monticola) and California red fir (Abies magnifica). Trees growing here make <10% total canopy cover with <5% seedling recruitment into the understory.

Understory:
Woolly mule-ears (Wyethia mollis) and arrowleaf balsamroot (Balsamorhiza sagittata) are most common, but seem to be exclusive of each other. Bluntlobe lupine (Lupinus obtusilobus), mountain monardella (Monardella odoratissima), California stickseed (Hackelia californica), Sierra stickseed (Hackelia nervosa), dusky onion (Allium campanulatum), naked buckwheat (Eriogonum nudum), western sweetroot (Osmorhiza occidentalis), mountain tarweed (Madia glomerata) and hairy brakenfren (Pteridium aquilinum var. pubescens) are additional forbs that may grow on this site.

Grasses make up a very small amount of the overall cover, but species include squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), western needlegrass (Achnatherum occidentale) and California brome (Bromus carinatus). Scattered shrubs growing here include whitethorn ceanothus (Ceanothus cordulatus), roundleaf snowberry (Symphoricarpos rotundifolius), Sierra gooseberry (Ribes roezlii) and rubber rabbitbrush (Ericameria nauseosa ssp. nauseosa var. speciosa).

Patchy forbs with scattered trees and a few grasses - Community Phase 1.2
Plant community 1.2 is representative of how this landscape responds after a fire. Most of the woolly mule-ears (Wyethia mollis) and arrowleaf balsamroot (Balsamorhiza sagittata) would be top killed by a fire. By removing this vegetation, competition for space and resources is reduced. Squirreltail (Elymus elymoides) and blue wildrye (Elymus glaucus) will take advantage of this opportunity and regenerate quickly. Due to its relatively small size and low density, squirreltail (Elymus elymoides) is top killed by fire and will resprout from its root crown (Simonin 2001). Immediately following a disturbance such as fire, blue wildrye (Elymus glaucus) will increase dramatically, but it is a relatively short lived perennial and “will decrease in abundance and vigor after three to four years” (Johnson 1999). California brome (Bromus carinatus) has been a pioneering species on a variety of sites following low intensity fire. It is a prolific seed producer and responds well to disturbance but will decline over time (Tollefson 2006). It is expected that these grass species will be very abundant following a fire or other disturbance, but they will decrease relatively quickly, to allow for the regeneration of the previous plant community.

Roundleaf snowberry (Symphoricarpos rotundifolius) is sparsely present in plant community 1.1 but would likely increase after a fire. It is described as having “high resistance to fire” and characterized as a “survivor”. It is commonly one the first species to re-colonize after fire as it is generally only top killed and regenerates from rhizomes (McWilliams 2000).

Hairy brackenfern (Pteridium aquilinum var. pubescens) and field horsetail (Equisetum arvense) represent a small percentage of the total groundcover but respond favorably to fire. Field horsetail is adapted to severe fire, has deep rhizomes and regenerates quickly (Sullivan 1993). Hairy brackenfern has evolved with fire and, after fire, new sprouts are more vigorous (Crane 1990) than previous growth. In the short term, these adaptations may allow these species to increase in total biomass.

Community Phase Pathway 1.2a
1.2a – With time this site will move back toward plant community 1.1. Woolly mule-ears and arrowleaf balsamroot will increase and gradually shade out less competitive species. Species that are abundant in plant community 1.2 will remain in plant community 1.1 but in smaller quantities. Trees will remain a small percentage of the plant community but should fire remove competitive growth, seedlings will have a greater chance of establishing.

Overstory:

The overstory canopy includes western white pine (Pinus monticola) and California red fir (Abies magnifica). Trees growing here make <10% total canopy cover with <5% seedling recruitment into the understory.

Understory:
The understory of plant community 1.2 will be dominated by grasses like blue wildrye (Elymus glaucus) and california brome (Bromus carinatus). Total ground cover will be between 10-25 percent.

Ecological Site Interpretations

Animal Community:
This site can provide good foraging resource early in the growing season, for species like deer. When ground cover is high small mammals and rodents will use the site for shelter, therefore it can also be a good hunting ground for predatory birds.

Grazing animals will eat the leaves of woolly mule-ears (Wyethia mollis) and arrowleaf balsamroot (Balsamorhiza sagittata) in the early spring, but they quickly dry and become undesirable later in growing season. Grazers will also eat sunflower-like flower heads before the seeds ripen (McWilliams, 2002). Blue wildrye (Elymus glaucus) also provides fair forage value along with being a deep rooted drought tolerant perennial (Johnson, 1999).

Plant Preference by Animal Kind:

Hydrology Functions:
This site is in hydrologic soil group b.

Recreational Uses:
This area provides scenic vistas.

Wood Products:

Other Products:

Other Information:
Native Americans fermented the roots of woolly mule-ears (Wyethia mollis) in a pit with hot stones to make a sweet flavored food. Arrowleaf balsamroot (Balsamorhiza sagittata) was used by many Native American tribes for food and medicine. The young shoots were eaten in spring. The large tap root, bud stalks and seeds were eaten as well. It was used to treat a variety of ailments including stomachache, headache, wounds, insect bites, swellings, tuberculosis and whooping cough (McWilliams, 2002). Arrowleaf balsamroot is still valued for food and medicinal uses.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Very Deep Loamy Slopes	F022BI113CA	This is an open red fir forest found on very deep hydrothermally altered soils.
Loamy Seeps	R022BI209CA	This site is associated with wet seeps and springs in drainages and valley bottoms.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
There are two NRCS soil pits for this site with vegetation data.

789317
789175- Site location

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	4 E
Section:	15
Datum:	NAD83
Zone:	10
Northing:	4479536
Easting:	624772
General Legal Description:	The site is about 3,800 feet north-northeast from the Sulfur Works parking lot on Highway 89.
Latitude Degrees:	

Latitude Minutes:

Latitude Seconds:

Latitude Decimal:

Longitude Degrees:

Longitude Minutes:

Longitude Seconds:

Longitude Decimal:

Universal Transverse Mercator (UTM) system: NAD83104479536624772

Relationship to Other Established Classifications:

Other References:

Crane, M.F. 1990. Pteridium aquilinum. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory. [Available online: http://www.fs.fed.us/database/feis/]

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Kok, Luitjen Jakob de, (1989). Effects of atmospheric hydrogen sulfide on plant metabolism. Dissertation available on line at: http://irs.ub.rug.nl/ppn/056909357.

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Site Description Approval:

Author	Date	Approval	Date
Erin Hourihan, Marchel M. Munnecke	1/30/2008	Kendra E Moseley	2/17/2010

Site Description Revision Approval:

Author	Date	Approval	Date
Marchel Munnecke	1/1/2011	Kendra Moseley	1/25/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Glaciated Mountain Slopes

/ *Arctostaphylos nevadensis* /
(/ pinemat manzanita /)

Site ID: R022BI204CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 5 to 80, but generally 15 to 50.
Landform: Mountain slope.
Soils: Well drained, shallow to moderately deep soils over bedrock. Tephra or ash deposits are over or mixed with the colluvium or residuum. Ashy-skeletal, amorphic Xeric Vitricryands and Ashy-skeletal, glassy Lithic Vitricryands.
Temp regime: Cryic (but in some areas bordering on frigid).
MAAT: 38 to 43 degrees F (3.3 to 6.1 degrees C).
MAP: 55 to 117 inches (1,397 mm to 2,972 mm).
Soil texture: Ashy highly organic sand and gravelly ashy sandy loam. Surface fragments: 2 to 17 percent gravel.
Vegetation: Pinemat manzanita (Arcostaphlyos nevadensis), with scattered western white pine (Pine monticola), California red fir (Abies magnifica), mountain hemlock (Tsuga mertensiana) and Sierra lodgepole pine (Pinus contorta ssp. murrayana).

Physiographic Features

This ecological site is found on mountain slopes, knobs on glaciated lava flows and scoured glacial-valley walls and floors. Elevation ranges from 5,722 to 8,500 feet. Slopes generally range from 15-50%, however due to the locations of this site, slopes can range anywhere from 5 to 80% in some places.

Landform: (1) Mountain slope

	Minimum	Maximum
Elevation (feet):	5722	8500
Slope (percent):	5	80
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	High	Very high
Aspect:	South SouthEast SouthWest	

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 55 to 117 inches (1,397 mm to 2,972 mm) and the mean annual temperature ranges from 38 to 43 degrees F (3.3 to 6.1 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 65 to 195 days.

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

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	65	195
Mean annual precipitation (inches):	55.0	117.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the Terrracelake and Acroph soil components. The Terracelake soils are well drained and moderately deep with volcanic bedrock encountered between 20 to 40 inches. The Acroph soils are well drained and shallow with andesite, dacite or rhyodacite bedrock encountered between 10 to 20 inches. These soils have tephra or ash deposits over or mixed with the colluvium or residuum. The surface textures are ashy highly organic sand and gravelly ashy sandy loam, with loamy sand and sandy loam subsurface textures. These soils have 60 to 80 percent rock fragments in the lower horizons.

Terracelake taxonomic class: Ashy-skeletal, amorphic Xeric Vitricryands
Acroph taxonomic class: Ashy-skeletal, glassy Lithic Vitricryands

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

Map Unit Component percent
112 Terracelake 13
113 Acroph 3
113 Terracelake 35
137 Acroph 3
149 Acroph 4
150 Acroph 15
151 Acroph 20
152 Acroph 15

Parent Materials:
Kind: Tephra, Colluvium, Residuum
Origin: Volcanic rock

Surface Texture: (1) Ashy highly organic sand
(2) Gravelly ashy sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	2	17
Surface Fragments > 3" (% Cover):	0	1
Subsurface Fragments <=3" (% Volume):	20	45
Subsurface Fragments > 3" (% Volume):	5	35

Drainage Class: Well drained To Well drained
Permeability Class: Impermeable To Very slow

	Minimum	Maximum
Depth (inches):	10	40
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.5	6.7
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.9	2.6

Plant Communities

Ecological Dynamics of the Site

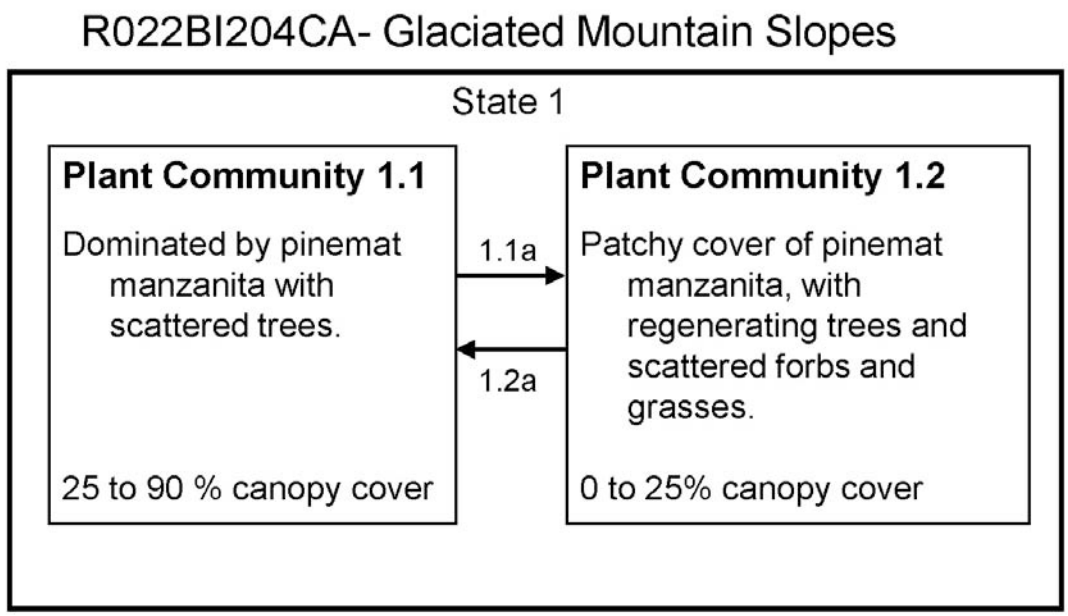
This ecological site is characterized by open slopes dominated by pinemat manzanita (Arctostaphylos nevadensis), with less than 25 percent tree cover. Tree species include California red fir (Abies magnifica), western white pine (Pinus monticola), mountain hemlock (Tsuga mertensiana) and Sierra lodgepole pine (Pinus contorta ssp. murrayana).

The soils on this site are limited by bedrock contact between 10 to 40 inches and have very coarse textures with very low water holding capacities. In addition, this site is often situated on southern slopes and/or on convex topographies that drain rather that hold water. Trees do not establish well on these sites because they are unable to tap into deeper water sources and the seasonal water supply is quickly drained away, transpired or evaporated.

Pinemat manzanita is characteristic of dry cold sites on well drained soils. Pinemat manzanita is considered to be important for soil stabilization, especially on steep slopes, and is known to recover quickly following a disturbance such as fire. Reproduction techniques employed by pinemat manzanita include sprouting and establishing from seed. Seeds require treatment before germination, with digestion by animals or fire cracking the seed coat (Hurteau, 2009). Hurteau reports that pinemat manzanita has an obligate relationship with mycorrhizal fungi. These fungi are important for water and nutrient uptake. Expanded root systems provided by mycorrhizal fungi help plants extract water from the soil, especially during drought conditions. Plants assist the fungi by providing carbohydrates from their photosynthetic processes. The research is unclear on whether mycorrhizal fungi in sites with a well established shrub field will aid or inhibit conifer regeneration.

Extensive cover of pinemat manzanita can create competition for water in the upper soil profile, especially during the dry summer months (Rose, 2003). This does not affect trees already established on the site as they are deeper rooted and able to utilize moisture stored deeper in the profile, but it is problematic for seedling establishment. Initially a high percentage of shrub cover may aid seedling germination by providing shelter and protection. Ultimately, however, very few seedlings will persist on a shrub dominated site due to increased competition for soil moisture. A combination of competition from the shrub component and relatively shallow soil will prevent this site from becoming forested.

<u>State and Transition Diagram</u>



<u>Natural State - State 1</u>

This state represents the natural state and conditions for this ecological site. There is not an altered state.

Pinemat manzanita dominated slope with scattered trees - Community Phase 1.1

Glaciated Mountain Slopes

Community phase 1.1 is the reference community for this ecological site. It consists of scattered mature trees with an extensive understory of pinemat manzanita (Arcostaphlyos nevadensis). Tree species include western white pine (Pine monticola), California red fir (Abies magnifica), mountain hemlock (Tsuga mertensiana) and Sierra lodgepole pine (Pinus contorta ssp. murrayana).

Large scale disturbances do not regularly occur on this site, creating the potential for plant community 1.1 to remain relatively unchanged for decades and possibly centuries.

Community Phase Pathway 1.1a

1.1a- A lighting strike could burn small areas of pinemat manzanita or strike individual trees, creating open areas and an opportunity for seedling and shrub regeneration.

Pinemat manzanita dominated slope with scattered trees Plant Species Composition:

Grass/Grasslike					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
1 -Grass/ grasslike					0	10		

	western needlegrass	ACOC3	*Achnatherum occidentale*	0	5	0	2
	sedge	CAREX	*Carex*	0	1	0	1
	squirreltail	ELEL5	*Elymus elymoides*	0	4	0	2

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
2 -Forbs					**1**	**7**		
		rockcress	ARABI2	*Arabis*	0	2	0	1
		buckwheat	ERIOG	*Eriogonum*	1	5	1	3

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
3 -Shrubs					**250**	**560**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	250	550	35	90
		oceanspray	HODI	*Holodiscus discolor*	0	10	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	High	Foliar Cover Percent Low	High
4 -Tree					**0**	**35**		
		California red fir	ABMA	*Abies magnifica*	0	20	0	5
		Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	3	0	1
		western white pine	PIMO3	*Pinus monticola*	0	8	0	2
		mountain hemlock	TSME	*Tsuga mertensiana*	0	4	0	1

Annual Production by Plant Type:

Plant Type	Annual Production (lbs/AC) Low	Representative Value	High
Grass/Grasslike	0	5	10
Forb	0	2	7
Shrub/Vine	250	404	560
Tree	0	15	35
Total:	250	426	612

Structure and Cover:

Ground Cover

Vegetative Cover	Minimum	Maximum
Grass / Grasslike	0%	5%
Forb	0%	5%
Shrub/ Vine	35%	90%
Tree	1%	25%
Non-Vascular Plants	0%	2%
Biological Crust		
Non-Vegetative Cover	**Minimum**	**Maximum**
Litter	35%	80%
Surface Fragments > 0.25" and <= 3"	0%	50%
Surface Fragments > 3"	0%	35%
Bedrock	0%	10%
Water	0%	0%
Bare Ground	0%	10%

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	1%	%	%				
> 0.5 - < 1 feet	0%	9%	0%	3%				
> 1 - <= 2 feet					35%	90%	0%	1%
> 2 - < 4.5 feet							0%	1%
> 4.5 - <= 13 feet							0%	4%
> 13 - < 40 feet							0%	2%
< 40 - >= 80 feet							5%	15%
> 80 - < 120 feet								
>= 120 feet								

Overstory:

Mature trees are scattered around the site, with less than 25 percent total canopy. Representative overstory canopy cover is: California red fir (Abies magnifica), 3 percent; western white pine (Pinus monticola), 4 percent; mountain hemlock (Tsuga mertensiana), 2 percent; and Sierra lodgepole pine (Pinus contorta var. murrayana), 1 percent.

Understory:

The understory is dominated by pinemat manzanita (Arcostaphylos nevadensis) with about 60 percent cover. It is separated by patches of open ground with a light cover of grasses and forbs growing mostly within the pinemat manzanita canopy. The herbaceous community accounts for about 8 percent total cover.

Patchy cover of pinemat manzanita with regenerating shrubs and trees - Community Phase 1.2

Community phase 1.2 exists after a disturbance creates openings in the shrubs for regrowth. If the correct conditions were present, a fire could remove a large amount of the vegetation on this site. Pinemat manzanita is known to respond favorably following a fire. Heavy recruitment from seed has been documented after fire (Howard 1993). This suggests that seeds lay dormant in the soil until a fire occurs, prepping the seed for germination and providing an opening for establishment. Species richness could increase following a fire since seeds stored in the soil would take advantage of reduced competition from the shrubs.

Community Phase Pathway 1.2a

1.2a- With time pinemat manzanita re-colonizes open patches on the ground. Trees establish where the opportunity exists.

Overstory:

Mature trees remain scattered around the site, but some may have been removed by fire, reducing the canopy cover slightly. Species include California red fir (Abies magnifica), western white pine (Pinus monticola), mountain hemlock (Tsuga mertensiana) and Sierra lodgepole pine (Pinus contorta var. murrayana). Tree regeneration will be relatively slow due to limited seed sources availability and competition for resources with pinemat manzanita.

Understory:

Large patches of regenerating pinemat manzanita (Arcostaphylos nevadensis) and increased herbaceous cover follow disturbance.

Ecological Site Interpretations

Animal Community:

The older leaves of pinemat manzanita are not considered to be a preferred forage plant by any species of wildlife or livestock. The fruit however is eaten by black bear, deer, coyote, and various birds and rodents.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:

The prostrate growth form and strong branches of pinemat manzanita make walking across this site difficult and prevent sites like this from becoming a preferred recreation location.

Wood Products:
Pinemat manzanita branches can be used to make various wood tools.

Other Products:
Ethnobotanical uses for pinemat manzanita include a treatment for diarrhea and poison oak (Toxicodendron diversiloba)poisoning.

Other Information:
Dried pinemate manzanita berries are a potential food source for humans and dried leaves can be smoked like a type of tobacco.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid And Cryic Gravelly Slopes	F022BI115CA	This site has similar species but is found on the adjacent deeper soils with greater than 25 percent tree cover.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Bouldery Glacially Scoured Ridges Or Headlands	F022BI102CA	This site has similar species but is a forest site with higher production and diversity.

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
There are four NRCS vegetation plots used to describe this ecological site.

789314- Acroph modal pit- higher elevation
789318
789322- Terracelake modal pit
789339

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	5 E
Section:	17
Datum:	NAD83
Zone:	10
Northing:	4480405
Easting:	630803
General Legal Description:	The site location is about 1 mile east north east of the Kings Creek Picnic Area
Latitude Degrees:	
Latitude Minutes:	

Latitude Seconds:

Latitude Decimal:

Longitude Degrees:

Longitude Minutes:

Longitude Seconds:

Longitude Decimal:

Universal Transverse Mercator (UTM) system: NAD83104480405630803

Relationship to Other Established Classifications:

Other References:

Howard, Janet L. 1993. Arcostaphylos nevadensis. In: Fire Effects Information System [online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station Fire Science Laboratory. Available: http://www.fs.fed.us/database/feis/ [2009, July 21].

Hurteau, Matthew D. Plant Guide Pinemat Manzanita. USDA-NRCS National Plant Data Center. [online] Available: http://www.plants.usda.gov/plantguide/docpg_arne.doc [2009, July 22]

Phillips, Jonathon D, Alice V. Turkington and Daniel A. Marion. Weathering and vegetation effects in early stages of soil formation. Catena 72: 21-28. 2008. [online] http://www.sciencedirect.com

Pinder J.E.III, G. C. Kroh, J.D. White and A.M. Basham May. The relationship between vegetation type and topography in Lassen Volcanic National Park. Plant Ecology 131:17-92. 1997.

Rose, K. L., R. C. Graham and D. R. Parker. Water source utilization by Pinus jeffreyi and Arctostaphylos patula on thin soils over bedrock. Oecologica 134:46-54 (2003).

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
		Kendra Moseley	3/4/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Cirque Floor

/ / *Lupinus obtusilobus - Eriogonum umbellatum*
(/ / bluntlobe lupine - sulphur-flower buckwheat)

Site ID: R022BI205CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 1 to 35, but generally 2 to 15.
Landform: Ground moraines on cirque floors and lava plateaus.
Soils: Well drained, moderately deep, and formed in glacial till from volcanic rock. Dense till occurs between 20 to 40 inches.
Temp regime: Cryic.
MAAT: 38 to 41 degrees F (3 to 5 degrees C).
MAP: 81 to 125 inches (2,057 to 3,175 mm).
Soil texture: Gravelly ashy sandy loam
Surface fragments: 20 to 60 percent gravels and 0-5 percent cobbles.
Vegetation: Mixed forbs often dominated by bluntlobe lupine (Lupinus obtusilobus) with scattered mountain hemlock (Tsuga mertensiana), Western white pine (Pinus monticola) and California red fir (Abies magnifica).
Note: Tree growth restricted by dense till layer and cold air drainage.

Physiographic Features

This ecological site is situated on ground moraines, cirque floors, and lava plateaus ranging from 6,970 to 9,160 feet in elevation. Slopes range from 1 to 35 percent however slopes typically are 1 to 15 percent.

Landform:	(1) Cirque
	(2) Ground moraine
	(3) Lava plateau

	Minimum	Maximum
Elevation (feet):	6970	9160
Slope (percent):	1	35
Water Table Depth (inches):	60	
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	Medium
Aspect:	North East West	

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 81 to 125 inches (2,057 to 3,175 mm) and the mean annual temperature ranges from 38 to 41 degrees F (3 to 5 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 65 to 190 days.

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

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	65	190
Mean annual precipitation (inches):	81.0	125.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is not influenced by water features.

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the Xeric Vitricryands, cirque floor soil component. These soils are well drained, moderately deep, and formed in glacial till from volcanic rock. Dense till is encountered between 20 to 40 inches. The surface texture is a gravelly ashy sandy loam with similar subsurface textures. The AWC (available water capacity) is 1.74 to 4.54 inches in the upper 20 to 40 inches of soil (low to very low). Permeability is very rapid to rapid in the upper horizons and very slow through the dense till.

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

Map Unit Component / Percent
114 Xeric Vitricryands, cirque floor / 2
115 Xeric Vitricryands, cirque floor / 5
116 Xeric Vitricryands, cirque floor / 15
136 Xeric Vitricryands, cirque floor / 15
144 Xeric Vitricryands, cirque floor / 55

Parent Materials:
Kind: Subglacial till
Origin: Volcanic rock

Surface Texture: (1)Very gravelly ashy sandy loam
Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	20	60
Surface Fragments > 3" (% Cover):	0	5
Subsurface Fragments <=3" (% Volume):	15	40
Subsurface Fragments > 3" (% Volume):	0	70

Drainage Class: Well drained To Well drained
Permeability Class: Very rapid To Very slow

	Minimum	Maximum
Depth (inches):	20	40
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		

Soil Reaction (1:1 Water):	6.0	7.0
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.74	4.54

Plant Communities

Ecological Dynamics of the Site

This ecological site is found on moderately deep soils on cirque floors. Bluntlobe lupine (Lupinus obtusilobus) dominates this site, reaching nearly 50% cover in some areas. Other grasses, grass-likes, and forbs equal about 10 to 15% of the total cover. There is low cover from scattered mountain hemlocks (Tsuga mertensiana).

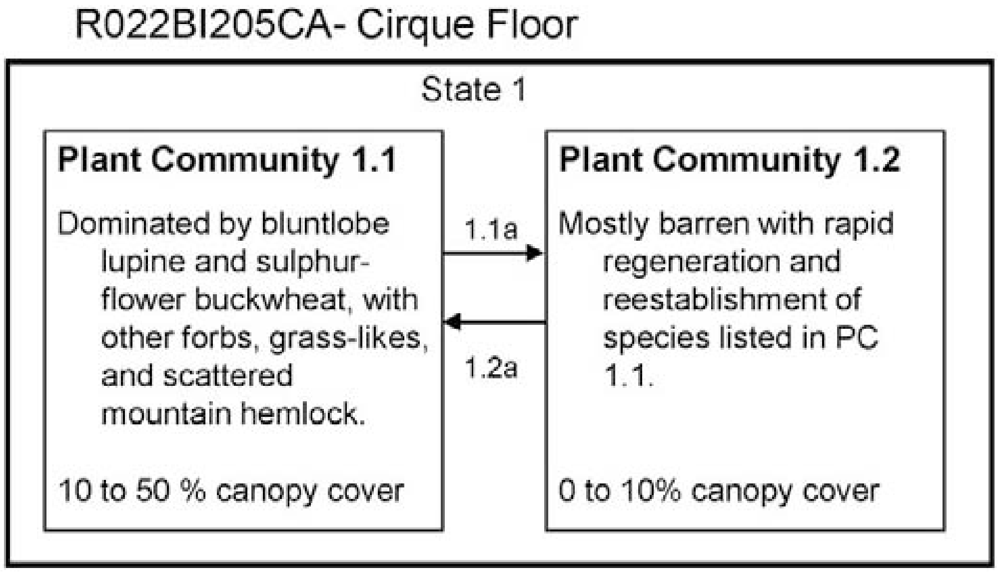
Late snow melt and cool temperatures year-round create conditions for a short growing season, and therefore species that grow here must be capable of withstanding these harsh conditions. This site is situated in lower landform positions where cool air drains down from the upper elevations. This cold air can pool in flatter basins or depressions, causing frost pockets during the growing season. Severe frost can cause mortally of mountain hemlock (Tsuga mertensiana), western white pine (Pinus monticola) and California red fir (Abies magnifica) seedlings. In addition, dense till is encountered at depths of 20 to 40 inches, which restrict deep root development.

Single and small clumping trees are scattered throughout the site but canopy cover is less than 10 percent. Historically it is likely this site remained in the forb and grass state (Community 1.1) for hundreds of years. Disturbances combined with ideal climatic conditions would allow the site to move to a new plant community phase (Community 1.2). Ordinary environmental conditions do not favor seedling establishment on this site. Mountain hemlock can exist in a variety of successional states, as minor or dominate species, as well as a pioneering species on certain sites (Tesky, 1992).

The life forms growing here are well adapted to the harshness of this site. Perennial plants are small, close to the ground, and often widely spaced (Billings and Mooney 1968). The majority of biomass from the plant community on this site is located underground, allowing the plants a large area to store reserves (Billings and Mooney, 1968) for use throughout the winter. The short growing season and high elevation means the plants will break dormancy as early as possible and maintain an increased photosynthetic rate while conditions are favorable, before the onset of dormancy. Plants are able to survive drought conditions brought on by frozen soils and dry winds during the winter months by decreasing water potentials and closing stomata (Billings and Mooney 1968).

The fire interval for this site is poorly documented but is estimated to be between 400 to 800 years (Tesky, 1992) for the mountain hemlock zone. The fire interval may be longer or even absent due to the deficiency of established overstory and lack of available fuel.

State and Transition Diagram



Natural State - State 1

Low growing forb community with some grasses and scattered trees - Community Phase 1.1

Cirque Floor

Total canopy cover is between 10% and 50%, depending on the location. Often 80% to 90% of the total canopy is bluntlobe lupine (Lupinus obtusilobus). Other forbs present include various species of buckwheat (Eriogonum spp.), Davis' knotweed (Polygonum davisiae), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), and occasionally purple mountainheath (Phyllodoce breweri). Squirreltail (Elymus elymoides), sedge (Carex spp.), and rush (Juncus spp.) are present in small amounts. Mountain hemlock (Tsuga mertensiana), western white pine (Pinus monticola) and California red fir (Abies magnifica) are present in trace amounts in some areas.

Lupine (Lupinus spp.) species commonly have a symbiotic relationship with nitrogen-fixing bacteria. These bacteria influence the site by increasing nitrogen levels and soil organic matter (Titus 2009). Studies have shown lupine can have facultative or inhibitory affects on other species trying to inhabit a site (Titus 2009). It is likely bluntlobe lupine was a pioneering species on this site and that it will persist as the dominant species throughout the successional process, due to its affect on soil fertility.

Grasses are present in negligible amounts. Sedges and rushes are slightly more common; they particularly take advantage of the soil moisture provided during and after snowmelt. Trees are a minor component of this plant community and are present in small patches scattered around the site, ranging from 2% to 5%. The relatively small number of trees on this site will remain viable through vegetative reproduction, also called layering. Layered saplings grow in the shade and protection of the parent tree, which provides nutrients through its established root system (Tesky, 1992). This site will be dominated by forbs for hundreds of years should conditions not be conducive to seedling establishment. Mountain hemlocks are a minor climax species in this plant community phase.

This site is an important high elevation summer grazing resource for wildlife like deer and is a favored habitat of rodents. The tree species provide shelter and protection for birds and larger wildlife.

Community Phase Pathway 1.1a

This community can sustain itself without large scale disturbances, however small scale disturbances such as rodent activity, small single tree lighting strikes, or snow creep can create openings for regeneration (Community 1.2).

Low growing forb community with some grasses and scattered trees Plant Species Composition:

Grass/Grasslike

					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**
1 -naitve grasses/grass likes					**7**	**33**		
		Ross' sedge	CARO5	*Carex rossii*	4	12	1	3
		squirreltail	ELEL5	*Elymus elymoides*	0	6	0	2
		Parry's rush	JUPA	*Juncus parryi*	3	15	1	5

Forb

					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**
2 -native forbs					**200**	**829**		
		Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0	6	0	2
		marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	0	9	0	3
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	50	800	3	50
		Davis' knotweed	PODA	*Polygonum davisiae*	0	2	0	2
		Shasta knotweed	POSH	*Polygonum shastense*	0	4	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
3 -native trees					**0**	**32**		
		California red fir	ABMA	*Abies magnifica*	0	5	0	2
		western white pine	PIMO3	*Pinus monticola*	0	13	0	4
		mountain hemlock	TSME	*Tsuga mertensiana*	0	15	0	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	7	20	33
Forb	200	406	829
Tree	0	19	32
Total:	207	445	894

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	1%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	2%	15%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	0%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	1%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	0%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	18%	78%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	20%	60%		**Tree Snags** per Acre**			
Surface Fragments > 3"	0%	5%		Hard Snags***			
Bedrock	0%	0%		Soft Snags***			
Water	0%	0%					
Bare Ground	0%	16%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full

integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	1%	8%	2%	12%				
> 0.5 - < 1 feet	0%	2%	10%	50%				
> 1 - <= 2 feet							0%	2%
> 2 - < 4.5 feet							0%	4%
> 4.5 - <= 13 feet							1%	5%
> 13 - < 40 feet								
< 40 - >= 80 feet								
> 80 - < 120 feet								
>= 120 feet								

Overstory:
Trees account for a small amount of this plant community. Scattered trees and/or small clumps of mountain hemlock (Tsuga mertensiana) can be found on and around the site. Other species include California red fir (Abies magnifica) and western white pine (Pinus monticola). Total tree canopy cover ranges from 2% to 5%.

Understory:
Vegetative cover is largely made up of bluntlobe lupine (Lupinus obtusilobus) with lesser amounts of marumleaf buckwheat (Eriogonum marifolium), Davis' knotweed (Polygonum davisiae), Shasta knotweed (Polygonum shastense), Mt. Hood pussypaws (Cistanthe umbellata var. umbellate), Ross' sedge (Carex rossii), Parry's rush (Juncus parryi), purple mountainheath (Phyllodoce breweri), and squirreltail (Elymus elymoides). Cover and production vary greatly, depending upon the abundance of bluntlobe lupine.

Mostly barren with some forbs and grasses - Community Phase 1.2
This plant community is made up of bluntlobe lupine (Lupinus obtusilobus), pussypaws (Cistanthe umbellata var. umbellata), various buckwheats (Eriogonum spp.), and trace amounts of grasses and grass likes. Species are represented in smaller quantities and are much less productive than for Community 1.1. The landscape appears to be mostly barren with existing vegetation being widely spread across the site. Total canopy cover is between 0% and 10%.

Small scale disturbances like rodent burrowing, snow creep and severe frost could reduce the

canopy cover from Community 1.1. The small gaps opened by such disturbances provide opportunities for regeneration.
A particularly dry year with less than normal snow pack could also reduce the plant cover from Community 1.1. Plants would remain sparse until the conditions were conducive for an increase in biomass production and a pulse of recruitment.

Assuming that succession occurs along an elevational gradient, higher elevation sites should be more homogeneous than lower sites (Dlugosh, 1999), especially with time. Therefore, immediately following a disturbance this site will increase in biodiversity, with a majority of the species from plant Community 1.1 being present. Over the long term however, heterogeneity is expected to decrease due to a variety of influencing factors (Dlugosh, 1999). This means that, with time, the variety of plant species present will decrease and the abundance of one or two will increase.

Community Phase Pathway 1.2a
Regeneration would likely come from rodent or wind dispersed seed from species already present.
Time and growth of the perennial cover will shift this community toward plant Community 1.1.

Overstory:
Trees are a small component of this plant community. Species can include mountain hemlock, California red fir, and western white pine. Seedling recruitment into this stand is very slow. Total canopy cover ranges from 0% to 5%.

Understory:
Large open areas void of vegetation are broken up by the occasional forb or graminoid. Species include bluntlobe lupine, buckwheat, knotweed, and mountain heath. Sedges, rushes and grasses are also present. Overall canopy cover is between 0% and 10%.

Ecological Site Interpretations

Animal Community:
The plant communities growing on this site provide habitat and shelter for large wildlife as well as birds. The forbs and grasses provide a nutritious summer grazing resource, even in limited quantities. High elevation sites with limited stands of mountain hemlock (Tsuga mertensiana) are home to Clark's nutcracker, deer mice and various species of chipmunks. The upper limits of this ecological site are home to gray-crowned rosy finch, pika, and the golden mantled ground squirrel.

Gray-crowned rosy finch use Lassen Volcanic National Park as a winter range. They eat mostly insects and some vegetation while commonly foraging among low-growing plants, in snow fields, or in and among conifers.

A variety of invertebrates also use this site, the most common of which is the California tortoise shell butterfly. This orange-brown butterfly can regularly be seen by the thousands around the peaks of mountains.

Plant Preference by Animal Kind:

Hydrology Functions:

This site is in the soil hydrologic group b.

Recreational Uses:

Hiking and photography opportunities are available on this site.

Wood Products:

Not applicable

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Cryic Coarse Loamy Colluvial Slopes	F022BI104CA	This is a mountain hemlock forest.
Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes	F022BI111CA	This is a sub-alpine mixed-conifer forest.
Upper Cryic Slopes	F022BI124CA	This is a tree-line mountain hemlock-whitebark pine forest.
Alpine Slopes	R022BI207CA	This is an alpine range site found on steeper slopes and deeper soils.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:

This site has been correlated with the following states:
CA

Inventory Data References:

There are two points of data collection for this site represented by NRCS vegetation plots:

789254
789283- site location

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	4 E
Section:	11
Datum:	NAD83
Zone:	10
Northing:	4480770
Easting:	625872

General Legal Description:	The site location is about 900 feet north of the Bumpass Hell parking lot, off of HW 89.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104480770625872

Relationship to Other Established Classifications:

Other References:

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Taylor, Alan H. 1995. Forest Expansion and Climate Change in the Mountain Hemlock (Tsuga mertensiana) Zone, Lassen Volcanic National Park, California, U.S.A. Artic and Alpine Research, Vol. 27, No. 3, 1995, pp. 207-216.

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Tesky, Julie L. 1992. Tsuga mertensiana. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
[Available online: http://www.fs.fed.us/database/feis/] (2008, June 16).

Woo, Ming-ko, Philip Marsh, and John W. Pomeroy; 2000. Snow, frozen soils, and permafrost hydrology in Canada, 1995-1998. Hydrological Processes 14, 1591-1611 (2000). [Available online: http://www3.interscience.wiley.com]

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
		Kendra Moseley	3/4/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Cryic Lacustrine Flat

/ / *Carex utriculata* - *Carex nebrascensis*
(/ / Northwest Territory sedge - Nebraska sedge)

Site ID: R022BI206CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by a small meandering Rosgen “E” type channel
Slopes: 0 to 4 percent
Landform: Relict glacial lakes
Soils: Very deep glaciolacustrine deposits; varying depths of organic horizons; stratified layers of buried A horizons
Temp regime: Cryic
MAAT: 3.3 to 5 degrees C (38 to 41 degrees Fahrenheit)
MAP: 57 to 111 inches (1,448 to 2,819 mm)
Soil texture: Silty clay loam or organic material
Surface fragments: 0 to 25 percent gravel
Vegetation: Several montane meadow plant communities dominated by graminoid species.

Physiographic Features

This site is located on relic glacial lakes in wide valleys between 6,280 and 7,510 feet in elevation. Slopes are generally 0 to 4 percent, but may reach up to 8 percent.

Landform: (1) Glacial lake (relict)

	Minimum	Maximum
Elevation (feet):	6280	7510
Slope (percent):	0	8
Water Table Depth (inches):	0	60

Flooding:		
Frequency:	Rare	Frequent
Duration:	Long	Long
Ponding:		
Depth (inches):	0	10
Frequency:	Rare	Frequent
Duration:	Long	Very long
Runoff Class:	Very high	Very high
Aspect:	South No Influence on this site	

Climatic Features

This site receives between 57 to 111 inches (1,448 to 2,819 mm) of precipitation a year (PRISM data). The majority of this precipitation falls in the form of snow. Approximately 80% of the total precipitation falls from October through April; July and August have the lowest levels of monthly precipitation. The mean annual air temperature ranges from 38 to 41 degrees F (3.3 to 5 degrees C). The frost free (>32F) period is from 50 to 85 days, and the freeze free (>28F) period is from 60 to 110 days.

There are no representative climate stations for this site. The nearest is Manzanita Lake (5,800 feet in elevation), approximately 10 miles northwest to most of this site.

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	60	110
Mean annual precipitation (inches):	57.0	111.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

The majority of this site is classified as a Palustrine Emergent Wetland, with a small Rosgen "E" type channel meandering through the site. This area will pond and flood during and after spring snow melts.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Riverine	Upper Perennial	Unknown
	Palustrine	N/A	Emergent Wetland

Stream Types: (RosGen Narrative)

E6, E6b-This stream is a single thread channel that is slightly entrenched, it typically gets out of bank two years out of three. It has a very low width to depth ratio and very high sinuosity. Its slope is typically less than 2 percent, but it can range from 2 to 3.9 percent (b modifier). It is a silt/clay-bottom stream.

Representative Soil Features

This ecological site has been correlated with very deep, poorly and very poorly drained soils that formed primarily in glaciolacustrine deposits from volcanic parent material. These soils formed in glacial-valley floors, with minor sediment re-deposition from small stream channels.

These soils have had several episodes of burial, indicated by the stratification in the profiles. There are 1 to 2 sequences of buried soils. The buried surface soils have dark silty clay loam textures and 10 to 30 percent organic matter. At the bottom of the buried soils, are coarse sandy loam textures. The progression of lake filling, channel migrations and flood events may be responsible for these layers. There is an uneven distribution of water in the soil layers due to the soil texture. In October the silty clay loam textures were moist at the surface and the lower depths. Artesian water tables were encountered in the lower coarse-textured horizons that upwelled when the silty clay loam "cap" was opened.

The water table is at or above the surface after snow melt, dropping through summer to about 20 inches below surface in the lowest and -wettest areas to around 55 inches in the higher positions.

These soils are in the cryic temperature regime, characterized by a mean annual soil temperature below 8 degrees Celsius and a difference in mean annual summer to winter temperatures of less than 6 degrees. Other variables to affect this regime are soil saturation and the presence or absence of an O horizon. For a complete description of the cryic temperature regime please refer to the Keys to Soil Taxonomy (USDA, 2010).

The two taxonomic soil classes associated with this site are:
1. Ashy skeletal, glassy, nonacid Aquandic Cryaquents
2. Loamy over ashy or ashy pumiceous, aniso, isotic over glassy, nonacid, Vitrandic Cryofluvents.

The Aquandic Cryaquents have silty clay loam surface textures with gleyed soil colors at the surface, indicating prolonged periods of saturation. These soils have a buried A horizon at 20 to 28 inches. There is 5 to 10 percent organic matter in the surface horizon and 10 to 30 percent organic matter in the buried surface horizon. The buried surface horizon has a mucky silty clay loam texture. The upper silty clay loam horizons and the mucky silty clay loams are above very gravelly ashy clay loam horizons. An artesian water table was found at a depth of 28 inches (October 10, 2006) and filled the pit to 20 inches. The surface pH was 6.5 and remained relatively consistent though the profile.

The Vitrandic Cryofluvents have an organic horizon from 0 to 3 inches, a gravelly ashy sandy loam from 3 to 8 inches, and a very gravelly ashy coarse sand from 8 to 11 inches. From 11 to 13 inches is a buried A horizon with a mucky clay loam texture. Silty clay loams and gravelly ashy coarse sandy loam horizons are above another buried A horizon at 36 to 55 inches. The lower buried horizon has an ashy silt loam texture with extremely gravelly coarse sand below. An artesian water table was encountered at 55 inches and filled the pit to 8 inches. The surface pH was 6.5 in the organic horizon but dropped to 5.2 in the A horizon, increasing slightly with depth to a pH of 6.5 at 36 inches.

Aquandic Cryaquents soils have a higher water table and a slightly lower position within the meadow, so they subsequently pond and/or flood for longer durations. Both of these soils support the Northwest Territory Sedge Community (PCC1) and Nebraska Sedge Community (PCC2). Other soils are present in these meadows but are considered minor components or are too limited in distribution to warrant description for this project.

This ecological site is associated with the following map units and soil components in the Lassen Volcanic National Park Soil Survey (CA789):

Map Unit, Component, Percent
139 Aquandic Cryaquents, 15
139 Vitrandic Cryofluvents, 3
163 Aquandic Cryaquents, 30
163 Vitrandic Cryofluvents, 65
175 Vitrandic Cryofluvents, 15
175 Aquandic Cryaquents, 3

Parent Materials:

Kind: Glaciolacustrine deposits
Origin:

Surface Texture:

(2) Silty clay loam

Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	25

	Minimum	Maximum
Surface Fragments > 3" (% Cover):	0	0
Subsurface Fragments <=3" (% Volume):	0	45
Subsurface Fragments > 3" (% Volume):	0	5

Drainage Class: Poorly drained To Very poorly drained
Permeability Class: Very slow To Slow

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.1	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	5.4	8.4

Plant Communities

Ecological Dynamics of the Site

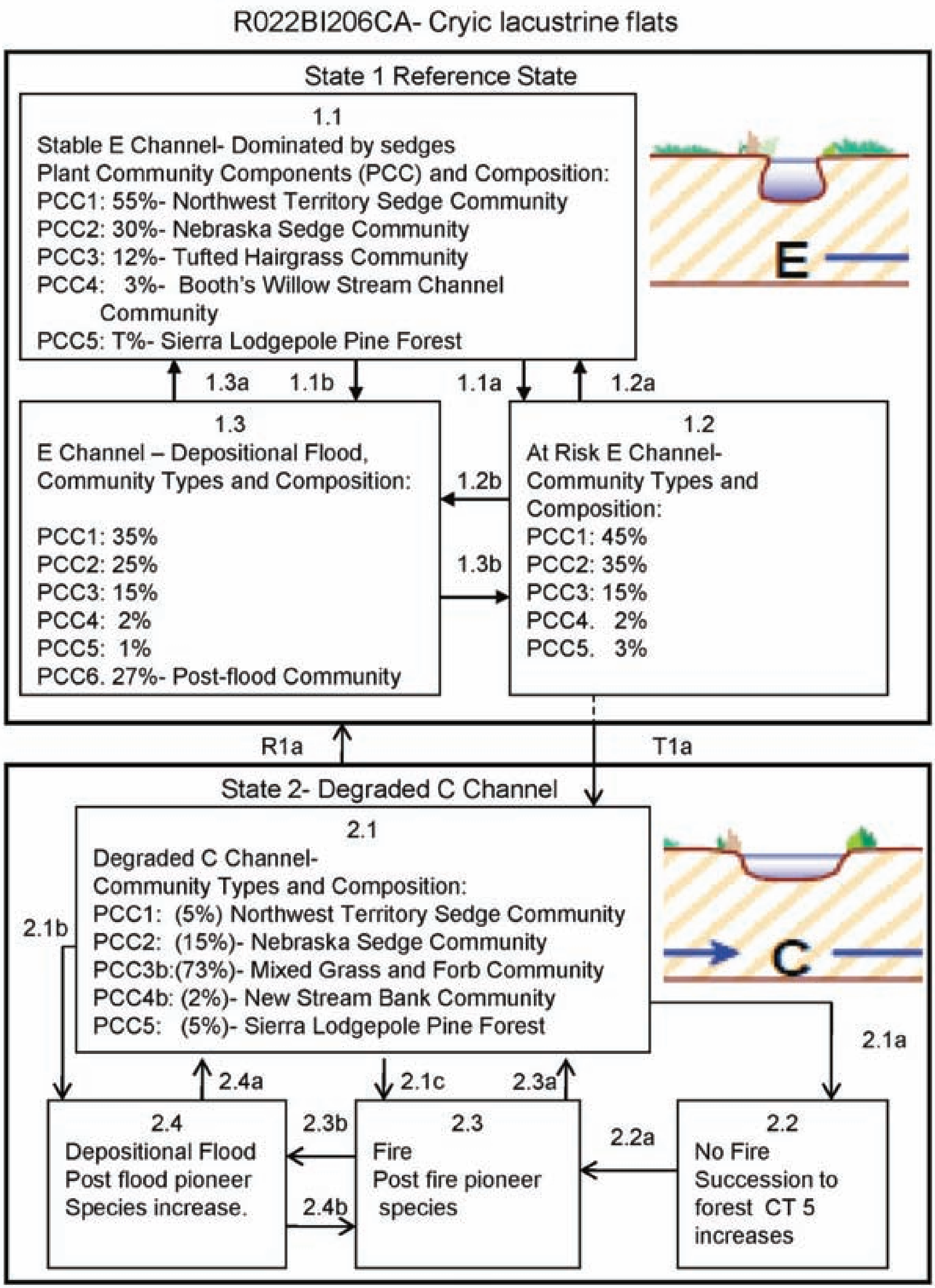
This ecological site is found on glacial valley floors with low relief. Small meandering channels that weave their way through the meadows regularly overflow their banks. Several different plant communities are found within theses meadows. Their presence and distribution are directly linked to the hydrology of the meadows and the stream system. In pristine properly functioning systems, these meadows have an "E" type channel (Rosgen stream classification system). Thick mats of sedge roots stabilize channel banks and help maintain a low channel width-to-depth ratio and high stream sinuosity. Large portions of these meadows remain flooded or saturated to the surface for most of the summer.

"E" type channels are often considered stable systems but they respond quickly to disturbances, which may cause channel incision or bank erosion. This can shift an "E" type channel towards a "C" type channel. Upper Kings Meadow, Lower Kings Meadow and Dersch Meadow are included within this ecological site. The “E” channel concept is based on Upper Kings Meadow, with an educated assumption that Dersch Meadow has started to shift towards a “C” type channel. Limited vegetation and stream channel data has been collected for this ecological site. Standard protocols for collecting data on riparian ecological sites are currently being developed. In the future, stream and valley cross sections, stream bed particle size, and channel sinuosity will be measured to classify the steam type. This data will help determine the status of the stream channel, in relation to steam succession. Vegetation and soil data will be collected along representative zones along the cross section, such as the floodplain or terrace. If possible, this data could be collected in the future and used to fully describe this riparian ecological site.

This ecological site is a complex of riparian plant community components that are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community component composition as a result of disturbance, rather than focusing on the succession of one plant community.

Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram



Reference State - State 1

State 1 represents the reference state for this meadow system, a stable "E" type channel. The reference state is similar to the historic state, but may have been lightly affected by grazing and road construction. In a stable "E" channel, a stream's velocity is balanced with its sediment transport capability. The stream banks are stable and protected with a dense mat of sedge roots and rhizomes. These channels are deeper than they are wide and have a high sinuosity. The stream frequently overtops the channel and floods onto the expansive floodplain.

Stable E Channel - Community Phase 1.1

Reference State

This community has developed with a stable "E" channel system that seasonally floods and ponds. The area has a high water table throughout most of the summer. Rhizomatous peat-forming sedges dominate this site because they can withstand long durations of total inundation. In summer they rely upon the shallow water table to survive. Even though these are peat-forming sedges there is not a thick peat layer in these meadows. Since the water table drops to below 20 inches at the end of summer, it is likely the organic matter decomposes. Several plant community components are associated with this community phase and their distribution is related to water table depth. The most hydrophytic plant communities are found along the stream channel and in the lowest positions of the meadow. Drier plant communities are found as the meadow slopes upward.

Plant Community Components and Composition:

PCC1: 55%
Northwest Territory Sedge Community
This community is found in the wettest zone of the meadow. Northwest Territory sedge (Carex utriculata) and/or blister sedge (Carex vesicaria) provide 50 to 80 percent cover in this community, with some mosses and organic matter on the surface. These sedges are able to withstand total inundation for several months, and produce dense rhizamotous root mats. Annual production ranges from 919 to 1,540 lbs/acre.

PCC2: 30%
Nebraska Sedge Community
This community is found adjacent to the Northwest Territory Sedge Community, just above the wettest part of the meadow. Nebraska sedge (Carex nebrascensis) dominates with tundra aster (Oreostemma alpigenum var. alpigenum, formerly Aster alpigenus). Other plants include water sedge (Carex aquatilis), swordleaf rush (Juncus ensifolius), and mountain rush (Juncus arcticus ssp. littoralis). Nebraska sedge is a heavily rhizomatous wetland plant capable of forming almost monotypic stands that can survive total inundation for 3 months (Hoag, 1998). Total canopy cover ranges from 40 to 60 percent, and annual production ranges from 360 to 696 lbs/acre. In some cases a high cover of tundra aster indicates a disturbance, but it is a natural native component as well.

PCC3: 11%
Tufted Hairgrass Community
Tufted hairgrass (Deschampsia cespitosa) distinguishes this community and is found along the drier margins of the meadows. Other common plants include mountain rush (Juncus arcticus ssp. Littoralis, formerly Juncus balticus), tundra aster (Oreostemma alpigenum var. alpigenum), longstalk clover (Trifolium longipes), tinker's penny (Hypericum anagalloides), and Rydberg's penstemon (Penstemon rydbergii). Total canopy cover ranges from 50 to 70 percent and annual production ranges from 400 to 771 lbs acre.

PCC4: 3%
Booth’s Willow Stream Bank Community
This plant community lies immediately adjacent to the stream channel. It is sometimes referred to as the green-line community, which exists just above the bank-full water level. It has created a small hump of vegetation that is slightly higher than the nearby plant communities. Booth's willow (Salix boothii) is a low-lying shrub found intermittently along the channel. Greater diversity exists along the upper channel than in the surrounding flats. Common plants include alpine shootingstar (Dodecatheon alpinum), elephanthead lousewort (Pedicularis groenlandica), seep monkeyflower (Mimulus guttatus), Oregon saxifrage (Saxifraga oregana), and various mixed sedges (Carex spp.). In some areas the Northwest Territory Sedge Community comes right to the stream edge or is interspersed with this community. Total canopy cover is around 90 percent and annual production ranges from 291 to 774 lbs/ acre.

PCC5: 1%
Sierra Lodgepole Pine Forest

Although this plant community is generally located adjacent to the meadow on drier outwash terraces, it can be present within the meadow in some areas. Sierra lodgepole pine (Pinus contorta var. murrayana) dominates this forest with moist understory associates such as blue wildrye (Elymus glaucus) and California false hellebore (Veratrum californicum). Tree canopy ranges from 10 to 60 percent with 15 to 30 percent understory cover.

Community Phase Pathway 1a

This pathway is followed by natural processes that cause the meadow to become drier. Several years of drought may cause this. Also, the meadows are relic lake basins that are very slowly filling-in from sedimentation and the accumulation of organic matter, which is another natural process for creating drier sites. Additionally, the channel may be gradually downcutting to balance its gradient with that of the surrounding valley slope.

Community Phase Pathway 1b

This pathway is created when a flood deposits a layer of sediment deep enough to bury the existing vegetation, initiating regeneration.

Stable E Channel Plant Species Composition:

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -grass/grasslike					**910**	**1540**		
		Northwest Territory sedge	CAUT	*Carex utriculata*	300	600	20	40
		blister sedge	CAVE6	*Carex vesicaria*	600	900	40	60
		spikerush	ELEOC	*Eleocharis*	10	40	0	5
2 -grass/grasslike					**360**	**621**		
		Nebraska sedge	CANE2	*Carex nebrascensis*	360	600	30	50
		sedge	CAREX	*Carex*	0	15	0	3
		mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	0	16	0	2

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
2 -forbs					**0**	**65**		
		gentian	GENTI	*Gentiana*	0	15	0	3
		tundra aster	ORALA3	*Oreostemma alpigenum var. andersonii*	0	40	0	5
		beardtongue	PENST	*Penstemon*	0	10	0	1

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
3 -forbs					**0**	**25**		
		beardtongue	PENST	*Penstemon*	0	25	0	3

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
3 -Grass/grasslike					**400**	**746**		
		sedge	CAREX	*Carex*	125	250	25	50
		tufted hairgrass	DECE	*Deschampsia cespitosa*	275	495	25	45
		bulrush	SCIRP	*Scirpus*	0	1	0	1
4 -grass/grasslike					**40**	**240**		
		water sedge	CAAQ	*Carex aquatilis*	15	40	2	5
		sedge	CAREX	*Carex*	25	200	3	25

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
4 -shrubs					**250**	**415**		
		alpine laurel	KAMI	*Kalmia microphylla*	0	15	0	1
		Booth's willow	SABO2	*Salix boothii*	250	400	5	8

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
4 -forbs					**1**	**39**		
		Chamisso arnica	ARCH3	*Arnica chamissonis*	0	3	0	1
		alpine shootingstar	DOAL	*Dodecatheon alpinum*	0	2	0	1
		bigleaf lupine	LUPO2	*Lupinus polyphyllus*	0	10	0	1
		seep monkeyflower	MIGU	*Mimulus guttatus*	0	6	0	2
		elephanthead lousewort	PEGR2	*Pedicularis groenlandica*	0	5	0	1
		yampah	PERID	*Perideridia*	0	5	0	1
		Sierra bog orchid	PLDIL	*Platanthera dilatata var. leucostachys*	0	1	0	1
		sparse-flowered bog orchid	PLSP2	*Platanthera sparsiflora*	0	1	0	1
		Oregon saxifrage	SAOR2	*Saxifraga oregana*	0	5	0	1

western false asphodel	TROCO2	*Triantha occidentalis ssp. occidentalis*	0	1	0	1

Dry At Risk E Channel - Community Phase 1.2

This community phase develops over time when prolonged drought and/or a natural drying of the meadow create a shift in the plant communities. The water table becomes lower during the growing season due to diminished water supply or channel downcutting. With a lower water table, the less hydrophytic vegetation can establish in the lower and normally wetter areas of the meadow. The stream banks remain stable and vegetated with sedges, but if the water table remains low the sedges will eventually die-out and shift this community to State 2.

The same plant communities described above in Community 1.1 are present in this community phase as well, but their relative proportions have shifted toward the drier plant community components.

Community Types and Composition:
PCC1. (45%) - Northwest Territory Sedge Community
PCC2. (35%) - Nebraska Sedge Community
PCC3. (15%) - Tufted Hairgrass Community
PCC4. (2%) - Booth's Willow Stream Bank Community
PCC5. (3%) - Sierra Lodgepole Pine Forest

Community Phase Pathway 1.2a

This pathway is created when the site becomes wetter for natural reasons. A drought cycle may end, or new springs may emerge.

Community Phase Pathway 1.2b

This pathway is created when a flood deposits a layer of sediments deep enough to bury the existing vegetation, initiating regeneration.

Depositional Flood - Community Phase 1.3

This community phase has developed because of a depositional flood. Although "E" type channels do not typically generate catastrophic floods, they can experience large snow melts or rain-on-snow events. These events transport sediment that settles-out as the water spreads across these wide low-gradient basins. The soils have layers of 8 to 25 inches of deposition; however these events may be more related to post- glacial activity than modern depositional events and a deposition of 1 to 2 inches seems more likely at this time. After a shallow depositional flood event, sedge communities can resprout from rhizomes and recover quickly. Other community types may take longer to recover, and a new community type of pioneer species may be present for a short period post-flood. If a thick layer of deposition alters the stream channel and water depth, the distribution of plant community components could change.

The same plant communities described above in Community 1.1 are present in this community phase as well, but there is a new pioneer plant community.

Plant Community Component and Composition:
PCC1. (35%) – Northwest Territory Sedge Community

PCC2. (25%) – Nebraska Sedge Community
PCC3. (15%) – Tufted Hairgrass Community
pCC4. (2%) – Booth’s Willow Steam Channel Community
PCC5. (1%) – Sierra Lodgepole Pine Forest
PCC6. (27%) – Post-flood Pioneer Plant Community – Data is lacking on this post-flood pioneer plant community. Species would vary depending upon the water table depth but may include lupines (Lupinus spp.), buckwheats (Eriogonum spp.), and rabbitbrush (Ericameria spp.)

Community Phase Pathway 1.3a
This pathway is created with time and allows for the recovery of the plant communities after the flood event.

Community Phase Pathway 1.3b
This pathway is possible if the sediment deposition is deep enough to create changes in the plants’ ability to reach the water table. Thick layers of sedimentation may lead to a drier, grass-dominated meadow for a period of time.

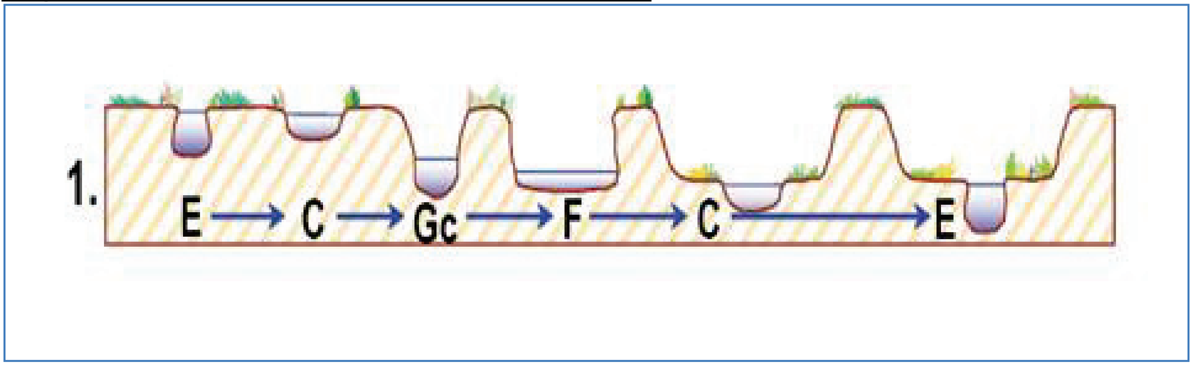
Transition - 1
This transition is often initiated by a disturbance that alters the hydrology of the site or impacts the vegetation along the stream bank. Alterations that can affect the hydrology of this site include channel realignment and/or confinement, culvert installations, and road construction. Previous cattle grazing may have reduced the vegetation along the stream banks and caused bank erosion with their hooves. Non-native grasses may have been seeded for forage. The alterations mentioned above have straightened the channel, eliminating its ability to meander. This increases the shear stress along the stream bank, which accelerates stream bank erosion, thereby increasing sediment supply and decreasing sediment transport capacity. This causes channel aggredation, in which the channel fills with sediment. As the channel fills it becomes wider and shallower, causing even more bank erosion and more sediment supply. This now-wider and shallower channel is more representative of a “C” type channel (Rosgen, 1996). As the channel straightens it has a shorter course down the valley, creating a steeper gradient. The stream may adjust by headcutting into the base level of the channel until it establishes a new gradient through the meadow. As the stream bed is lowered, so is the water table in the meadow. The new larger and steeper channel can contain more flow, reducing the frequency of flooding and the extent of the floodplain. Grazing can cause the same processes mentioned above, but uses a different trigger. The removal of the riparian vegetation by grazing and the trampling of the exposed stream banks cause bank erosion. The eroding banks create sediments that are deposited downstream, and the processes above are initiated.

<u>Degraded "C" Channel - State 2</u>
This state represents the altered and degraded condition for this meadow complex. The stream has become unstable and readjusted itself to resemble a Rosgen “C” type channel. Several factors have caused this change. The triggers are discussed in Transition 1. The banks have eroded creating a wide, shallow channel with point bars. The channel is continually down-cutting, increasing the channel gradient and lowering the water table. The combination of the initial disturbances with the lower water table has shifted the plant composition toward drier community types, reducing the distribution of the beneficial sedges.

The Rosgen Stream Succession diagram below shows a possible stream succession pathway for this ecological site. The STM above only incorporates the shifts from an “E” type channel to a “C” type channel. The lower reaches of this ecological site in Dersch Meadow may be going through later stages of stream succession, but channel measurements have not been taken to fully develop these concepts. Further down-cutting and the lowering of the water tables could trigger the development of later stages of stream succession.

If the “C” type channel in State 2 continues to down-cut, an entrenched low gradient “Gc” type channel develops. This gully-like entrenched channel is unstable and will naturally begin to widen over time into an entrenched “F” type channel. These deeply incised channels (“Gc” and “F”) generally lose the wetland obligate species and become dominated by upland grass, shrub and/or forest plant communities. The broadly entrenched “F” type channel allows for sediment deposition, which builds point bars and floodplains with a meandering channel. Riparian vegetation begins to reestablish on the new floodplains, which increases channel stability. An entrenched “C” type channel with a developed floodplain and a meandering channel will eventually develop within the entrenched “F” type channel. If conditions remain stable, the “C” type channel will narrow and deepen, creating an entrenched “E” type channel. This new “E” type channel may resemble the original “E” type channel with wetland plant communities, but it will be constrained by terraces to the lower floodplain area. The old floodplain becomes a terrace, disconnected from flood events. The terrace has a lower seasonally water table which supports upland plant communities.

Degraded "C" Channel - Community Phase 2.1



Rosgen Stream Succession Model

This community phase has a lower water table as a consequence of unnatural disturbances (see Transition 1 narrative). Non-native grasses may be present and the composition of the plant community components has shifted to favor the Mixed Grass and Forb Community Component PCC3b, rather than the wetter Northwest Territory Sedge Community PCC1. The steep banks have lost some of their stability because of the disintegration of the sedge roots that hold the soil in place and provide resistance to erosion by the stream.

The plant community components described below are similar to the plant communities described in State 1, but the relative proportions have changed. Vegetation data was collected for this community phase, but was collected in one plot across the entire meadow. Total production is 1285 lbs/acre, which represents the overall production of community component PCC1, PCC2 and PCC3b. It is difficult to split production and cover by community component, from this plot.

State 2 community components in this phase are very similar to State 1 community components. There are very few non-native species present. However there is an increase in native disturbance indicator species, such as tundra aster and mountain rush.

Plant Community Components and Composition:

PCC1. (5 %) - Northwest Territory Sedge Community - Northwest Territory sedge (Carex utriculata) and/or blister sedge (Carex vesicaria). This community has limited distribution in this state.

PCC2. (15 %) - Nebraska Sedge Community - Nebraska sedge (Carex nebrascensis) dominates with a large component of tundra aster (Oreostemma alpigenum var. alpigenum). Other plants include: water sedge (Carex aquatilis), swordleaf rush (Juncus ensifolius), and mountain rush (Juncus arcticus ssp. littoralis), and Lemmon's Indian paintbrush (Castilleja lemmonii).

PCC3b. (73 %) - Mixed Grass and Forb Community - This grass dominated community expands into areas that were dominated with sedges. It has changed from the State 1 CT3 because there is less overall cover, and more diversity of native pioneer species. Tufted hairgrass (Deschampsia cespitosa) is still dominant. Other common plants include: mountain rush (Juncus arcticus ssp. littoralis), tundra aster (Oreostemma alpigenum var. alpigenum), longstalk clover (Trifolium longipes), tinker's penny (Hypericum anagalloides), Rydberg's penstemon (Penstemon rydbergii), mat muhly (Muhlenbergia richardsonis), pullup muhly (Muhlenbergia filiformis), primrose monkeyflower (Mimulus primuloides), and violet (Viola sp.).

PCC4b. (2 %) - New Stream Bank Community - This plant community is immediately adjacent to the stream channel, and replaces the Booth’s willow stream bank community. The dynamics of the channel have changed, leaving eroded banks and point bars. The new substrate is more suitable for pioneer forbs, possibly mountain alder and lemons willow. Instead of the Northwest Territory sedge (Carex utriculata) community adjacent to this community the mixed grass and forb community is present. More data is needed on this community type.

PCC5. (5 %) - Sierra Lodgepole Pine Forest - This plant community is adjacent to the meadow on the drier outwash terraces, but has moved into the meadow in some areas. Sierra lodgepole pine (Pinus contorta var. murrayana) dominates this forest with moist understory associates such as blue wildrye (Elymus glaucus) and California false hellebore (Veratrum californicum).

Community Phase Pathway 2.1a
This pathway is followed in the absence of fire, which allows the Sierra lodgepole pine to encroach upon the meadow.

Community Phase Pathway 2.1b
This pathway is created when a flood creates erosion and deposition, leaving barren soil for early successional species to establish.

Community Phase Pathway 2.1c
This pathway is created when a fire burns into the meadow and initiates regeneration.

No fire - Community Phase 2.2
Because of a lower water table, Sierra lodgepole pine (Pinus contorta var. murrayana) is able to establish in the meadow. Fire could be important in maintaining the open meadow by removing the fire intolerant Sierra lodgepole pine seedlings. The sedge and grassland communities generally recover quickly after fire. Fire may initiate in the surrounding forest and burn into these meadows.

California red fir (Abies magnifica) forests are present on the nearby hillslopes and have a fire frequency from 10 to 65 years (Bancroft, 1979; Taylor et al., 1991). Jeffrey pine (Pinus jeffreyi) and white fir (Abies concolor) forests are present at the lower elevations of this site and experience more frequent fire cycles.

The fire frequency for the adjacent Sierra lodgepole pine forest may be longer than usual because this area is often wet and does not easily ignite. The Sierra lodgepole pine community may live for 100 years or more. As the forest ages, the trees become more vulnerable to diseases and bark beetle attacks. Mountain pine bark beetle (Dendroctonus ponderosae) may kill entire stands of forest, leaving standing dead trees. After a high mortality pest outbreak there is a high fuel load, which can fuel a high severity fire. This Sierra lodgepole pine forest encroaches primarily upon the grassland community. Because of the increase in water uptake by the trees and a subsequent loss through evapotranspiration, this forest may decrease the available water in the meadow and lower the water table even further.

The same plant communities are present as mentioned in Community Phase 2.1, but Community Type 5, the Sierra Lodgepole Pine Community, will increase at the expense of Community Type 3b, the Mixed Grass and Forb Community.

Community Phase Pathway 2.2a
This pathway is created when a fire burns into the meadow and initiates regeneration.

Fire - Community Phase 2.3
This community phase develops after fire. Over time the potential for fire will increase in this state. The water table is lower, and the duration and depth of ponding has decreased. There are more grasses, which provide fine flashy fuels that ignite easily and spread fire quickly. Large fuels from the Sierra lodgepole pine forest can drive more severe fires into the meadow from surrounding hillslopes.

There may be a short-lived pioneer plant community after a fire. Many sedges and grasses resprout after fire and may recover quickly. The initial pioneer forbs that develop after a fire will slowly die out as the grasses and sedges regain dominance.

Community Phase Pathway 2.3a
This pathway is created with time and the recovery of the meadow community components.

Community Phase Pathway 2.3b
This pathway is created when a flood deposits a layer of sediment deep enough to bury the existing vegetation and initiate regeneration.

Flood - Community Phase 2.4
This community phase has developed after a deposition flood. A flood impacting this degraded "C" type channel will cause more severe bank erosion and uneven deposition of sediments, unlike the broad settling of sediments in the stable "E" state. The flow in this "C" channel will be primarily self-contained and probably not extend into the major flood plain. The concentrated flow increases the hydraulic friction on the already unstable and poorly vegetated stream banks. These floods will principally affect the community components adjacent to the stream channel, creating new plant communities of pioneer forb and grass species.

Community Phase Pathway 2.4a
This pathway is created with time and allows for the recovery of the plant communities after a flood event.

Community Phase Pathway 2.4b
This pathway is created by an unlikely fire event, which would initiate community regeneration.

Restoration Pathway - 2
The processes that have altered this stream system are not easy to restore. The goals are to raise the water table, increase the channel sinuosity, and re-establish riparian vegetation on the stream banks (particularly those sedges with thick root mats) to hopefully reduce bank erosion. Each segment of the stream channel should be surveyed to determine if the channel needs to be restored and, if so, will restoration be effective? Some questions to consider are: what caused the change in the hydrology; is the site cut off from its full water supply; is it getting excess flow; has the channel been manipulated and channelized; can the stream be reconstructed to its natural course or to a suitable alternative; is the channel headcutting and, if so, what is causing this and can it be restored?

Ecological Site Interpretations

Animal Community:
This site provides valuable wildlife resources such as water and cover. In addition, wildlife and livestock depend on the leaves, stems, and seeds of Nebraska sedge, tufted hairgrass, and other various grasses and sedges as forage. The sedges and bunchgrasses provide nesting habitat for waterfowl and cover for small mammals.

Plant Preference by Animal Kind:

Hydrology Functions:
The hydrological function of this meadow is to provide a catchment for water, sediments, and nutrients. The meadow allows sediment from melting spring snow to settle out and trap nutrients in surface and subsurface flows. This meadow also provides water storage, which is slowly released down the drainage throughout the year.

Recreational Uses:
These meadows provides open space for wildlife viewing, fishing and photographic opportunities.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
	F022AE008CA	This wet Sierra lodgepole forest borders the meadows.
	F022AE017CA	This is a California red fir-Sierra lodgepole pine forest found on the adjacent hillslopes.
	R022AE213CA	This is a riparian complex associated with the larger and steeper channels below this site.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Alluvial Flat	R022BI202CA	This is a lower elevation, frigid meadow site associated with year-round springs.
Frigid Lacustrine Flat	R022BI217CA	This frigid meadow site is associated with relic glacial lakes at lower elevations.

State Correlation:
This site has been correlated with the following states:

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

789182- Aquandic Cryaquents(near soil type location, 789181)
789183

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	5 E
Section:	33

Datum:	NAD83
Zone:	10
Northing:	4480081
Easting:	629789
General Legal Description:	The type location is about .38 miles north of Summit Lake, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104480081629789

Relationship to Other Established Classifications:

Other References:

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Alpine Slopes

Tsuga mertensiana / / Elymus elymoides - Lupinus obtusilobus
(mountain hemlock / / squirreltail - bluntlobe lupine)

Site ID: R022BI207CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 15 to 150, generally are 20 to 75.
Landform: Mountain slopes and volcanic domes.
Soils: Very deep to moderately deep, well drained soils with greater than 35 percent rock fragments. Bedrock occurs between 20 to 60 inches in the moderately deep and deep soils.
Temp regime: Cryic.
MAAT: 38 to 41 degrees F (3.3 to 5 degrees C).
MAP: 73 to 125 inches (1,854 to 3,175 mm)
Soil texture: Gravelly ashy sandy loam, extremely gravelly ashy fine sandy loam, and very gravelly ashy loamy coarse sand.
Surface fragments: 25 to 60 percent gravels and 20 to 55 percent large rock fragments.
Vegetation: low cover of mountain hemlock with mixed forbs such as bluntlobe lupine (Lupinus obtusilobus) and mountain pride (Penstemon newberryi).

Physiographic Features

This ecological site is confined to the upper elevations of exposed colluvial aprons, mountain slopes, volcanic domes and cirque walls at tree line and above. This site is correlated to map units that extend up to 10,450 feet, but the site itself does not extend above treeline. Treeline varies due to climatic conditions and exposure, but generally stays consistent at approximately 9,000 feet. Slopes range from 15 to 150 percent, but are generally between 20 to 75 percent.

Landform:	(1) Volcanic dome
	(2) Mountain slope

(3) Colluvial aprons

	Minimum	Maximum
Elevation (feet):	6470	10450
Slope (percent):	15	150
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Medium	High
Aspect:	North East West	

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 53 to 125 inches (1,346 to 3,175 mm) and the mean annual temperature ranges from 38 to 41 degrees F (3.3 to 5 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 65 to 190 days.

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

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	65	190
Mean annual precipitation (inches):	53	125

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is not influenced by water features.

Wetland Description:	System	Subsystem	Class

Representative Soil Features

This site is associated with the Terracelake, Readingpeak, Emeraldlake and Vitrandic Cryorthents, debris flows, high elevation soil components. These soils formed from ash or tephra over colluvium and residuum or in debris flows. They are very deep to moderately deep, well drained soils with greater than 35 percent rock fragments. The surface textures are gravelly ashy sandy loam, extremely gravelly ashy fine sandy loam, and very gravelly ashy loamy coarse sand, with coarse to medium subsurface textures. The percentage and size of rock fragments generally increases with depth. Bedrock occurs between 20 to 60 inches in the moderately deep and deep soils. These soils have very low to moderate AWC (available water capacity). These soils generally have moderately rapid permeability in the upper horizons, with impermeable bedrock below.

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

Map Unit Component / Percent
114 Acroph / 3
114 Emeraldlake / 25
114 Terracelake / 23
116 Acroph / 5
136 Acroph / 10
137 Terracelake / 2
144 Terracelake / 5
149 Emeraldlake / 15
149 Terracelake / 3
167 Emeraldlake / 35
167 Terracelake / 15
170 Emeraldlake / 20
170 Readingpeak / 15
170 Terracelake / 12
174 Terracelake / 7
177 Vitrandic Cryorthents, debris flows high elevation / 85

Parent Materials:
Kind: Debris flows, ash or tephra over colluvium, and residuum
Origin: Volcanic rock

Surface Texture: (1)Gravelly ashy sandy loam
(2)Extremely gravelly ashy fine sandy loam
(3)Very gravelly ashy loamy coarse sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	25	60
Surface Fragments > 3" (% Cover):	20	55
Subsurface Fragments <=3" (% Volume):	50	75
Subsurface Fragments > 3" (% Volume):	10	40

Drainage Class: Well drained To Somewhat excessively drained
Permeability Class: Moderately rapid To Impermeable

	Minimum	Maximum
Depth (inches):	20	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	6.7
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.04	5.37

Plant Communities

Ecological Dynamics of the Site

This ecological site is found at upper elevations on exposed northern slopes throughout Lassen Volcanic National Park. Vegetation varies in different areas but the most common species associated with this site are bluntlobe lupine (Lupinus obtusilobus), mountain pride (Penstemon newberryi), woodrush (Luzula spp.), and Howell’s pioneer rockcress (Arabis platysperma var. howellii).

Cover is relatively low for all species across the site with the exception of bluntlobe lupine, which can range from 25 to 45%. Accompanying forbs equal about 1 to 8% in cover, depending on the species. Plants growing here are generally prostrate or low growing with the majority of the biomass underground, a common trait of alpine species (Billings and Mooney, 1968). Slope and aspect are largely responsible for the range in plant cover, as well changes in species from site to site. Slope orientation accounts for variability in local hydrologic dynamics, affecting the vegetation and soil development (Woo, Marsh, and Pomeroy, 2000).

All species growing on this ecological site must be able to tolerate a short growing season, heavy snow pack, freezing temperatures, and high winds. All limit the productivity of the site, making it only a moderately important wildlife resource.

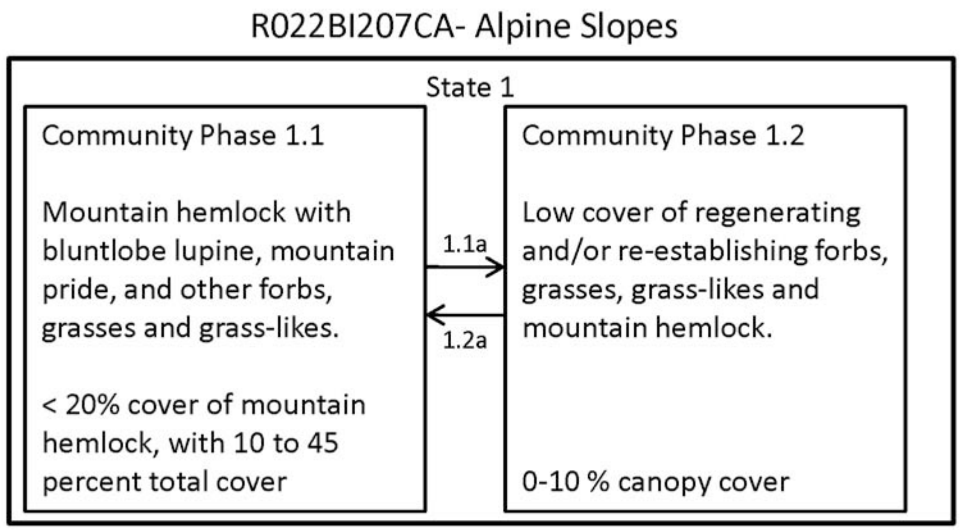
Tree cover is generally low, between 1 to 20 percent, and dominated by mountain hemlock (Tsuga mertensiana). The trees at this elevation are very slow growing. Older trees may be 500 years old while younger trees appear to be 75 to 200 years old. The high elevations are buried with deep snow from November to June and remain cool for most of the year. Several physiological adaptations allow mountain hemlock to survive in this cold environment. They have maximum photosynthetic rates at colder temperatures than lower elevation trees, and close stomata to reduce water loss during dormant periods. The tips of mountain hemlock are very flexible, an attribute that reduces snow build-up and stem breakage. Snow burial can be helpful in protecting trees from strong winter winds, desiccation from warm winter winds and sunny winter days, extreme cold, and repeated freezing and thawing (Arno and Hammerly, 1984). Snow burial can, however, be detrimental as well. In some areas, those portions of the trees exposed above the snow can die back, leaving short multi-stemmed trees. Snow creep can create pistol-butted trees, and avalanches can destroy swaths of forest.

Timberline trees are able to withstand extremely cold winter conditions when they are dormant but need at least a 2 to 3-month frost free growing period in the summer. During this short growing season, usually in July and August, new mountain hemlock growth is susceptible to frost. The new shoots are soft and succulent and need time to "ripen" (Arno and Hammerly, 1984). The duration of the growing season is crucial for seedling establishment. As elevations increase, temperatures drop and the growing season is shortened. Growing season length is one of the limiting factors to determine treeline. Another is wind. Wind induced treelines can be caused by drought conditions, due to increased evapotranspiration (Tomback, et al. 2001).

The fire interval is poorly documented for this site but is estimated to be between 400 to 800 years (Tesky, 1992). The natural fire cycle for the native forb community is described as infrequent, indicating a range from 75 to 150 years (Morgan et al. 1996). Fire is of slight concern in this ecosystem because there is a lack of available fuel, both in the canopy and on the ground. The high winds and steep slopes prevent a heavy litter accumulation.

Historically the plant community on this site is much like the one that exists today. There has been little to no direct human impact at this elevation.

State and Transition Diagram



Natural State - State 1

Mountain hemlock with forbs and grasses - Community Phase 1.1

Alpine slopes

This plant community is associated with a late successional community on this ecological site. Mountain hemlock trees are present but are mostly widely scattered and small or shrubby. Total canopy cover is less than 20%. Vegetation can vary from site to site but the most common species associated with this plant community are bluntlobe lupine (Lupinus obtusilobus), mountain pride (Penstemon newberryi), woodrush (Luzula spp.), and Howell's pioneer rockcress (Arabis platysperma var. howellii). Other species found in smaller quantities on this ecological site may include Ross' sedge (Carex rossii), squirreltail (Elymus elymoides), western needlegrass (Achnatherum occidentale), mountain monardella (Monardella odoratissima), purple mountainheath (Phyllodoce brewerii), prickly hawkweed (Hieracium horridum), Sierra cliffbrake (Pellaea brachyptera), Shasta knotweed (Polygonum shastense), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), dwarf mountain ragwort (Senecio fremontii), Davidson's penstemon (Penstemon davidsonii), King's sandwort (Arenaria kingii) and various buckwheat species (Eriogonum spp.).

There are minor amounts of tree and shrub species present in various quantities. Mountain hemlock (Tsuga mertensiana) is the most common, ranging from 1 to 15%. Additional tree species include whitebark pine (Pinus albicaulis) and California red fir (Abies magnifica). Trees growing on this site are commonly reduced to a shrubby form or remain small due to the harshness of the exposed slope. It is typical to find trees growing on or near rock outcrops; these rocks serve as anchors and protection. Shrubs present in minor amounts can include pinemat manzanita (Arctostaphylos nevadensis) and oceanspray (Holodiscus discolor).

Ross's sedge is well suited to this site. It is very drought tolerant and is also has a high level of winter hardiness. Ross's sedge is tolerant of a variety of soil conditions and is able to grow on steep slopes and unstable hillsides (Anderson, 2008).

Community Phase Pathway 1.1a

1.1a- A disturbance such as a rock slide, avalanche or perhaps a lightning strike could remove existing vegetation and leave a mostly barren landscape.

Mountain hemlock with forbs and grasses Plant Species Composition:

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -naitve grasses/grass likes					**6**	**36**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	3	15	1	3
		sedge	CAREX	*Carex*	0	6	0	2
		squirreltail	ELEL5	*Elymus elymoides*	0	15	0	3
		woodrush	LUZUL	*Luzula*	3	10	1	5

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
2 -native forbs					**100**	**474**		
		Sacramento waxydogbane	CYHU	*Cycladenia humilis*	0	2	0	1
		marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	0	12	0	8
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	6	0	3
		prickly hawkweed	HIHO	*Hieracium horridum*	0	7	0	3
		bluntlobe lupine	LUOB	*Lupinus obtusilobus*	25	400	2	45
		mountain monardella	MOOD	*Monardella odoratissima*	0	15	0	4
		Sierra cliffbrake	PEBR3	*Pellaea brachyptera*	0	6	0	2
		mountain pride	PENE3	*Penstemon newberryi*	0	15	0	8
		Davis' knotweed	PODA	*Polygonum davisiae*	0	6	0	3
		Shasta knotweed	POSH	*Polygonum shastense*	0	5	0	2

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
3 -native shrubs					**100**	**300**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	25	200	1	25
		oceanspray	HODI	*Holodiscus discolor*	0	75	0	10
		mountain pride	PENE3	*Penstemon newberryi*	0	15	0	8
		purple mountainheath	PHBR4	*Phyllodoce breweri*	0	10	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
4 -native trees					**0**	**40**		
		California red fir	ABMA	*Abies magnifica*	0	10	0	2
		whitebark pine	PIAL	*Pinus albicaulis*	0	10	0	2
		mountain hemlock	TSME	*Tsuga mertensiana*	0	15	0	3

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	6	21	46
Forb	100	255	474
Shrub/Vine	100	111	300
Tree	0	20	40
Total:	206	407	860

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	1%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	3%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	8%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	1%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	0%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	0%	30%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	25%	60%		**Tree Snags** per Acre**			
Surface Fragments > 3"	20%	55%		Hard Snags***			
Bedrock	5%	30%		Soft Snags***			
Water	0%	0%					
Bare Ground	0%	22%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	1%	7%	%	%				
> 0.5 - < 1 feet	1%	3%	5%	20%				
> 1 - <= 2 feet	0%	3%	10%	25%	1%	35%		
> 2 - < 4.5 feet					0%	10%	0%	2%
> 4.5 - <= 13 feet							0%	5%
> 13 - < 40 feet							1%	3%
< 40 - >= 80 feet							5%	12%
> 80 - < 120 feet								
>= 120 feet								

Overstory:

Percent cover can vary from a trace to approximately 20%, depending on the site. On the harshest sites trees are reduced to a shrubby growth form. Mountain hemlock is the most commonly occurring species, while California red fir and whitebark pine occur less frequently.

Understory:

Species composition and production varies from site to site. Some sites are almost bare while others have up to 45% vegetative ground cover. Limited available resources do not allow all species to occur on every site.

Barren with few forbs and grasses - Community Phase 1.2

Following disturbance, forbs and grasses would begin to return immediately. This plant community is characterized by large open patches void of vegetation, with intermittent grass or forb plants and occasional shrubs. Much of the propagation that could re-colonize this site would come from wind or animal dispersed seed. Species composition would reflect the native plants of nearby sites as well as the remaining seed bank. There is little threat of nonnative plant invasion on this site due to the "inability of the weedy species to produce enough seeds to compensate for the high mortality rate caused by the harsh environment", and the stress adapted characteristics of plants that occur on the site (Denslow, 1980).

Although mountain hemlock is very hardy, regeneration and establishment may be slower than other high elevation tree species. Since seed production and germination depend on the amount of precipitation received during the growing season, mountain hemlock performs better during years of higher precipitation (Tesky, 1992). Mountain hemlock also reproduce vegetatively through layering (Tesky 1992), a form of reproduction that helps to fill gaps created by disturbances. Following a disturbance on this site the trees will be mostly young but, with the proper conditions they will survive and increase in overall canopy cover.

Community Phase Pathway 1.2a

1.2a- Regeneration of mountain hemlock and colonization of shrubs, forbs, and grasses will increase the total canopy cover. With time, proper conditions, and the absence of large scale disturbances, mountain hemlock seedlings establish on the site. Understory species will increase percent cover from plant Community 1.2. Species will reflect the harshness of the environment, and the rate of propagation will be much the same for recently disturbed openings as for long undisturbed patches within the same site, according to Denslow, 1980.

Ecological Site Interpretations

Animal Community:

High elevation sites with limited stands of mountain hemlock (Tsuga mertensiana) are home to Clark's nutcracker, deer mice and various species of chipmunks. The upper limits of this ecological site are home to gray-crowned rosy finch, pika, and the golden mantled ground squirrel.

Pikas are a smaller cousin of the rabbit, are diurnal and choose to live on rocky sites at high elevations. They eat the leaves and stems of grasses, forbs, and shrubs. They do not hibernate and are known for making haystacks during the summer months to ensure their survival through the winter. Winter survival is directly related to the success of their haying the previous summer (Smith 1994).

A variety of invertebrates also use this site, the most common of which is the California tortoise shell butterfly. This orange-brown butterfly can be seen by the thousands, commonly around the peaks of mountains.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:

This site is generally found on very steep rocky slopes not well suited for trails, but providing excellent views.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Cryic Coarse Loamy Colluvial Slopes	F022BI104CA	This is a mountain hemlock forest site, generally found downslope or in more protected conditions.
Upper Cryic Slopes	F022BI124CA	This is a mountain hemlock and whitebark pine forest with a lupine dominated understory on surrounding slopes.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789208 Emeraldlake modal
789260
789319
789320
789323 Site location for Ecological Site
789390

Type Locality:

State:	CA
County:	Shasta
Township:	
Range:	
Section:	
Datum:	NAD83
Zone:	10
Northing:	4481571
Easting:	629422
General Legal Description:	This site is approx. 0.5 miles east-southeast of the Terrace Lake Trailhead, on the north facing slope between Reading Peak and Shadow Lake.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	

Longitude Decimal:

Universal Transverse Mercator (UTM) system: NAD83104481571629422

Relationship to Other Established Classifications:
This site is approx. 0.5 miles east southeast of the Terracelake Trailhead, on the north facing slope between Reading Peak and Shadow Lake.

Other References:
Arno, Stephen F. and Hammerly, Ramona p. 1984. Timberline, Mountain and Artic Forest Frontiers. The Mountaneers, Seattle, WA.

Anderson, Michelle D. 2008. Carex rossii. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [Available online: http://www.fs.fed.us/database/feis/ [2008, November 21].

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra Moseley	1/20/2010

Site Description Revision Approval:

Author	Date	Approval	Date
		Kendra Moseley	3/4/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Cryic Pyroclastic Cones

/ *Holodiscus discolor* - *Ceanothus prostratus* / *Eriogonum umbellatum*
(/ oceanspray - prostrate ceanothus / sulphur-flower buckwheat)

Site ID: R022BI208CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 10 to 80 percent, but are generally 10 to 45.
Landform: Shoulders of nunataks and cinder cones.
Soils: Well drained, shallow to moderately deep. Indurated bedrock is encountered between 10 to 40 inches. Skeletal soils with high percentage of cobbles and stones. There is 10 percent rock outcrop.
Temp regime: Cryic.
MAAT: 41 to 43 degrees F (5 to 6.1 degrees C).
MAP: 37 to 81 inches (940 to 2,057 mm).
Soil texture: Stony ashy loamy sand
Surface fragments: Range from 10 to 30 percent, with 5 percent subangular fine gravel, 1 percent subangular medium gravel, 5 percent subangular cobbles and 5 percent subangular stones.
Vegetation: A mixed shrubland with oceanspray (Holodiscus discolor), prostrate ceanothus (Ceanothus prostratus), rabbit brush (Ericameria nauseosa ssp. nauseosa var. nauseosa) and other forbs and grasses.

Physiographic Features

This ecological site is found on the shoulders of pyroclastic cones at 6,960 to 8,330 feet in elevation. Slopes range from 10 to 80 percent, but are generally between 10 to 45 percent.

Landform: (1) Cinder cone
(2) Nunatak

	Minimum	Maximum
Elevation (feet):	6960	8330
Slope (percent):	10	80
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	High	High
Aspect:	South East West	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 37 to 81 inches (940 to 2,057 mm). The mean annual temperature ranges from 41 to 43 degrees F (5 to 6.1 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 65 to 190 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	65	190
Mean annual precipitation (inches):	37.0	81.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the Xeric Vitricryands, bedrock soil component. These soils are well drained, shallow to moderately deep with very low available water capacity (AWC). They formed in tephra over residuum from volcanic rocks. The A1 and A2 horizons have a stony ashy loamy sand texture. Subsurface textures are extremely stony ashy sandy loam and very stony medial very fine sandy loam. Indurated bedrock is encountered between 10 to 40 inches.

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

Map Unit Component Comp %
122 Xeric Vitricryands, bedrock 20

Parent Materials:
Kind: Tephra over residuum
Origin: Volcanic rock

Surface Texture: (1)Stony ashy loamy sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	3	15
Surface Fragments > 3" (% Cover):	8	15
Subsurface Fragments <=3" (% Volume):	5	40
Subsurface Fragments > 3" (% Volume):	10	85

Drainage Class: Well drained To Well drained
Permeability Class: Impermeable To Impermeable

	Minimum	Maximum
Depth (inches):	10	40
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.1	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.4	2.14

Plant Communities

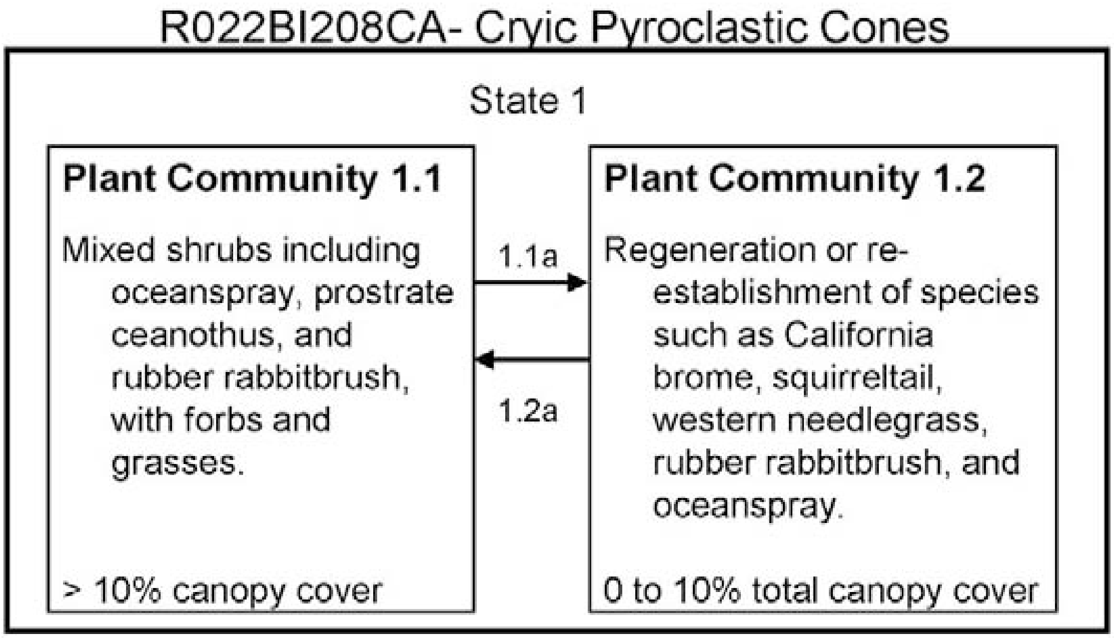
Ecological Dynamics of the Site

This ecological site is found on cinder cones and nunataks in the eastern portion of Lassen Volcanic National Park. A colorful combination of shrubs and forbs contrast against dark volcanic outcrops and rocks. Common plants include oceanspray (Holodiscus discolor), prostrate ceanothus (Ceanothus prostratus), rubber rabbit brush (Ericameria nauseosa ssp. nauseosa var. nauseosa), wavyleaf Indian paintbrush (Castilleja applegatei ssp. pinetorum), sulphur-flower buckwheat (Eriogonum umbellatum var. nevadense), and granite prickly phlox (Linanthus pungens). There is less than 10 percent cover of the larger montane shrubs such as greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus prostratus), Sierra chinquapin (Chrysolepis sempervirens), and bitter cherry (Prunus emarginata).

This site is limited by water availability. Soils are 10 to 40 inches deep over indurated bedrock. Above the bedrock is a droughty coarse-textured soil with a moderate amount of cobbles and stones. In addition, this site is often situated on south-facing shoulders and ridges of cinder cones that are exposed to high solar radiation, resulting in water loss to evaporation, evapotranspiration, and natural drainage. Although the cinder cones receive abundant snow in winter, wind re-deposits the snow on the leeward side of the ridges, leaving them exposed early in the spring. Trees in this area seem to be anchored in bedrock outcrops, which likely provide shelter from wind, partial shade for seedling development, and fissures that allow for penetration of roots and water.

Due to the lack of large fuels, a fire would be relatively mild on this site. Lighting is common on the cinder cones, but fuel loads are light, patchy, and interlaced with bedrock outcrops. Fires could spread through patches, but would most likely remain small and be of low to moderate intensity.

State and Transition Diagram



Natural State - State 1

Shrubs, forbs, and grasses. - Community Phase 1.1

Cryic Pyroclastic Cones

A mixed shrubland with forbs and grasses is the reference community for this ecological site. Trees will not successionally replace this community due to the characteristics of the site mentioned above. The dominant species include oceanspray (Holodiscus discolor), prostrate ceanothus (Ceanothus prostratus), and rabbitbrush (Ericameria nauseosa ssp. nauseosa var. nauseosa),

Shrubs like oceanspray (Holodiscus discolor), bush chinquapin (Chrysolepis sempervirens), and greenleaf manzanita (Arctostaphylos patula) are well suited to this site. Oceanspray (Holodiscus discolor) occurs in many successional communities and is well adapted to fire and disturbance (Archer 2000). Bush chinquapin (Chrysolepis sempervirens) is very tolerant of the harsh, rocky conditions found here, and the seeds are preferred food for small mammals and birds (Howard 1992), attracting various wildlife species to the site. Greenleaf manzanita (Arctostaphylos patula), whose seeds are commonly dispersed by birds and small mammals, also does well in dry environments such as this.

Community Phase Pathway 1.1a

1.1a. Fire is the most likely disturbance for this site and would create small pockets of regeneration (Community 1.1).

Shrubs, forbs, and grasses. Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -forbs					**0**	**74**		
		Lemmon's rockcress	ARLE	*Arabis lemmonii*	0	1	0	1
		wavyleaf Indian paintbrush	CAAPP4	*Castilleja applegatei ssp. pinetorum*	0	5	0	2
		naked buckwheat	ERNU3	*Eriogonum nudum*	0	10	0	2
		sulphur-flower buckwheat	ERPO16	*Eriogonum polyanthum*	0	20	0	2
		sulphur-flower buckwheat	ERUMN	*Eriogonum umbellatum var. nevadense*	0	20	0	2
		granite prickly phlox	LIPU11	*Linanthus pungens*	0	5	0	2
		silverleaf phacelia	PHHA	*Phacelia hastata*	0	8	0	2
		turpentine wavewing	PTTET	*Pteryxia terebinthina var. terebinthina*	0	5	0	2

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -grass/ grasslike					**10**	**131**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	10	45	1	4
		California brome	BRCA5	*Bromus carinatus*	0	16	0	2
		squirreltail	ELEL5	*Elymus elymoides*	0	70	0	6

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -shrubs					**90**	**965**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	0	30	0	2
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	15	220	1	8
		prostrate ceanothus	CEPR	*Ceanothus prostratus*	20	290	2	24
		snowbrush ceanothus	CEVE	*Ceanothus velutinus*	0	100	0	2
		bush chinquapin	CHSE11	*Chrysolepis sempervirens*	20	80	1	4

rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	20	95	2	8
oceanspray	HODI	*Holodiscus discolor*	15	120	5	25
bitter cherry	PREM	*Prunus emarginata*	0	30	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	10	48	131
Forb	10	29	74
Shrub/Vine	200	350	965
Total:	220	427	1170

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	1%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	1%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	2%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	1%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	0%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	35%	60%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	3%	15%		**Tree Snags** per Acre**			
Surface Fragments > 3"	8%	25%		Hard Snags***			
Bedrock	2%	10%		Soft Snags***			
Water	0%	0%					
Bare Ground	0%	5%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	%	%	0%	3%	%	%		
> 0.5 - < 1 feet	1%	10%	0%	10%	2%	24%		
> 1 - <= 2 feet	0%	2%	0%	1%	0%	2%		
> 2 - < 4.5 feet					5%	25%		
> 4.5 - <= 13 feet					2%	18%		
> 13 - < 40 feet								
< 40 - >= 80 feet								
> 80 - < 120 feet								
>= 120 feet								

Understory:
This plant community consists of mostly shrubs and sub-shrubs intermixed with a few forbs and grasses. The most notable species are oceanspray (Holodiscus discolor), rubber rabbit brush (Ericameria nauseosa ssp. nauseosa var. nauseosa), and sulfur-flower buckwheat (Eriogonum polyanthum). Large montane shrubs such as greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus velutinus), bush chinquapin (Chrysolepis sempervirens), and bitter cherry (Prunus emarginata) provide less than 10 percent cover. There is a variety of other species including western needlegrass (Achnatherum occidentale), California brome (Bromus carinatus), squirreltail (Elymus elymoides), Lemmon's rockcress (Arabis lemmonii), wavyleaf Indian paintbrush (Castilleja applegatei ssp. pinetorum), naked buckwheat (Eriogonum nudum), sulphur-flower buckwheat (Eriogonum umbellatum var. nevadense), granite prickly phlox (Linanthus pungens), prostrate ceanothus (Ceanothus prostrates), and turpentine wavewing (Pteryxia terebinthina var. terebinthina). Total canopy cover is about 40 percent.

Barren with few shrubs, forbs, and grasses - Community Phase 1.2
Community 1.2 exists for several years after a fire. Fires are more likely to produce small burned patches than large-scale devastation. The native perennial bunch grasses present in this area can resprout from the root crown or germinate from on or off-site seed sources. Included are California brome (Bromus carinatus), squirreltail (Elymus elymoides) and western needlegrass (Achnatherum occidentale).

Rubber rabbitbrush (Ericameria nauseosa ssp. nauseosa var. nauseosa) will not only resprout from adventitious buds on remaining roots and stems after a fire, it will germinate prolifically from off-site seed sources. It is likely to dominate early and stay abundant, along with the grasses. Oceanspray (Holodiscus discolor) is often top-killed by fire but resprouts from the root crown. It regenerates from stored seed as well, but seedlings are not usually abundant. Bush chinquapin (Chrysolepis sempervirens) can resprout after fire and regenerate from seed. Greenleaf manzanita (Arctostaphylos patula) is a fire dependent shrub because its seeds remain dormant in the soil until heat from fire scarifies the seed coat. The presence of greenleaf manzanita on this site may indicate past fires. Sometimes the canopy is enhanced after fire, although a full recovery may take 5 to 10 years.

Other forb and grass species may resprout or regenerate from seed after fire as well. There may be a flush of post fire annuals.

Community Phase Pathway 1.2a
1.2a. With time and growth this pathway will lead to the recovery of the canopy cover (Community 1.1).

Ecological Site Interpretations

Animal Community:
The shrub dominated plant community on this site provides important browse for wildlife. Oceanspray is a moderately important browse species for mule deer within the park. In addition to browse, species like oceanspray provide cover for large wildlife, and food and nesting habitat for small mammals and birds. Seeds produced by bush chinquapin are an important food source for ground squirrels and chipmunks, as well as birds. Flowers produced by buckwheat species host a variety of butterflies and moths. There are several forb and grass species growing here that are favored grazing species by wildlife.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This site is situated on upper cinder cones that provide excellent views, but trails need to be designed carefully to prevent erosion.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Cryic Coarse Loamy Colluvial Slopes	F022BI104CA	This is a mountain hemlock forest found above this site.
Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes	F022BI111CA	This is a sub-alpine mixed-conifer forest that surrounds this site.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789200- site location
789250

Type Locality:

State:	CA
County:	Lassen
Township:	30 N
Range:	6 E
Section:	1
Datum:	NAD83
Zone:	10
Northing:	4484003
Easting:	647642
General Legal Description:	The type location is near Red Cinder Cone, about 3.5 miles north-northeast of the new Juniper Lake ranger station.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104484003647642

Relationship to Other Established Classifications:

Other References:

Archer, Amy J. 2000. Holodiscus discolor. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences

Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, September 19].

Howard, Janet L. 1992. Chrysolepis sempervirens. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, September 19].

Simonin, Kevin A. 2001. Elymus elymoides. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: httphttp://www.fs.fed.us/database/feis/ [2009, September 24].

Tollefson, Jennifer E. 2006. Bromus carinatus. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, August 26].

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	1/30/2008	Kendra E Moseley	2/17/2010

Site Description Revision Approval:

Author	Date	Approval	Date
		Kendra Moseley	3/4/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Loamy Seeps

/ *Alnus incana ssp. tenuifolia* / *Senecio triangularis - Veratrum californicum*
(/ mountain alder / arrowleaf ragwort - California false hellebore)

Site ID: R022BI209CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by thermal springs, seeps, and active soil movement.
Slopes: 10 to 80 percent, but generally less than 50 percent.
Landform: Seeps on mountain slopes.
Soils: Very deep, poorly drained soils that formed in slope alluvium over colluvium over till from hydrothermally altered rocks.
Temp regime: Frigid.
MAAT: 38 to 42 degrees F (3.3 to 5.5 degrees C).
MAP: 63 to 119 inches (1,600 to 3,023 mm).
Soil texture: Gravelly mucky fine sandy loam
Surface fragments: 0 to 18 percent gravel
Vegetation: Several montane seep plant communities dominated by graminoid species with willow and mountain alder.
Notes: Portions of this site have debris flows and active soil movement.

Physiographic Features

This ecological site occurs on mountain slopes. The majority of this site is in the core of Brokeoff volcano. Elevations range from 5,680 feet to 8,570 feet. Slopes range from 10 to 80 percent, but are generally less than 50 percent.

The wetter areas of this site have a seasonal water table that fluctuates from 0 to 80 inches during spring and early summer and may drop to below 80 inches in the drier months.

Landform:	(1) Mountain slope	
	Minimum	Maximum
Elevation (feet):	5680	8570
Slope (percent):	10	80
Water Table Depth (inches):	0	80
Flooding:		
Frequency:		
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:		
Duration:	None	None
Runoff Class:		
Aspect:	South SouthEast SouthWest	

Climatic Features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 63 to 119 inches (1,600 to 3,023 mm) and the mean annual temperature ranges from 38 to 42 degrees F (3.3 to 5.5 degrees C). The frost free (>32F) season is 60 to 85 days. The freeze free (>28F) season is 75 to 190 days.

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

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	63.0	119.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is associated with intermittent streams and small perennial seeps and springs.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Riverine	Upper Perennial	Unknown

Representative Soil Features

The Endoaquepts soil component associated with this site consists of very deep, poorly drained soils that formed in slope alluvium over colluvium over till from hydrothermally altered rocks.

There is a thin layer of leaf litter and twigs over an A horizon that has gravelly mucky fine sandy loam textures with fine textured subsurface horizons. Clay increases with depth from 8 to 40 percent, until the lowest horizon. Subsurface textures in order of increasing depth are; gravelly loam, very gravelly loam, silty clay loam, cobbly silty clay loam, stony silty clay loam, very stony clay, and gravelly clay loam. Redoximorphic features are present beginning at about 6 inches and continuing to 30 inches below the surface. Gleyed soil colors are present below 30 inches.

In some areas there is a layer of till below these seeps. Over this till is fine-textured colluvial material mixed with cobbles and stones. The parent material was derived from hydrothermally altered rock. Acidic steam and water of various temperatures and pH have altered the mineralogy of the rock to produce soils with a significantly higher amount of clay and a lower pH than those soils in the rest of the Park. The soils on the slopes adjacent to this site have pH ranges from 4.7 to 5 in the lower horizons, but the soils associated with this site have pH ranges from 6.5 to 7.2.

This ecological site has been correlated with the following map units and soil components:

Map Unit/ Component /Component percent
789118 Endoaquepts/ 5
789119 Endoaquepts/ 14
789127 Endoaquepts/ 1
789171 Endoaquepts/ 5
789176 Endoaquepts/ 1

Parent Materials:
Kind: Slope alluvium over colluvium over till
Origin: Hydrothermally altered volcanic rock
Surface Texture: (1)Gravelly mucky fine sandy loam
Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	10

Surface Fragments > 3" (% Cover):	0	8
Subsurface Fragments <=3" (% Volume):	0	30
Subsurface Fragments > 3" (% Volume):	0	30

Drainage Class: Poorly drained To Poorly drained
Permeability Class: Very slow To Very slow

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.8	6.7
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	3.61	11.37

Plant Communities

Ecological Dynamics of the Site

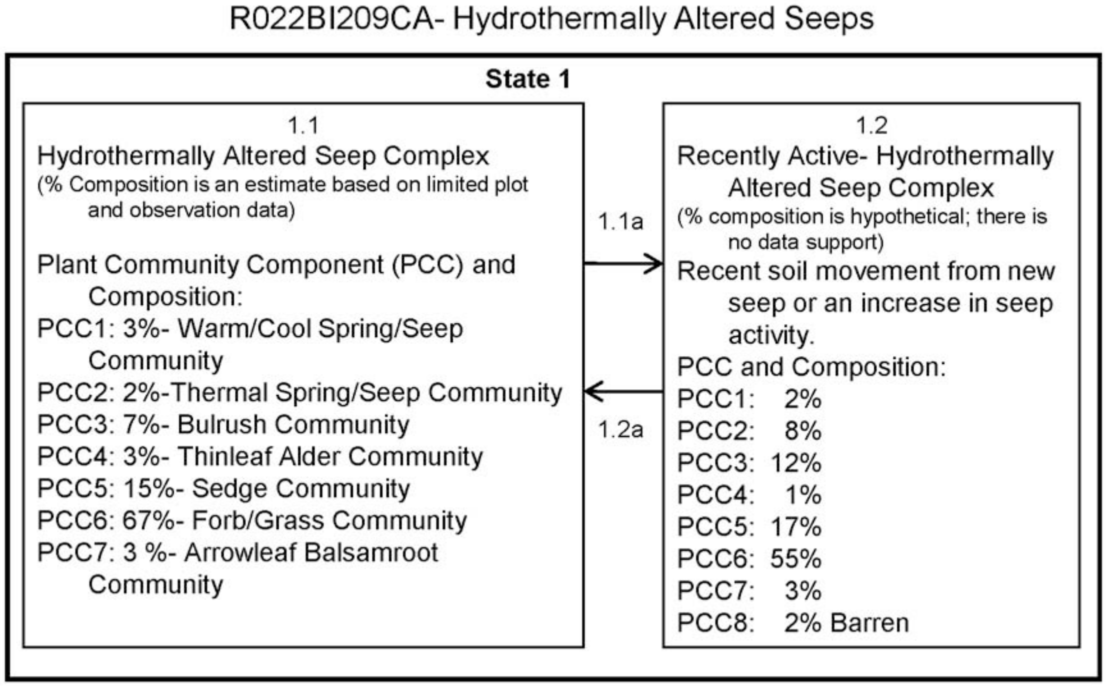
This ecological site is an association of spring-fed seeps on mountain slopes that have formed within the hydrothermally altered area of Brokeoff Volcano. There are multiple hot and cool springs associated with this site. Each spring has unique physical and biological characteristics. Some of these springs are hot while others are cool in temperature. Most have relatively low flow rates, which create a small stream channel below the source. The hot springs are a small percentage of this ecological site, but are biologically significant. The springs provide a year-round water source for the sloping meadows down slope. This ecological site is associated with the Endoaquepts soil component, a minor component for map units that do not have geothermal features. Consequently, hot springs may not be present in all areas where this site is mapped.

A diversity of plant communities are found within this riparian ecological site. Species composition varies due to proximity to springs, wetness, and soil stability. Common plants include mountain alder (Alnus incana ssp. tenuifolia), sedges (Carex ssp.), arrowleaf ragwort (Senecio triangularis), California false hellebore (Veratrum californicum var. californicum), blue wildrye (Elymus glaucus), fowl mannagrass (Glyceria striata), common cowparsnip (Heracleum maximum), smallwing sedge (Carex microptera), analogue sedge (Carex simulata), seep monkeyflower (Mimulus guttatus) and white marsh marigold (Caltha leptosepala).

This ecological site is a complex of riparian plant communities which are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community component composition as a result of disturbance, rather than focusing on the succession of one plant community. It may be that a certain plant community component is an early succession plant community that increases after disturbance.

Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram



State 1 - State 1

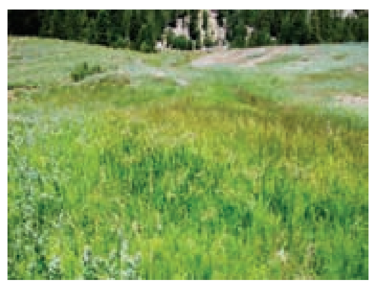
This state represents the natural conditions for this ecological site.

Hydrothermally Altered Seep Complex - Community Phase 1.1

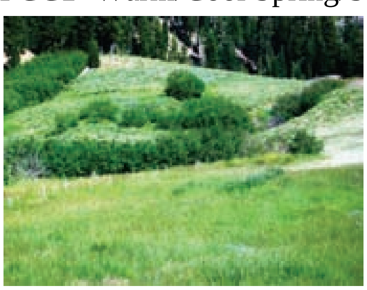
Loamy Seeps View

PCC1- Warm/Cool Spring/Seep

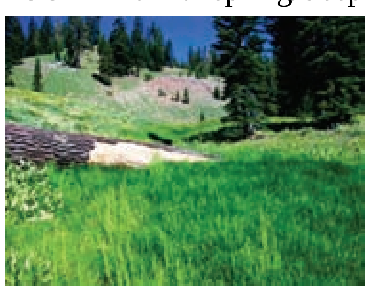
PCC2- Thermal spring/Seep



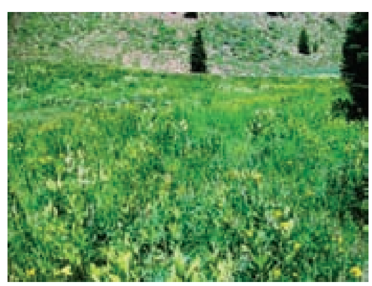
PCC3 Bulrush



PCC4- Thinleaf Alder



PCC5- Sedge



PCC6- Forb/ Grass


PCC7- Arrowleaf Balsamroot

There is a wide variety in micro-habitats within this ecological site and the plant communities associated it. The sloping valley generally has an active hot or cool spring at the upper ends of the meadow. These springs provide water for the meadow plant communities down the drainage.

Six dominant plant communities have been identified, but there are several other plant communities present.

PCC1: Warm/Cool Spring/Seep Community

This plant community is found at the source of a spring or seep. The composition of plant species in this community is highly variable. Soil-vegetation data was not collected at the source of these springs, so this plant community is based on field notes and photos. Several variables affect the vegetation at the spring, including water temperature, water chemistry, valley slope, soil stability, and flow rate. The photo above for PCC11 is from a stable, cool temperature seep with low flow. It is surrounded by sedges (Carex spp.), mosses, alpine shooting star (Dodecatheon alpinum), American bistort (Polygonum bistortoides), spikerush (Eleocharis spp.), and Howell's marsh marigold (Caltha leptosepala ssp. howellii). Annual production was not collected for this community type.

PCC2: Thermal Spring/Seep Community

This community is found at the source of active thermal springs. Most of these hot springs have neutral pH and low chloride concentrations. The hot springs are associated with the nearby steam vents, formed from vapor-dominated hydrothermal systems. Precipitation infiltrates over time through the rock, then vaporizes and rises to the surface (Thompson, 1985).

Hot springs have variable characteristics. For example, the one in the photo above and described here emerged onto a flat terrace of calcified material. Shortly after emerging, a mat of algal growth forms in the water and along the margins of the small stream. The spring is bordered primarily by seep monkeyflower (Mimulus guttatus). A complex microbial community lives in the geothermal waters but a detailed investigation and description of these microbial communities is beyond the resources for this ecological site at this time. Hot springs ecology is a relatively new science, but studies conducted in Lassen Volcanic National Park indicate that several microbial communities are associated with specific hot spring characteristics. Microbes reside in thermal waters within specific zones of tolerance for temperature and acidity. A study in Cold Boiling Lake indicates that sulfur-metabolizing archaeans are present in the hottest zones (above 60 degrees C), with iron-oxidizing bacteria in cooler zones and photosynthetic algae and cyanobacteria in more moderate zones. Cold Boiling Lake is acidic however, so it's possible the microbial communities may differ for this site. Cyanobacteria and algae species form thin, dense green microbial mats. These mats are an ecosystem unto themselves with a diversity of organisms, each performing a specific task within the system. The cyanobacteria are on the surface of the mats and produce oxygen through photosynthesis. The oxygen filters into the lower layer where aerobic bacteria and archaea utilize it. The respiration between these organisms can deplete oxygen, creating an anoxic zone where purple sulfur bacteria reside. The purple sulfur bacteria use sulfide produced from sulfide-reducing bacteria (Wilson, et al., 2008 and Engleman).

PCC3: Bulrush Community

This community is found in wet saturated areas near spring sources. It is composed of panicled bulrush (Scirpus microcarpus), Congdon's bulrush (Scirpus congdonii), field horsetail (Equisetum arvense), Ranunculus flammula (greater creeping spearwort), bugle hedgenettle (Stachys ajugoides), willowherb (Epilobium sp.), and Douglas' sagewort (Artemisia douglasiana). This is not a complete species list. Annual production ranges from 3,000 to 3,500 lbs/ acre.

PCC4: Thinleaf Alder Community

The thinleaf alder (Alnus incana ssp. tenuifolia) community is found along active stream channels. Although thinleaf alder dominates, a variety of other species are present, including fowl mannagrass (Glyceria striata), field horsetail (Equisetum arvense), bugle hedgenettle (Stachys ajugoides), willowherb (Epilobium sp.), Douglas' sagewort (Artemisia douglasiana), California false hellebore (Veratrum californicum), and arrowleaf ragwort (Senecio triangularis). The cover of thinleaf alder is very dense, and the diversity and production of the understory is low beneath the canopy. In the canopy openings associated species exhibit higher cover and production. Production of mountain alder ranges from 2,800 to 3,500 lbs/acre. Production of the associated species in the canopy openings (adjusted for production across the landscape) ranges from 300 to 500 lbs/acre.

PCC5: Sedge Community

The sedge plant community is found in stable, flatter areas. It is generally separated from the spring source by a seep community or the bulrush community. It is dominated by mixed sedges (Carex spp.), including littleleaf sedge (Carex luzulifolia), smallwing sedge (Carex microptera), Nebraska sedge (Carex nebrascensis), and analogue sedge (Carex simulata). Other common species are tundra aster (Oreostemma alpigenum), willowherb (Epilobium sp.), tinker's penny (Hypericum anagalloides), Scouler's St. Johnswort (Hypericum scouleri Hook. ssp. scouleri), and mountain rush (Juncus arcticus ssp. littoralis). Species from the grass and forb community are present in small amounts. Annual production ranges from 2,800 to 3,300 lbs/ acre.

PCC6: Forb and Grass Community

This community is dominated by California false hellebore (Veratrum californicum) and arrowleaf ragwort (Senecio triangularis). Other species that may be present include common yarrow (Achillea millefolium), western needlegrass (Achnatherum occidentale), pussytoes (Antennaria sp.), California brome (Bromus carinatus), squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), common cowparsnip (Heracleum maximum), meadow barley (Hordeum brachyantherum), bigleaf lupine, (Lupinus polyphyllus), and yampah (Perideridia sp.). Annual production ranges from 3,200 to 3,600 lbs/acre.

PCC7: Arrowleaf Balsamroot Community

The arrowleaf balsamroot (Balsamorhiza sagittata) community is found adjacent to the wet meadow and on dry hummocks within the meadow. It is heavily dominated by arrowleaf balsamroot, with a low cover of longspur lupine (Lupinus arbustus), mountain monardella (Monardella odoratissima), Indian paintbrush (Castilleja sp.), California brome (Bromus carinatus), squirreltail (Elymus elymoides), and yampah (Perideridia sp.). Western white pine (Pinus monticola), California red fir (Abies magnifica), and mountain hemlock have low cover. Annual production ranges from 500 to 900 lbs/acre.

If this site becomes permanently stable there is some indication that thinleaf alder thickets may develop. This would be another state, but without data support this state was not included at this time.

Community Phase Pathway 1.1a

This pathway is created by changes in spring flow, channel course, or stream gradient, which alters the surrounding hydrology and plant communities.

Recently Active- Hydrothermally altered seep complex - Community Phase 1.2

Headcut

Barren

This Community Phase is a natural phase within State 1. It has the same plant community components as Community Phase 1.1, but the relative distribution of each component has shifted due to changes in hydrology. Additional research into the activity rate of the hot springs and soil movement would be beneficial to determine the impact of these activities on this ecological site. Such research may indicate additional community phases. The scale of impact could potentially be larger than indicated here.

Spring flow can easily be diverted by buildup of microbial and vegetative root mats. The barren community in the photo above was created when the small stream was diverted by a dense vegetative growth of seep monkeyflower. The subsequent decline in water availability caused the hydrophytic vegetation to decline and the more upland species have not yet established. With time these hummocks will re-vegetate. The plant community that will return depends upon water table depth.

The hummocky nature of these sloping meadows may be a result of slow soil movement. As the fine textured soils saturate and become viscid, the stream headcuts through the lower toeslopes of the hummocks as it tries to regain a natural gradient. As the stream down cuts, it creates drier terraces above the channel. The forb/grass community may replace the wetter community components.

PCC8, Barren Community
This community is basically barren, but there are scattered plants present including mountain rush (Juncus arcticus ssp. littoralis), seep monkeyflower (Mimulus guttatus), bugle hedgenettle (Stachys ajugoides), Douglas' thistle (Cirsium douglasii), Douglas' sagewort (Artemisia douglasiana), mat muhly (Muhlenbergia richardsonis), and sanddune wallflower (Erysimum capitatum). Annual production has not been collected on this plant community but is estimated to be between 10 to 70 lbs/acre.

Community Phase Pathway 1.2a
This pathway is created during periods of stability.

Ecological Site Interpretations

Animal Community:
This site provides basic and valuable resources for wildlife such as water, forage, and cover. The leaves, stems, and seeds of Nebraska sedge, tufted hairgrass, and other grasses and sedges provide forage for wildlife and livestock. The sedges and bunchgrasses provide nesting habitat for waterfowl and cover for small mammals.

Plant Preference by Animal Kind:

Hydrology Functions:
The hydrologic function of this ecological site is to provide a catchment for water, sediments, and nutrients. These sites allow sediments from spring snow melt to settle out and trap nutrients in surface and subsurface flows. This site stores water and releases it slowly down the drainage throughout the year.

Recreational Uses:
This site provides beautiful open scenery for wildlife viewing and photography. Caution is recommended travelling in this area because of hydrothermal seeps.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Very Deep Loamy Slopes	F022BI113CA	This is an open red fir forest found on the adjacent hillslopes.
Moderately Deep Fragmental Slopes	R022BI203CA	This is an open arrowleaf balsamroot- woolly mule-ears site found on adjacent mountain slopes.
Active Hydrothermal Areas (Complex)	R022BI216CA	This site is associated with the steep, active hydrothermal areas. It is sparsely vegetated and dry.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Alluvial Flat	R022BI202CA	This is a montane meadow-fen site found at lower elevations on more stable sites.
Spring Complex	R022BI211CA	This is spring site is dominated by mountain alder and is found on hillslopes.
Frigid Lacustrine Flat	R022BI217CA	This meadow site is found on lake margins and relic glacial lakes.
Thermal Seeps	R022BI218CA	This site is associated with thermal springs near Drakesbad Meadow.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789258 Type location
789258B (PCC3)
789281 (PCC5 and PCC6)
789282(PCC3, PCC5 and PCC6)
789344

Type Locality:

State:	CA
County:	Tehama
Township:	30 N
Range:	4 E
Section:	22
Datum:	NAD83
Zone:	10
Northing:	4477823
Easting:	624614
General Legal Description:	The type location is about 1/2 a mile SSW of Sulphur Works parking lot in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	

Latitude Decimal:

Longitude Degrees:

Longitude Minutes:

Longitude Seconds:

Longitude Decimal:

Universal Transverse Mercator (UTM) system: NAD83104477823624614

Relationship to Other Established Classifications:

Other References:

Bestelmeyer, Brandon T.; Brown, Joel R.; Havstad, Kris M.; Alexander, Robert; Chavez, George; and Herrick Jeffrey E.; 2003. Development and Use of State-and-Transition Models for Rangelands. Journal of Range Management, Vol. 56, No. 2 (Mar., 2003), pp. 114-126. Allen Press and Society for Range Management. Stable URL: http://www.jstor.org/stable/4003894

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Wilson, Mark S.; Siering, Patricia L.; White, Christopher L.; Hauser, Michelle E.; and Bartles, Andrea N. (2008). Microbial diversity and dynamics in an acidic hotspring at Lassen Volcanic National Park. Environmental Microbiology, 56 (2), 292-305 (http://www.springerlink.com/content/371xh7144562w637)

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Frigid Loamy Flood Plains

/ *Alnus incana ssp. tenuifolia - Salix lemmonii* / *Carex angustata - Carex nebrascensis*
(/ mountain alder - Lemmon's willow / widefruit sedge - Nebraska sedge)

Site ID: R022BI210CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by a “C” type stream channel.
Slopes: 0 to 3 percent
Landform: Flood plain, but also includes dynamics involving associated stream channel and stream terrace.
Soils: Very deep, poorly drained soils that formed in alluvium from volcanic rocks.
Temp regime: Frigid.
MAAT: 42 to 43 degrees F (5.5 to 6.1 degrees C).
MAP: 45 to 87 inches (1,143 to 2,210 mm).
Soil texture: Stony ashy loam.
Surface fragments: 0 to 21 percent composed of: 5 percent subrounded fine gravel, 5 percent subrounded medium and coarse gravel, and 5 percent subrounded stones.
Vegetation: Several riparian stream communities including a pioneer forb community, a thinleaf alder community and a Sierra lodgepole pine forest.

Physiographic Features

This site encompasses the stream channel, its associated flood plains and lower terraces. This site is found between 5,240 and 6,460 feet in elevation. Slopes range from 0 to 3 percent.

Landform: (1) Flood plain

	Minimum	Maximum
Elevation (feet):	5240	6460
Slope (percent):	0	3

Water Table Depth (inches):	0	51
Flooding:		
Frequency:	Rare	Frequent
Duration:	Brief	Long
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 45 to 87 inches (1,143 to 2,210 mm) and the mean annual temperature ranges from 42 to 43 degrees F (5.5 to 6.1 degrees C). The frost free (>32F) season is 70 to 90 days. The freeze free (>28F) season is 85 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	70	90
Freeze-free period (days):	85	200
Mean annual precipitation (inches):	45.0	87.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This ecological site is associated with small stream channels and the associated flood plains and lower terraces.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Riverine	Lower Perennial	Unconsolidated Bottom

Stream Types: (RosGen Narrative)

C3,C3b,C3c--This stream is a single-thread channel that is slightly entrenched, it typically gets out of bank two years out of three. It has a moderate to high width to depth ratio and high sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier) or be less than 0.1 percent (c- modifier). It is a cobble-bottom stream.

C4,C4b,C4c--This stream is a single-thread channel that is slightly entrenched, it typically gets out of bank two years out of three. It has a moderate to high width to depth ratio and high sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier) or be less than 0.1 percent (c- modifier). It is a gravel-bottom stream.

C5,C5b,C5c--This stream is a single-thread channel that is slightly entrenched, it typically gets out of bank two years out of three. It has a moderate to high width to depth ratio and high sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier) or be less than 0.1 percent (c- modifier). It is a sand-bottom stream.

Representative Soil Features

The Aquandic Humaquepts, Flood Plains soil component is associated with this site. It consists of very deep, poorly drained soils that formed in alluvium from volcanic rocks. The A horizons have a stony ashy loam texture with medium subsurface textures and a high percentage of rock fragments. Redoximorphic features including masses of oxidized iron and gleyed soil colors are present 7 inches below the surface. The water table is high after spring snow melt but drops quickly.

This ecological site has been correlated with the following map units and soil components:

Map Unit/ Component /Component percent
789125 Aquandic Humaquepts, flood plains/ 40

Parent Materials:
- Kind: Alluvium
- Origin: Volcanic rock

Surface Texture: (1)Stony ashy loam
Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	16
Surface Fragments > 3" (% Cover):	0	5
Subsurface Fragments <=3" (% Volume):	0	30
Subsurface Fragments > 3" (% Volume):	0	30

Drainage Class: Poorly drained To Poorly drained
Permeability Class: Moderate To Moderate

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	3.06	8.56

Plant Communities

Ecological Dynamics of the Site

This site is associated with alluvial deposits from Holocene age stream processes, and a Rosgen “C” type channel. These channels are in lower gradient, glacially carved U shaped valleys, where deposition occurs to form flood plains. The alluvial deposits and channel migration are restricted to the valley floors. As the channels migrate in the confined corridors, former channels are buried with overbank deposits from subsequent channel courses and typically form soil profiles with coarser channel deposits under finer overbank deposits. As down cutting occurred (likely due to uplift) the streams cut down into the original flood plain surfaces and transformed them into stream terraces and formed new flood plains at the lower channel level (NRCS, 2010).

This site supports a "C" type channel according to the Rosgen classification scheme. A "C" type channel is a slightly entrenched single thread meandering channel with a well defined floodplain. The channel has moderate to high sinuosity generally with less than 2 percent gradient, but it can range from 2 to 3.9 percent (b modifier) . These channel types generally have a width to depth ratio greater than 12, which means they are wide and shallow. They are often found in broad valleys with well developed alluvial floodplain terraces and such channels typically flood over bank two years out of three. In an undegraded state, a 50 year flood event should overflow onto the floodplain.

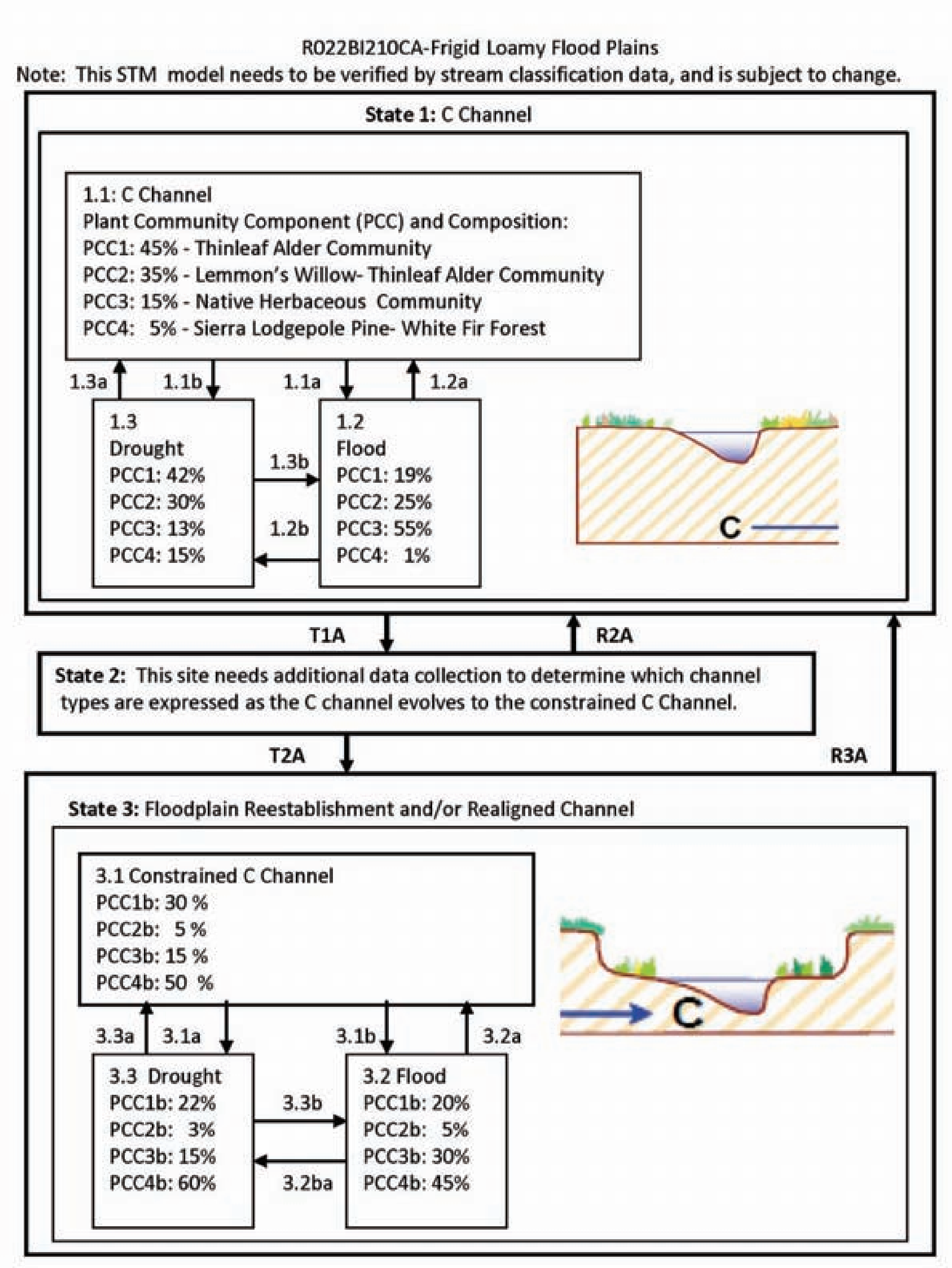
C type channels are constantly in the process or transporting and storing sediments from upstream sources or bank erosion. As the particle size of the channel bottom material decreases, the sediment supply generally increases and so does the erosion potential. The channel on this site supports cobble- bottom (C3), gravel-bottom (C4), and sand bottom (C5) reaches which have moderate to very high erosion potentials, respectively. The sensitivity to disturbance is very high for both C4 and C5 types, and moderate for C3. Vegetation exerts a very high controlling influence on stream dynamics in all three types (Rosgen, 1994).

The plant community along the channel occurs in distinct zones related to variable water table depth and disturbance events. A shrub community comprised of thinleaf alder or a mix of thinleaf alder and Lemmon's willow dominates the site in an undisturbed state. The riparian shrub community requires seasonal flooding and a water table that normally remains within 3 feet of the surface. Both thinleaf alder and Lemmon's willow are flood and shade tolerant and act as an important stabilizing component of the streambank. Streambanks anchored by these shrubs are stable and can withstand relatively severe spring runoff and flooding. As alder and willow thickets develop after floods finer fluvial deposits are trapped within the extensive root networks, facilitating sediment accumulation. Thus the coarse channel deposits of cobble, gravel or sand, where thinleaf alder and willow typically establish, eventually develop a loam or sandy loam surface soil texture from overbank deposits overlaying the coarser channel deposits. In addition, thinleaf alder improves soil fertility through the addition of nitrogen to the soil from nitrogen-fixing root nodules and a nitrogen-rich leaf litter. The finer sediment (overbank deposits) and increased fertility enables establishment and retention of a native herbaceous community that provides valuable forage and habitat for wildlife. At this site, the adjacent upland habitat is a coniferous forest of Sierra lodgepole pine and white fir.

C type channels can become unstable due to disturbances which impact the stream bank vegetation, change the flow regime, or alter the channel morphology. Overgrazing and excessive trampling by livestock can seriously reduce streambank stability. Continued disturbance can entrench the stream, disconnecting it from its floodplain and creating a deeply incised G or F type channel. These channels ("G" and "F") generally lose the wetland obligate species and become dominated by upland grass, shrub and/or forest plant communities. Eventually, a new entrenched "C" type channel may form that resembles the original "C" type channel. The entrenched channel supports wetland plant communities but it is constrained by terraces to the lower floodplain where a lower water table supports a greater proportion of upland plants.

This ecological site is a complex of riparian plant communities that are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community component composition as a result of disturbance, rather than focusing on the succession of one plant community. Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram



C Channel - State 1

This state is a single thread C type channel set in a broad valley bottom with gentle slopes associated with Holocene alluvial deposits. C channels are considered slightly entrenched and have a moderate to high width to depth ratio. Sinuosity is moderate to high, resulting in a well-defined meandering channel. The slope is low gradient and point bar formation and riffle/pool morphology are common features. C channels tend to be wide and shallow with a well-defined floodplain and may have alluvial terraces of abandoned floodplains.

Obligate wetland species dominate the site in the undisturbed community phase. A shrub community comprised of thinleaf alder is found on the stream banks of the active channel while a mixed community of thinleaf alder/Lemmon's willow is found on the floodplains. A pioneer plant community of native herbs is found on recently exposed substrate, generally along the stream channel, but may also be found on upper side channels. The adjacent upland habitat is coniferous forest of Sierra lodgepole pine and white fir.

C Channel - Community Phase 1.1

Lemmons Willow-Thinleaf Alder Community

The plant communities along the C channel occur in distinct zones related to variable water table depth and disturbance events. Approximately 45% of the total vegetation is a thinleaf alder community that forms a continuous stringer immediately adjacent to the stream where the water table stays relatively high year round. A mixed thinleaf alder/ Lemmon's willow community occupies the floodplains and accounts for 35% of the total vegetation. This community requires seasonal flooding and a water table that normally remains within 3 feet of the surface. Both thinleaf alder and Lemmon's willow are flood and shade tolerant and act as an important stabilizing component of the streambank. These shrubs produce copius amounts of seeds in the fall and winter and seeds germinate immediately after dispersal when conditions are favorable. Germination and seedling establishment is optimal on exposed mineral substrate. Thinleaf alder may also reproduce vegetatively through spreading underground rhizomes or suckers, but Lemmon's willow does not have this capacity. Both species can re-sprout vigorous following a top cut or fire.

Streambanks anchored by these shrubs are stable and can withstand relatively severe spring runoff and flooding. As alder and willow thickets develop after floods finer fluvial deposits are trapped within the extensive root networks, facilitating soil development. In addition, thinleaf alder improves soil fertility through the addition of nitrogen to the soil from nitrogen-fixing root nodules and a nitrogen-rich leaf litter. The improved soil texture and fertility enables establishment and retention of an understory dominated by sedges. The extensive root mats formed by the sedge component further stabilizes the streambank.

Drought and flood are the primary forces that drive transitions between alternate community phases. A lower water table from prolonged drought facilitates encroachment of the upland community on the floodplain and an associated reduction in the thinleaf alder/Lemmon's willow community. Conversely, a flood destroys sections of the thinleaf alder community within the active channel and favors establishment of the pioneering native herb community that colonizes recently exposed substrate and provides valuable forage and habitat for wildlife.

Plant Community Component (PCC) and Composition:

PCC1: 45% - Thinleaf Alder Community:
This community is found on the stream banks of the active channel. Data was not collected for this community component, for this state. However, it most likely has similar species as PCC1b, which is present in the constrained C channel in State 3. Thinleaf alder is the dominant shrub, associated species may be squirrel tail (Elymus elymoides), panicled bulrush (Scirpus microcarpus), common rush (Juncus effusus), smallwing sedge (Carex microptera), bigleaf sedge (Carex amplifolia), swordleaf rush (Juncus ensifolius), fowl mannagrass (Glyceria striata), bentgrass (Agrostis spp.), narrowfruit sedge (Carex specifica), stinging nettle (Urtica dioica), western pearly everlasting (Anaphalis margaritacea), fringed willowherb (Epilobium ciliatum), common cowparsnip (Heracleum maximum), stickywilly (Galium aparine) , seep monkeyflower (Mimulus guttatus), American vetch (Vicia americana), bugle hedgenettle (Stachys ajugoides), field horsetail (Equisetum arvense), Douglas' thistle (Cirsium douglasii), California false hellebore (Veratrum californicum var. californicum), naked buckwheat (Eriogonum nudum), sweetcicely (Osmorhiza berteroi), Douglas' sagewort (Artemisia douglasiana), sticky cinquefoil (Potentilla glandulosa), tall phacelia (Phacelia procera).

PCC2: 35% - Lemmon's Willow-Thinleaf Alder Community:
This plant community is found on floodplains. There is about 40% cover of Lemmons' willow (Salix lemmonii), and 10% cover of thinleaf alder (Alnus incana ssp. tenuifolia). Sedges

dominate the understory. Common plants are panicled bulrush (Scirpus microcarpus), widefruit sedge (Carex angustata), Nebraska sedge (Carex nebrascensis), manyrib sedge (Carex multicostata), lakeshore sedge (Carex lenticularis), mountain rush (Juncus arcticus ssp. littoralis), bluejoint (Calamagrostis canadensis), pale false mannagrass (Torreyochloa pallida), field horsetail (Equisetum arvense), threepetal bedstraw (Galium trifidum), violet (Viola sp.), bugle hedgenettle (Stachys ajugoides), common cowparsnip (Heracleum maximum), Utah serviceberry (Amelanchier utahensis), and other sedges (Carex spp.). Total annual production ranges from 1800 to 3500 lbs acre. Widefruit sedge produced the majority of the understory production.

PCC3: 15% - Native Herbaceous Community:
This is a pioneer plant community, which is found on recently exposed substrate, generally along the stream channel but may also be found on upper side channels. Data was not collected on this PCC, but it may be similar to PCC3b, which is associated with squirrel tail (Elymus elymoides), common rush (Juncus effusus), swordleaf rush (Juncus ensifolius), fowl mannagrass (Glyceria striata), bentgrass (Agrostis spp.), stinging nettle (Urtica dioica), western pearly everlasting (Anaphalis margaritacea), tiny trumpet (Collomia linearis), fringed willowherb (Epilobium ciliatum), common cowparsnip (Heracleum maximum), stickywilly (Galium aparine) , seep monkeyflower (Mimulus guttatus), American vetch (Vicia americana), bugle hedgenettle (Stachys ajugoides), field horsetail (Equisetum arvense), Douglas' thistle (Cirsium douglasii), California false hellebore (Veratrum californicum var. californicum), naked buckwheat (Eriogonum nudum), sweetcicely (Osmorhiza berteroi), Douglas' sagewort (Artemisia douglasiana), sticky cinquefoil (Potentilla glandulosa), tall phacelia (Phacelia procera). common sheep sorrel (Rumex acetosella) Jones' sedge (Carex jonesii)

PCC4: 5% - Sierra Lodgepole Pine- White Fir Forest:
This plant community is on rarely flooded flood plains. It would not be extensive in this state, because the high water table and occasional flood would keep the forest from establishing. This is often an open forest with multiple age classes of trees. The understory is dominated by grasses. Sierra lodgepole pine (Pinus contorta ssp. murrayana) is the dominant tree, with white fir (Abies concolor), incense cedar (Calocedrus decurrens), Jeffrey pine (Pinus jeffreyi), sugar pine (Pinus lambertiana), and black cottonwood (Populus balsamifera ssp. trichocarpa) occasionally present in small amounts. The dominant understory plants include blue wildrye (Elymus glaucus), bearded mellicgrass (Melica aristata), and western needlegrass (Achnatherum occidentale). Other plants are white hawkweed (Hieracium albiflorum), sweetcicely (Osmorhiza berteroi) naked buckwheat (Eriogonum nudum), dusky onion (Allium campanulatum), stickywilly (Galium aparine), yarrow (Achillea millefolium), American vetch (Vicia americana), Pacific bleeding heart (Dicentra formosa), California false hellebore (Veratrum californicum var. californicum), tiny trumpet (Collomia linearis), whitestem gooseberry (Ribes inerme), Gray's licorice-root (Ligusticum grayi), starry false lily of the valley (Smilacina stellata), whiskerbrush (Leptosiphon ciliatus ssp. ciliatus), California stickseed (Hackelia californica), common sheep sorrel (Rumex acetosella), little oniongrass (Melica fugax), narrowfruit sedge (Carex specifica), Jones' sedge (Carex jonesii), and California brome (Bromus carinatus). Total production is between 500 and 800 lbs/acre.

Community Phase Pathway 1.1a
This pathway is created when a flood scours the channel of existing vegetation, depositing a layer of sediment and initiating regeneration.

Community Phase Pathway 1.1b
This pathway is created by natural processes that cause the site to become drier, usually several years of drought.

Flood - Community Phase 1.2
This community phase develops after a major flood event. The plant community components remain the same, as described in Community phase 1.1, but the proportion of each community type shifts after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing large quantities of sediment in other areas. The destruction of sections of the thinleaf alder community in the channel is accompanied by a dramatic increase in the herbaceous pioneer community. After the flood the early seral grasses like squirrel tail and herbs quickly colonize the recently exposed substrate and within a season the herbaceous community may comprise over half (55%) of the total riparian vegetation.

Estimate of plant community component composition in this phase:

PCC1: 19%
PCC2: 25%
PCC3: 55%
PCC4: 1%

Community Phase Pathway 1.2a
This pathway is created with time and allows for the recovery of the plant communities after a flood event.

Community Phase Pathway 1.2b
This pathway is created with prolonged periods of drought.

Drought - Community Phase 1.3
This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates encroachment of the upland Sierra lodgepole pine- white fir forest on the floodplain, and an associated reduction in the thinleaf alder/Lemmon’s willow community.

Estimate of plant community component composition in this phase:

PCC1: 42%
PCC2: 30%
PCC3: 13%
PCC4: 15%

Community Phase Pathway 1.3a
This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Community Phase Pathway 1.3b
This pathway is created when a flood causes bank erosion and sediment deposition.

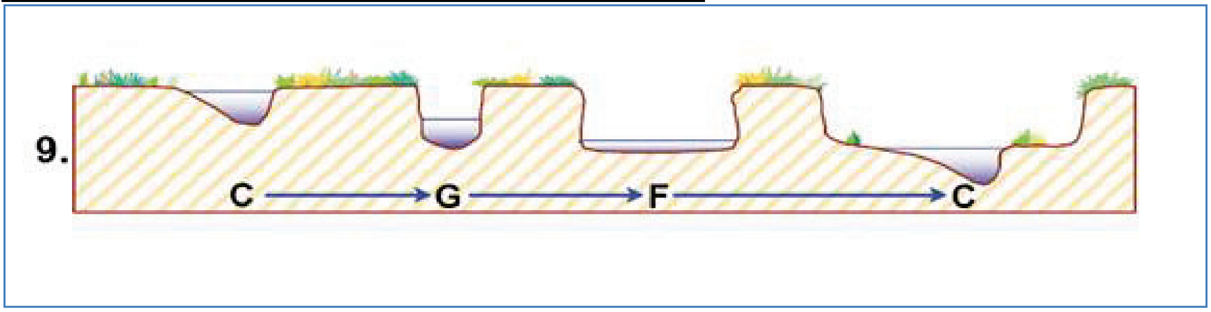
Transition - 1A
This transition can occur naturally as the “C” type channel in State 1 down-cuts through the valley bottom. The channel on this site supports cobble-bottom (C3), gravel-bottom (C4), and sand-bottom (C5) reaches which have moderate to very high erosion potentials, respectively. Bank erosion is a natural river adjustment process and can as the result of mass wasting, liquification, freeze-thaw, fluvial entrainment, and ice scour. The glacial outwash and alluvial deposits in the U-shaped valley bottom are gradually eroded through these processes.

This transition can also be initiated by a disturbance that alters the hydrology of the site or impacts the vegetation along the stream bank. Alterations that can affect the hydrology of this site include channel realignment and/or confinement, culvert installations, and road construction. Such alterations straightened the channel, eliminating its ability to meander. This increases the shear stress along the stream bank, which accelerates stream bank erosion, thereby increasing sediment supply and decreasing sediment transport capacity. As the channel straightens it has a shorter course down the valley, creating a steeper gradient. The stream may adjust by headcutting into the base level of the channel until it establishes a new gradient through the meadow. As the stream bed is lowered, so is the water table in the meadow. The new larger and steeper channel can contain more flow, reducing the frequency of flooding and the extent of the floodplain, creating terraces. Cattle grazing and/or the seeding of non-native grass for forage can cause a similar entrenchment of the channel but through a different mechanism. When cattle reduce vegetation and trample the exposed stream banks, the resulting erosion also leads to eventual straightening and headcutting of the channel. Likewise, when non-native grasses displace the native riparian sedges and rushes, the stabilizing root mats that help prevent erosion are also removed.

<u>Stream Channel Succession - State 2</u>

Additional stream classification data is required to determine which channel types are expressed as the C channel evolves in response to disturbance. In a typical succession scenario, the “C” type channel in State 1 down-cuts into an entrenched low gradient “G” type channel that naturally begins to widen over time into an entrenched “F” type channel. The plant community components associated with these possible successional channel types is not known. However, deeply incised “G” and “F” channels generally lose the wetland obligate species and become dominated by upland grass, shrub and/or forest plant communities. As the water table lowers at the site, the adjacent conifer community of Sierra lodgepole and white fir would encroach and reduce the thinleaf alder and mixed willow riparian community. Upland grass species like blue wildrye and western neeedlegrass would begin to dominate the native herbaceous community.

Stream Channel Succession - Community Phase 2.1



Rosgen Stream Succession Scenario #9

As the “C” type channel in State 1 down-cuts through deposits naturally or as a result of stream bank erosion, an entrenched low gradient “G” type channel develops. This gully-like entrenched channel is unstable and will naturally begin to widen over time into an entrenched “F” type channel. The broadly entrenched “F” type channel allows for sediment deposition, which builds point bars and floodplains with a meandering channel. As riparian vegetation begins to reestablish on the new floodplains, channel stability increases, and an entrenched “C” type channel with a developed floodplain and a meandering channel will eventually develop within the entrenched “F” type channel. This new entrenched “C” type channel may resemble the original “C” type channel with wetland plant communities, but it will be constrained by terraces to the lower floodplain area. The old floodplain becomes a terrace, disconnected from flood events. The terrace has a lower seasonal water table which supports a greater proportion of upland plant communities.

Transition - 2A
This transition occurs when continued sediment deposition in the broadly entrenched “F” type channel allows the riparian vegetation to reestablish on the new floodplain. The vegetation increases channel stability and eventually channel sinuosity returns and a new meandering channel will develop that is constrained by the old floodplain.

Restoration Pathway - 2A
Additional stream classification data is required to determine which channel types are expressed in State 2 as the C channel evolves in response to disturbance. Without this data it is not possible to identify the restoration pathway for the intermediate phase of the stream succession scenario.

Constrained C Channel - State 3
This C Channel has re-established a floodplain and natural sinuosity. It is constrained by the old flood plain, which is now a hydrologically disconnected terrace.

Constrained C Channel - Community Phase 3.1

Loamy Flood Plains

PCC4 encroaching PCC1b

This community phase has similar plant community components as community phase 1.1, but the species composition may have changed, and the overall distribution of the community components has changed. The species composition may include non-native species such as Kentucky bluegrass (Poa pratensis), common dandelion (Taraxicum officinale), common mullein (Verbascum thapsus), and rat-tail fescue (Vulpia myuros).

The composition of the plant communities has shifted primarily, because the stream channel incised through deposits creating a terrace with an upland plant community (PCC4). The riparian communities are confined to a smaller area within the new floodplain. In some areas, the sedges associated with the Lemmon's willow- thinleaf alder community (PCC2) have been replaced by grasses because of lower water tables.

PCC1b: 30%
This plant community is found along the stream banks. There are point bars, vertical and over hanging banks, and eroded un-vegetated banks. Thinleaf alder is the dominant shrub, with about 27 percent cover, and 2600 lbs/acre annual production. This plant community component may be similar to PCC1 in state 1, but has experienced bank erosion, channel incision, and the introduction of non-native species. Common species are: Kentucky bluegrass (Poa pratensis) squirrel tail (Elymus elymoides), panicled bulrush (Scirpus microcarpus), common rush (Juncus effusus), smallwing sedge (Carex microptera), bigleaf sedge (Carex amplifolia), swordleaf rush (Juncus ensifolius), fowl mannagrass (Glyceria striata), bentgrass (Agrostis spp.), timothy (Phleum pretense), narrowfruit sedge (Carex specifica), stinging nettle (Urtica dioica), western pearly everlasting (Anaphalis margaritacea), fringed willowherb (Epilobium ciliatum), common cowparsnip (Heracleum maximum), stickywilly (Galium aparine) , seep monkeyflower (Mimulus guttatus), American vetch (Vicia americana), bugle hedgenettle (Stachys ajugoides), field horsetail (Equisetum arvense), Douglas’ thistle (Cirsium douglasii), California false hellebore (Veratrum californicum var. californicum), common mullein (Verbascum thapsus), naked buckwheat (Eriogonum nudum), sweetcicely (Osmorhiza berteroi), Douglas’ sagewort (Artemisia douglasiana), sticky cinquefoil (Potentilla glandulosa), Bolander’s madia (Kyhosia bolanderi), and tall phacelia (Phacelia procera).

PCC2b: 5%
This plant community is similar to PCC2, but the composition of grasses and forbs has increased, while the sedges have decreased. The production of thinleaf alder (Alnus incana ssp. tenuifolia) and Lemmon’s willow (Salix lemmoni) is less than PCC2, in state 1. Lemmon’s willow may be much less abundant in PCC2b, than in PCC2. Total annual shrub production is about 1100 lbs/acre. Dominant plants are widefruit sedge (Carex angustata), blue wildrye (Elymus glaucus), California brome (Bromus carinatus), meadow barley (Hordeum brachyantherum), mountain rush (Juncus arcticus ssp. littoralis), and California false hellebore (Veratrum californicum var. californicum). Other species present are sedges (Carex spp.), Kentucky bluegrass (Poa pratensis), Gray’s licorice-root (Ligusticum grayi), bugle hedgenettle (Stachys ajugoides), Lemmon’s yampah (Perideridia lemmonii), longstalk clover (Trifolium longipes), Douglas’ knotweed (Polygonum douglasii), spreading groundsmoke (Gayophytum diffusum), Sierra stickseed (Hackelia nervosa), violet (Viola spp.), knotweed (Polygonum spp.), Rydberg’s penstemon (Penstemon rydbergii), Ashland cinquefoil (Potentilla glandulosa ssp. ashlandica), aster (Aster spp.), yarrow (Achillea millefolium), American vetch (Vicia americana), Douglas’ thistle (Cirsium douglasii), Oregon checkerbloom (Sidalcea oregana ssp. spicata), and rat-tail fescue (Vulpia myuros). Understory production ranges from 900 to 1200 lbs per acre.

PCC3b: 15%
This pioneer plant community is found on recently disturbed point bars and side channels. Common species are squirrel tail (Elymus elymoides), common rush (Juncus effusus), swordleaf rush (Juncus ensifolius), fowl mannagrass (Glyceria striata), bentgrass (Agrostis spp.), timothy (Phleum pretense), stinging nettle (Urtica dioica), western pearly everlasting (Anaphalis margaritacea), tiny trumpet (Collomia linearis), fringed willowherb (Epilobium ciliatum), common cowparsnip (Heracleum maximum), stickywilly (Galium aparine) , seep monkeyflower

(Mimulus guttatus), American vetch (Vicia americana), bugle hedgenettle (Stachys ajugoides), field horsetail (Equisetum arvense), California false hellebore (Veratrum californicum var. californicum), common mullein (Verbascum Thapsus), naked buckwheat (Eriogonum nudum), sweetcicely (Osmorhiza berteroi), Douglas' sagewort (Artemisia douglasiana), sticky cinquefoil (Potentilla glandulosa), common sheep sorrel (Rumex acetosella), Jones' sedge (Carex jonesii), and tall phacelia (Phacelia procera). Production data was not collected for this PCC.

PCC4b: 50%
This plant community is similar to Community Phase 1.1, Sierra Lodgepole Pine-White Fir Forest (PCC4), but includes several non-native grasses. As drier terraces now occupy a larger component of the valley bottom, the upland community comprises 50% of the formerly riparian vegetation. Please refer to the species listed in PCC4 in Community phase 1.1. Additional non-native species include Kentucky bluegrass (Poa pratensis) and rat-tail fescue (Vulpia myuros), but they are of limited extent.

Community Phase Pathway 3.1a
This pathway is created by natural processes that cause the meadow to become drier, such as prolonged drought.

Community Phase Pathway 3.1b
This pathway is created when a flood creates erosion and deposition, leaving barren soil for early successional species to establish.

<u>Flood - Community Phase 3.2</u>
This community phase develops after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing large quantities of sediment in other areas. The plant community components remain the same, as described in Community phase 1.1, but the proportion of each community types shifts. The destruction of sections of the thinleaf alder community in the channel is accompanied by a dramatic increase in the herbaceous pioneer community. However since the channel is constrained, the old flood plain is now a hydrologically disconnected terrace. With a lowered water table, the upland community gradually replaces the thinleaf alder /Lemmon's willow and may eventually occupy 45% of the formerly riparian vegetation.

Estimate of plant community component composition in this phase:

PCC1b: 20%
PCC2b: 5%
PCC3b: 30%
PCC4: 45%

Community Phase Pathway 3.2a
This pathway is created with time and allows for the recovery of the plant communities after a flood event.

Community Phase Pathway 3.2b
This pathway is created when the site becomes drier due to drought or other causes.

Drought - Community Phase 3.3
This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates encroachment of the upland Sierra lodgepole pine- white fir forest on the floodplain, and nearly eliminates the thinleaf alder/Lemmon's willow community.

Estimate of plant community component composition in this phase:

PCC1b: 22%
PCC2b: 3%
PCC3b: 15%
PCC4: 60%

Community Phase Pathway 3.3a
This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Community Phase Pathway 3.3b
This pathway is created when a flood leaves barren soil from erosion or deposition, allowing the pioneer plant community to increase in area.

Restoration Pathway - 3A
The processes that have altered this stream system may be natural or human-influenced. If the primary reason for channel adjustment is a result of natural erosion through alluvial deposits as a result of uplift, the channel should be fairly well readjusted and left alone. However, if human caused disturbance has caused the erosion, then restoration procedures should be considered.

The goal of restoration is to return the channel to its full potential, which is defined as the best channel condition, based on quantifiable morphological characteristics of that stream type. For a constrained C channel the goal is to raise the water table, increase the channel sinuosity, and re-establish riparian vegetation on the stream banks to reduce bank erosion. Each segment of the stream channel should be surveyed to determine the evolutionary stages of channel adjustment and evaluate the potential for natural recovery. If natural recovery does not seem likely, a thorough stream departure analysis can determine the feasibility of restoration, anticipate response to future changes in management, and develop appropriate restoration designs.

Ecological Site Interpretations

Animal Community:
This site provides valuable wildlife resources such as water and cover. Thinleaf alder and willow communities often serve as travel corridors for big game animals such as deer and many bird

species utilize these riparian corridors for nesting and brood rearing. Overhanging alder and willow branches provide shade and cover for salmonids. In addition, wildlife and livestock depend on the leaves, stems, and seeds of Nebraska sedge, and other various grasses and sedges as forage. The sedges and bunchgrasses provide nesting habitat for waterfowl and cover and forage for small mammals.

Plant Preference by Animal Kind:

Hydrology Functions:
The hydrological function of the flood plain is to provide a catchment for water, sediments, and nutrients. Floodplains may also provide water storage, which is slowly released down the drainage throughout the year.

Recreational Uses:
These streams provide scenic hiking corridors with wildlife viewing, fishing and photographic opportunities.

Wood Products:
N/A

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This white fir-Sierra lodgepole pine forest is found on adjacent old terraces and hillslopes.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Sandy Flood Plains	R022BI213CA	This riparian site is associated with smaller, B type channels.
Frigid Gravelly Flood Plains	R022BI215CA	This riparian ecological site is associated with larger stream flow with a C to D type channel succession.

State Correlation:
This site has been correlated with the following states:

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

789167- stream terrace
789205
789206- Soil type location

789206b
789206c

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	6 E
Section:	40
Datum:	NAD83
Zone:	10
Northing:	4477086
Easting:	638897
General Legal Description:	The type location is about 0.38 miles west of Kelly Camp, just inside the Lassen Volcanic National Park Boundary.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104477086638897

Relationship to Other Established Classifications:

Other References:

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke, Alison E Stanton	4/23/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Spring Complex

/ *Alnus incana ssp. tenuifolia* / *Heracleum maximum - Elymus glaucus*
(/ mountain alder / common cowparsnip - blue wildrye)

Site ID: R022BI211CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by multiple springs and seeps
Landform: Glacial-valley walls and floors
Elevation (feet): 5,400 to 8,210
Slope (percent): 2 to 50
Water Table Depth (inches): 0 to 49 percent (depending on soil component)
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 51 to 113 inches (1,295 to 2,870 mm)
Primary Precipitation: Snow from November to April
Mean annual temperature: 38 to 43 degrees F (3.3 to 6.1 degrees C).
Restrictive Layer: Bedrock (in some areas)
Temperature Regime: Frigid and Cryic
Moisture Regime: Aquic
Parent Materials: Slope alluvium over colluvium and colluvium from volcanic rocks
Surface Texture: Very bouldery mucky ashy sandy loam and very bouldery ashy loamy sand
Surface Fragments <=3" (% Cover): 0-25
Surface Fragments > 3" (% Cover): 0-40
Soil Depth (inches): 10 to 80
Vegetation: Wet springs dominated by thinleaf alder (Alnus incana ssp. tenuifolia), with a diversity of associated species including blue wildrye (Elymus glaucus), fowl mannagrass (Glyceria striata), rough hedgenettle (Stachys rigida var. rigida), seep monkeyflower (Mimulus guttatus), mosses and California false hellebore (Veratrum californicum var. californicum).

Physiographic Features

This ecological site is found on glacial-valley walls and floors. It occurs between 5,400 feet and 8,210 feet in elevation. Slopes range from 2 to 50 percent.

Landform: (1) Glacial-valley walls and floors

	Minimum	Maximum
Elevation (feet):	5400	8210
Slope (percent):	2	50
Water Table Depth (inches):	0	49
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 51 to 113 inches (1,295 to 2,870 mm) and the mean annual temperature ranges from 38 to 43 degrees F (3.3 to 6.1 degrees C). The frost free (>32F) season is 50 to 90 days. The freeze free (>28F) season is 65 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	50	90
Freeze-free period (days):	65	200
Mean annual precipitation (inches):	0.0	0.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0

Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is a seep and spring ecological site. Seep and spring areas are formed when fractures or fault zones allow water from deeper aquifers to discharge at the surface. The presence of seeps and springs is largely dependent upon characteristics of the local and regional geology. In some cases, the emerging groundwater flows downhill through very small channels called rivulets or runnels that lack the banks, beds, and floodplains of larger streams. Many seeps and springs adjoin rivers, streams, lakes, and other kinds of wetlands. Because of the water source, seeps and springs provide relatively constant inflow and water temperature.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Riverine	Upper Perennial	Unknown

Representative Soil Features

Aquepts and Typic Petraquepts, Bedrock soil components are associated with this site. The Aquepts soil component consists of deep and very deep, poorly drained soils that formed in slope alluvium over colluvium from volcanic rocks. Bedrock is encountered at 40 to 80 inches. There is a thin organic layer of leaves and twigs over a very bouldery mucky ashy sandy loam surface texture, with extremely bouldery ashy sandy loam, extremely cobbly ashy sandy loam, and extremely stony ashy sandy loam subsurface textures. Gleyed soil colors are present at the surface.

The Typic Petraquepts, Bedrock soil component is very shallow to moderately deep, poorly drained, and formed in colluvium from volcanic rocks. There is 2 to 7 inches of leaf litter over a very bouldery ashy loamy sand surface texture. Subsurface textures consist of extremely bouldery ashy coarse sandy loam and extremely bouldery ashy loamy coarse sand. Indurated bedrock occurs between 10 to 40 inches. Gleyed soil colors are present below the O horizons. The water table may be at or near the surface for prolonged periods during the growing season, but can drop to 49 inches in the Aquepts component later in the year and stays above 40 inches in the Typic Petraquepts, Bedrock component.

This ecological site has been correlated with the following map units and soil components:

Map Unit/ Component /Component percent
789126 Aquepts/ 2
789127 Aquepts/ 15
789129 Aquepts/ 2
789143 Aquepts/ 2
789144 Aquepts/ 3
789150 Aquepts/ 2

789151 Aquepts/ 1
789152 Aquepts/ 2
789154 Aquepts/ 3
789155 Aquepts/ 2
789156 Aquepts/ 5
789163 Aquepts/ 1
789166 Aquepts/ 2
789171 Aquepts/ 50
789171 Typic Petraquepts, Bedock / 35
789175 Aquepts/ 2
789176 Aquepts/ 1

Parent Materials:
Kind: Slope alluvium over colluvium, colluvium
Origin: Volcanic rock

Surface Texture: (1)Very bouldery ashy loamy sand
(2)Very bouldery mucky ashy sandy loam

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	25
Surface Fragments > 3" (% Cover):	0	40
Subsurface Fragments <=3" (% Volume):	0	50
Subsurface Fragments > 3" (% Volume):	0	80

Drainage Class: Poorly drained To Poorly drained
Permeability Class: Impermeable To Moderately rapid

	Minimum	Maximum
Depth (inches):	10	80
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.0	3.2

Plant Communities

Ecological Dynamics of the Site

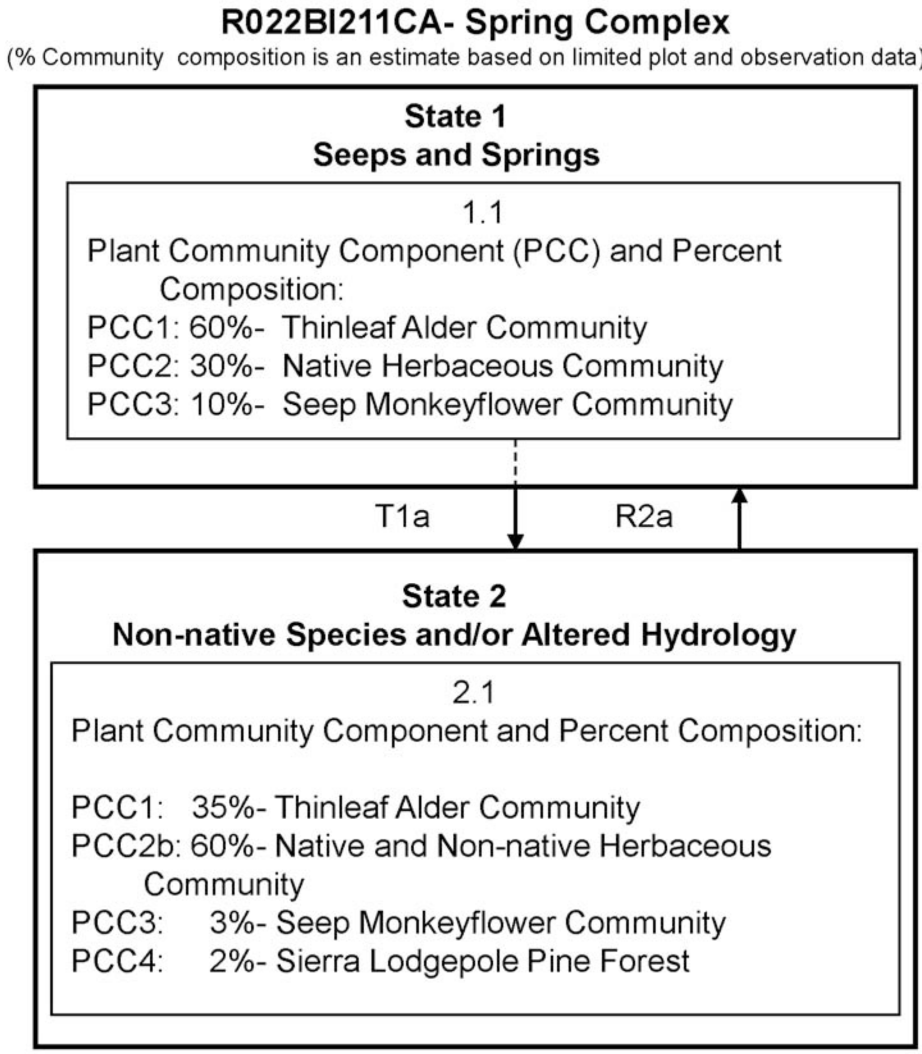
This ecological site is associated with seeps and springs. Seep and spring areas are formed when fractures or fault zones allow water from deeper aquifers to discharge at the surface. The emerging groundwater flows downhill through very small channels called rivulets or runnels that lack the banks, beds, and floodplains of larger streams. These channels are usually less than a couple feet wide and may not be very distinct. The more distinct channels are confined in shallow gully-like channels. Because of the underground water source, seeps and springs provide relatively constant inflow and water temperature and can support unique species adapted to these conditions.

There is a high diversity of plant species within these wet springs and each spring is unique. This ecological site does not attempt to capture all variations of species composition, but will focus on the main concept. Dense thickets of thinleaf alder (Alnus incana ssp. tenuifolia) occur on the site and support a low cover of shade tolerant forbs in the understory. Understory diversity and production is higher in the canopy openings between the alders where a Native Herbaceous Community thrives. Common grass and herbaceous species in that community include blue wildrye (Elymus glaucus), California false hellebore (Veratrum californicum var. californicum), fowl mannagrass (Glyceria striata), rough hedgenettle (Stachys rigida var. rigida), and common cowparsnip (Heracleum maximum). In areas where water flows over exposed bedrock a unique Seep Monkeyflower Community occurs that is dominated by mosses and seep monkeyflower (Mimulus guttatus). Disturbances that alter the hydrology of the site generally have a drying effect and make the site more prone to invasive species invasion and encroachment from the adjacent Sierra lodgepole pine forest.

Soils on these sites developed in volcanic slope alluvium and colluvium and are poorly drained. The water table is at the surface for most of the year, but may drop in drier areas during October, November, and December. The soils may be shallow to very deep, but consistently have a high percentage of large rock fragments throughout the profile and a relatively thin surface organic layer.

The riparian ecological site concept is a relatively new concept for ecological sites. Although this ecological site is not associated with a stream channel, it has several plant communities that are dependent upon water from the spring and seeps. The springs override other parameters that normally define ecological sites, such as soil or climatic variables. The state and transition diagram below illustrates the change in plant community component composition as a result of disturbance, rather than focusing on the succession of one plant community. Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram



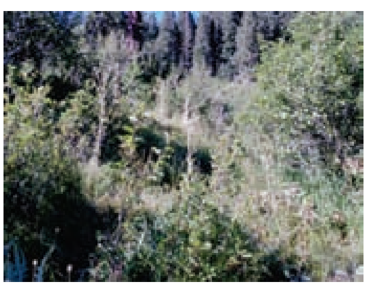
Springs and Seeps - State 1

This is a fairly stable site. Because of the underground water source, seeps and springs are relatively constant environments that are minimally affected by the temperature variations, scouring, and droughts that often affect riparian vegetation. However, springs are replenished by precipitation that percolates into the aquifer, so prolonged drought can alter the hydrology.

Springs are classified as gravity springs or artesian (DOI 2001). Gravity springs are created when water moves along an elevational gradient emerging at the surface. Aquifer springs are created when the water level of the ground water flow system is above the land surface and the water flows out at the surface under pressure from an aquifer outcrop or faults and fractures. The two main types of artesian springs are and fault springs. This ecological site incorporates a fault spring.

Springs and Seeps - Community Phase 1.1

Seep Monkeyflower Community



Thinleaf Alder and Herbaceous Community

This state has one community phase with three main plant community components. The composition of the community components remains relatively static across the hillslopes that receive flow from the springs. Other plant communities are associated with microclimates within these springs, such as saturated small basins or dry hummocks. However, variability is high and consistency is low, so they are not described as community components for this site. The Thinleaf Alder Community is the most widespread and it can be found on shallow to deep soils with varying degrees of wetness. There is very little understory directly under the alders but a Native Herbaceous Community is found in canopy openings among the alders and adjacent to bedrock outcrops. The Seep Monkeyflower Community is found where springs flow over broad benches of exposed bedrock. That unique assemblage of species is fairly open as the alders rarely establish on the bedrock. To capture the main concept, data was collected across the entire hillslope and the cover and production data in the table below is a combination of all three community components. Species are listed under the community component where they most commonly occur.

An estimate of plant community component composition:

PCC1: 60%- Thinleaf Alder Community
Thinleaf alder grows dense in this community with a low cover of shade tolerant forbs in the understory such as small enchanter's nightshade (Circaea alpina ssp. pacifica), redstem springbeauty (Claytonia rubra), brittle bladderfern (Cystopteris fragilis), Pacific bleeding heart (Dicentra Formosa), bugle hedgenettle (Stachys ajugoides), and violets (Viola spp.).

PCC2: 30%- Native Herbaceous Community
This community is found in patches within the alder where there are canopy opening for sufficient sunlight. It can also be continuous across open slopes. Associated plants are common yarrow (Achillea millefolium), western columbine (Aquilegia Formosa), Douglas' thistle (Cirsium douglasii), brittle bladderfern (Cystopteris fragilis), willowherb (Epilobium), stickywilly (Galium aparine), common cowparsnip (Heracleum maximum), streambank bird's-foot trefoil (Lotus oblongifolius), seep monkeyflower (Mimulus guttatus), western sweetroot (Osmorhiza occidentalis), hairy brackenfern (Pteridium aquilinum var. pubescens), arrowleaf ragwort (Senecio triangularis), woollyhead parsnip (Sphenosciadium capitellatum), and California false hellebore (Veratrum californicum var. californicum). Common grasses and grasslikes are bentgrass (Agrostis sp.), sedges (Carex spp.), tufted hairgrass (Deschampsia cespitosa), blue wildrye, (Elymus glaucus), and fowl mannagrass (Glyceria striata).

PCC3: 10%- Seep Monkeyflower Community
This community is dominated by seep monkeyflower (Mimulus guttatus) and mosses. It is a distinct assemblage of species, but it shares many species with the adjacent Native Herbaceous Communtiy. Associated species are common yarrow (Achillea millefolium), western columbine (Aquilegia Formosa), Douglas' thistle (Cirsium douglasii), brittle bladderfern (Cystopteris fragilis), willowherb (Epilobium), rushes (Juncus spp.), California grass of Parnassus (Parnassia californica), Parish's yampah (Perideridia parishii), streambank bird's-foot trefoil (Lotus oblongifolius), arrowleaf ragwort (Senecio triangularis), and woollyhead parsnip (Sphenosciadium capitellatum).

Springs and Seeps Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Forbs					**100**	**1124**		
		common yarrow	ACMI2	*Achillea millefolium*	0	10	0	3
		western columbine	AQFO	*Aquilegia formosa*	0	8	0	2
		small enchanter's	CIALP2	*Circaea alpina ssp.*	0	1	0	1

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
		nightshade		*pacifica*				
		Douglas' thistle	CIDO2	*Cirsium douglasii*	0	85	0	8
		redstem springbeauty	CLRU2	*Claytonia rubra*	0	1	0	1
		brittle bladderfern	CYFR2	*Cystopteris fragilis*	0	25	0	5
		Pacific bleeding heart	DIFO	*Dicentra formosa*	0	8	0	2
		willowherb	EPILO	*Epilobium*	0	1	0	1
		stickywilly	GAAP2	*Galium aparine*	0	1	0	1
		common cowparsnip	HEMA80	*Heracleum maximum*	0	80	0	7
		streambank bird's-foot trefoil	LOOB2	*Lotus oblongifolius*	0	10	0	5
		seep monkeyflower	MIGU	*Mimulus guttatus*	0	15	0	3
		western sweetroot	OSOC	*Osmorhiza occidentalis*	0	8	0	2
		California grass of Parnassus	PACA18	*Parnassia californica*	0	1	0	1
		Parish's yampah	PEPA21	*Perideridia parishii*	0	1	0	1
		hairy brackenfern	PTAQP2	*Pteridium aquilinum var. pubescens*	0	4	0	1
		arrowleaf ragwort	SETR	*Senecio triangularis*	0	150	0	15
		woollyhead parsnip	SPCA5	*Sphenosciadium capitellatum*	0	335	0	15
		bugle hedgenettle	STAJ	*Stachys ajugoides*	0	4	0	1
		California false hellebore	VECAC2	*Veratrum californicum var. californicum*	0	375	0	15
		violet	VIOLA	*Viola*	0	1	0	1

Grass/Grasslike

					Annual Production in Pounds Per Acre		**Foliar Cover Percent**	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**
1 -Grass- Grasslike					**40**	**443**		
		bentgrass	AGROS2	*Agrostis*	0	15	0	4
		sedge	CAREX	*Carex*	0	3	0	1
		tufted hairgrass	DECE	*Deschampsia cespitosa*	0	15	0	3
		blue wildrye	ELGL	*Elymus glaucus*	40	400	2	20
		fowl mannagrass	GLST	*Glyceria striata*	0	10	0	2

Shrub/Vine

					Annual Production in Pounds Per Acre		**Foliar Cover Percent**	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**

1 -Shrubs				**620**	**2600**		
	thinleaf alder	ALINT	*Alnus incana ssp. tenuifolia*	620	2600	25	77

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	40	200	443
Forb	100	820	1124
Shrub/Vine	620	1361	2600
Total:	760	2381	4167

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	2%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	15%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	8%	15%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	0%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	1%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	55%	95%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	0%	25%		**Tree Snags** per Acre**			
Surface Fragments > 3"	0%	40%		Hard Snags***			
Bedrock	0%	1%		Soft Snags***			
Water	0%	12%					
Bare Ground	1%	5%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	1%	0%	6%				
> 0.5 - < 1 feet	0%	8%	0%	35%				
> 1 - <= 2 feet	2%	22%	0%	50%				
> 2 - < 4.5 feet								
> 4.5 - <= 13 feet					30%	77%		
> 13 - < 40 feet								
< 40 - >= 80 feet								
> 80 - < 120 feet								
>= 120 feet								

Transition - 1A

This transition occurs when natural events or human intervention cause a change in spring flow and alters the hydrology of the site. Most often the disturbance will reduce water flow and cause the site to dry. The most likely disturbance at this site is diversion of flow through road construction. Road construction that did not take the site hydrology into consideration could intercept and divert flow. Water diversion is one of the most common disturbances of springs in the western US and has been shown to decrease biological diversity by reducing aquatic habitat and reducing soil moisture (DOI 2001). Grazing is another disturbance that could cause some drying of the site through vegetation removal, trampling, and soil compaction, but this particular area does not appear to be subject to grazing at the present time. Prolonged drought could naturally reduce some water flow at the site by reducing recharge to the aquifer. However, this type of seep and spring generally provides a relatively constant environment that is minimally affected by short term drought because of the underground water source.

Non-native Species and/or Altered Hydrology - State 2

Springs are vital water resources in the arid western United States. In many cases they have been developed to enhance water availability for livestock, big game, or human use. Livestock trampling, diversion, channelization, impoundment, and the encroachment of non-native plants and animals have altered the physical and biological characteristics of a majority of springs and they now bear little resemblance to their historic, unaltered conditions. The level of manipulation and disturbance at this site varies.

This state is characterized by altered hydrology and/or the presence of non-native plant species. In general, altered hydrology in a seep and spring wetland will facilitate the establishment of non-native species by reducing water flow and drying the soil. Less soil moisture reduces the competitive advantage of the obligate wetland species that are adapted to the wet spring conditions and enables non-native grasses and forbs to encroach.

Altered Hydrology - Community Phase 2.2

This community phase results from a disturbance that alters the site hydrology which generally reduces water flow. A reduction in water flow at this site causes the thinleaf alder and monkeyflower seep communities to decline and the herbaceous community doubles in extent to comprise 60% of the total vegetation. Under drier conditions, the herbaceous community becomes more dominated by grasses and non native species and the adjacent Sierra lodgepole pine forest encroaches on a limited basis.

Estimate of plant community component composition:

PCC1: 35%- Thinleaf Alder Community
Thinleaf alder grows dense in this community with a low cover of shade tolerant forbs in the understory such as small enchanter's nightshade (Circaea alpina ssp. pacifica), redstem springbeauty (Claytonia rubra), brittle bladderfern (Cystopteris fragilis), Pacific bleeding heart (Dicentra Formosa), bugle hedgenettle (Stachys ajugoides), and violet (Viola sp.).

PCC2b: 60%- Native and Non-native Herbaceous Community
This community is similar to PCC2 in State 1, Community Phase 1.1, but some non-native species have established and grasses have increased in cover. Non-native species include Kentucky bluegrass (Poa pratensis), timothy (Phleum pretense), bull thistle (Cirsium vulgare), and common dandelion (Taraxacum officinale).

PCC3: 3%- Seep Monkeyflower Community
This community is dominated by seep monkeyflower (Mimulus guttatus) and mosses. It is a distinct assemblage of species, but it shares many species with the adjacent Native Herbaceous Community. Associated species are common yarrow (Achillea millefolium), western columbine (Aquilegia Formosa), Douglas' thistle (Cirsium douglasii), brittle bladderfern (Cystopteris fragilis), willowherbs (Epilobium spp.), rushes (Juncus spp.), California grass of Parnassus (Parnassia californica), Parish's yampah (Perideridia parishii), streambank bird's-foot trefoil (Lotus oblongifolius), arrowleaf ragwort (Senecio triangularis), and woollyhead parsnip (Sphenosciadium capitellatum).

PCC4: 2%- Sierra Lodgepole Pine Forest
Sierra lodgepole pine (Pinus contorta ssp. murrayana) is the dominant tree, with white fir (Abies concolor), and Jeffrey pine (Pinus jeffreyi) occasionally present in small amounts. Understory plants include blue wildrye (Elymus glaucus), white hawkweed (Hieracium albiflorum), western sweetroot (Osmorhiza chilensis), naked buckwheat (Eriogonum nudum), stickywilly (Galium aparine), common yarrow (Achillea millefolium), American vetch (Vicia Americana), Pacific bleeding heart (Dicentra Formosa), California false hellebore (Veratrum californicum var. californicum), whitestem gooseberry (Ribes inerme), Gray's licorice-root (Ligusticum grayi), starry false lily of the valley (Maianthemum stellatum), California stickseed (Hackelia californica), and California brome (Bromus carinatus).

Restoration Pathway - 2A

The primary restoration objective is to restore the natural hydrology of the site. This may require reconstruction of roads and trails, so water flow is able to cross in alignment with the natural drainage. Non-native species should be removed.

Ecological Site Interpretations

Animal Community:

Spring wetlands provide habitat for aquatic plants and animals and a water source for terrestrial animals. Such wetlands provide a source of food and cover for birds, reptiles, amphibians, and mammals and they may be occupied by endemic vertebrates or macroinvertebrates.

Plant Preference by Animal Kind:

Hydrology Functions:

This site is a source of ground water and aquifer discharge, which has high water quality.

Recreational Uses:

This area provides wildlife viewing opportunities, but the lush vegetation makes cross country travel difficult. Trails should be constructed carefully, so water flow is not diverted.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Humic Loamy Gentle Slopes	F022BI110CA	This white fir mixed conifer site is found surrounding the springs at the lower elevations.
Frigid And Cryic Gravelly Slopes	F022BI115CA	This red fir forest site surrounds the springs at upper elevations.
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This lodgepole pine- white fir forest is found adjacent to the springs on drier areas between springs.
Thermal Seeps	R022BI218CA	This site is associated with the thermal springs and seeps near Drakesbad.

Similar Sites:

Site Name	Site ID	Site Narrative
Loamy Seeps	R022BI209CA	This site is located in the hydrothermally altered area, which is affected by active soil movement.

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

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

789212
789288
789350- Type location
789350b

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	5 E
Section:	22
Datum:	NAD83
Zone:	10
Northing:	4478371
Easting:	634761
General Legal Description:	The type location is about 0.38 miles west of Drakesbad Guest Ranch in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104478371634761

Relationship to Other Established Classifications:

Other References:

Bestelmeyer, Brandon T.; Brown, Joel R.; Havstad, Kris M.; Alexander, Robert; Chavez, George; and Herrick Jeffrey E.; 2003. Development and Use of State-and-Transition Models for Rangelands. Journal of Range Management, Vol. 56, No. 2 (Mar., 2003), pp. 114-126. Allen Press and Society for Range Management. Stable URL: http://www.jstor.org/stable/4003894

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US Department of the Interior. 2001. Riparian area management: A guide to managing, restoring, and conserving springs in the Western United States. Technical Reference1737-17. Bureau of Land Management. Denver, CO. 70 pp.

Weixelman, Dave; Weis, Sue; Linton, Fletcher; and Swartz, Heather; 2007. DRAFT: Condition Checklist for Fens in the Montane and Subalpine Zones of the Sierra Nevada and Southern Cascade Ranges, CA.

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Windy Peak

/ *Ericameria nauseosa ssp. nauseosa var. speciosa - Holodiscus discolor* / *Elymus elymoides - Linanthus pungens*
(/ rubber rabbitbrush - oceanspray / squirreltail - granite prickly phlox)

Site ID: R022BI212CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 10 to 45 percent.
Landform: Moraines over lava flow (Loomis Peak).
Soils: Deep and very deep, well drained soils that formed in ash mixed with till from rhyodacite. There is greater than 35 percent rock fragments in most of this soil. The densic contact is at depths of 40 to greater than 60 inches.
Temp regime: Cryic.
MAAT: 40 degrees F (4.4 degrees C).
MAP: 81 to 99 inches (2,057 to 2,515 mm).
Soil texture: Stony ashy loamy sand
Surface fragments: 15 to 60 percent subangular fine and medium gravel and 18 to 60 percent 5 nonflat subangular cobbles, and subangular stones.
Vegetation: Mixed shrubs such as rubber rabbit brush (Ericameria nauseosa ssp. nauseosa var. speciosa), antelope bitterbrush (Purshia tridentata), greenleaf manzanita (Arctostaphylos patula), oceanspray (Holodiscus discolor), with scattered and windblown whitebark pine (Pinus albicaulis), Jeffrey pine (Pinus jeffreyi), and mountain hemlock (Tsuga mertensiana).

Physiographic Features

This ecological site is found on moraines over lava flow on Loomis Peak. It occurs between 7,740 and 8,650 feet in elevation. Slopes range from 10 to 45 percent.

Landform: (1) Moraine
(2) Lava flow
(3) Mountain

	Minimum	Maximum
Elevation (feet):	7740	8650
Slope (percent):	10	45
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Low
Aspect:	North South East	

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 81 to 99 inches (2,057 to 2,515 mm) and the mean annual temperature ranges is 40 degrees F (4.4 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 65 to 190 days.

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

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	65	190
Mean annual precipitation (inches):	81.0	99.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System Subsystem Class

Representative Soil Features

This site is associated with the Xeric Vitricryands soil component, which consists of deep and very deep, well drained soils that formed in ash mixed with till from rhyodacite. The surface texture is stony ashy loamy sand with coarse textured subsurface horizons. There is greater than 35 percent rock fragments in most of this soil. There is a densic contact at a depth of 40 to greater than 60 inches. The mean AWC is low.

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

Map Unit Component Percent
137 Xeric Vitricryands 75

Parent Materials:
Kind: Ash mixed with till
Origin: Rhyodacite

Surface Texture: (1) Stony ashy loamy sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	15	60
Surface Fragments > 3" (% Cover):	18	60
Subsurface Fragments <=3" (% Volume):	5	61
Subsurface Fragments > 3" (% Volume):	0	30

Drainage Class: Well drained To Well drained
Permeability Class: Very slow To Very slow

	Minimum	Maximum
Depth (inches):	40	80
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		

Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.1	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.8	8.0

Plant Communities

Ecological Dynamics of the Site

This ecological site is characterized by extensive stands of shrubs and sub-shrubs, with a scattering of whitebark pine (Pinus albicaulis), Jeffrey pine (Pinus jeffreyi), and mountain hemlock (Tsuga mertensiana). The trees provide about 5-10 percent total canopy cover. Many of these trees have shrub-like stature or reduced heights due to wind exposure. Shrubs present on this site include rubber rabbitbrush (Ericameria nauseosa ssp. nauseosa var. speciosa), antelope bitterbrush (Purshia tridentata), greenleaf manzanita (Arctostaphylos patula), oceanspray (Holodiscus discolor), and the low-growing granite prickly phlox (Linanthus pungens). Forbs are commonly found in this plant community as well, species include marumleaf buckwheat (Eriogonum marifolium), sulphur-flower buckwheat (Eriogonum umbellatum), Pacific lupine (Lupinus lepidus), drawf alpinegold (Hulsea nana) and beardtongue (Penstemon spp.).

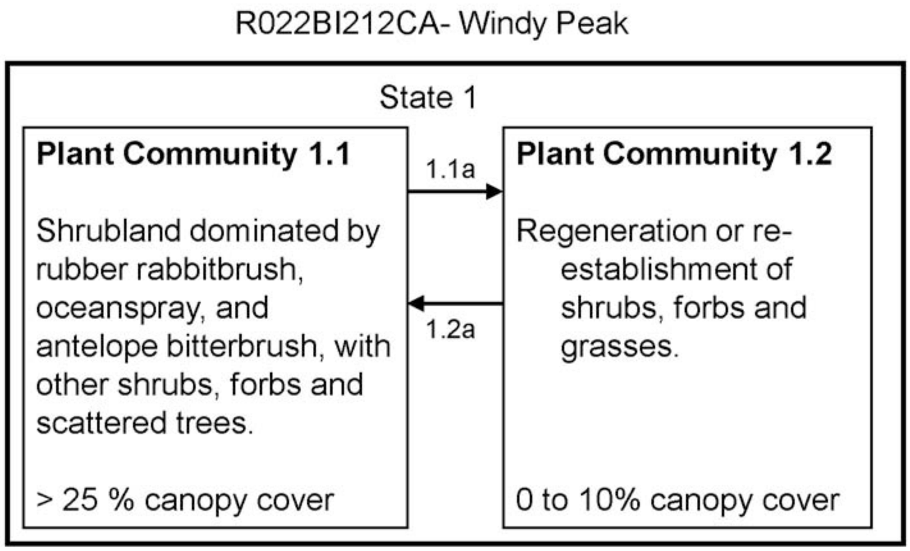
Rubber rabbitbrush, granite prickly phlox, antelope bitterbrush, oceanspray and greenleaf manzanita are well adapted to the course textured, well-drained soils found on this ecological site. The shrub species expressed on this site are commonly found early on in the successional stages and rely on some level of disturbance for regeneration. Without low frequency fire or other disturbances shrubby vegetation will become decadent and begin to die back.

Tolerance of dry, cold conditions allows these species to thrive on this ecological site. Adaptations, such as a long tap root, allow antelope bitterbrush to survive on course-textured soils with a high percentage of rock fragments (Zlatnik 1999). Similar to the other shrubs growing on this ecological site, greenleaf manzanita is well-adapted to well-drained soils, tolerant of cold temperatures (Wilken and Burgher 2009), and is a recurrent member of high elevation brush lands.

This ecological site provides important high elevation wildlife habitat. Antelope bitterbrush provides vital browse resource. Rodents, like deer mice, also rely on antelope bitterbrush for a large portion of their diet (Zlatnik 1999). This shrub also provides important cover for a wide variety of animals, including ungulates, birds, and rodents. During the winter rubber rabbitbrush is also considered to be an important resource for wildlife and some rodents (Tirmenstein 1999). The flowers, leaves, and young stems are commonly browsed by a variety of large animals and jack rabbits (Tirmenstein 1999). Oceanspray is generally not considered a good browse species, but can be moderately important for mule deer. More importantly, it provides nesting habitat, cover and food for non-game birds and small animals (Archer 2002).

At this elevation whitebark pine (Pinus albicaulis) commonly shares dominance with mountain hemlock (Tsuga mertensiana). Jeffrey pine (Pinus jeffreyi) also occurs on this high elevation site however not as commonly. These trees are adapted to the rocky, well-drained soils that are found on this site. Trees on this ecological site will remain small and appear stunted, due to the short growing season and harsh conditions. The patchy growth form of whitebark pine helps reduce mortality particularly on exposed sites.

State and Transition Diagram



Natural State - State 1

This is the natural state for this ecological site.

Scrubland >25 percent cover - Community Phase 1.1

Windy peak shrubland

Shrubs are the dominant vegetation on this ecological site, with scattered forbs. While trees are present they exhibit a reduced growth form and equal only about 5 to 10 percent total cover. Common trees are whitebark pine (Pinus albicaulis), Jeffrey pine (Pinus jeffreyi), and mountain hemlock (Tsuga mertensiana). Shrubs provide about 20 to 30 percent of the ground cover. Shrub species include antelope bitterbrush (Purshia tridentata), oceanspray (Holodiscus microphyllus) and rubber rabbitbrush (Ericameria nauseosa ssp. nauseosa var. speciosa). Common forb species include marumleaf buckwheat (Eriogonum marifolium), sulphur-flower buckwheat (Eriogonum umbellatum), Pacific lupine (Lupinus lepidus), granite prickly phlox (Linanthus pungens), drawf alpinegold (Hulsea nana), thickstem aster (Eurybia integrifolia), beardtongue (Penstemon sp.) and Indian paintbrush (Castilleja sp.).

Shrubs growing here are tolerant of dry, cold conditions and course-textured soils. Rubber rabbitbrush is considered an early- to mid-seral species. Seeds from rubber rabbitbrush are designed to easily disperse long distances by the wind. Making it the first to sprout from seed post-fire and perfect for colonizing disturbed sites (Tirmenstein 1999). Oceanspray is moderately shade-tolerant allowing it to persist throughout the successional process and is known to sprout readily post fire (Archer 2002). Antelope bitterbrush commonly colonizes after disturbance and can also persist throughout the successional process. Without disturbance occurring on a regular interval stands will become senescent and decadent (Zlantnik 1999). Occassional fire aides seed germination for greenleaf manzanita (Wilken and Burgher 2009). Granite prickly phlox (Linanthus pungens), a sub-shrub, exhibits the same adaptive characteristics as the full stature shrubs growing here.

Tree species represented here grow well on sites with cold winters, short growing season, well-drained soil, and a substantial snow pack. Jeffrey pine is relatively shade-intolerant and can be considered an early- to mid-seral species, except on harsh sites where they are considered the climax. This species has adapted to fire by developing a thick bark to increase the chances of survival (Gucker 2007). Whitebark pine has moderately thick bark therefore it is able to survive low-to-moderate intensity fires (Howard 2002).

A small fire from a lightning strike or other source could decrease shrub competition, creating gaps for seedling regeneration. This process is important for establishing seedlings of shade intolerant species like Jeffrey pine. Due to harsh conditions this ecological site will not develop into a forest. Disturbance will decrease shrub and tree cover temporarily while encouraging seedling regeneration. Shrubs will reestablish from seed and vegetative reproduction, after the old decadent stands have been removed by fire or other disturbance. Vegetation on this site will benefit from small fires or other disturbance which removes the old, dying, and decadent plants.

Community Phase Pathway 1.2a

This pathway is created fire and initiates regeneration (Community 1.2).

Scrubland >25 percent cover Plant Species Composition:

	Forb				**Annual Production in Pounds Per Acre**		**Foliar Cover Percent**	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**
1 -Forbs					**4**	**172**		
		Indian paintbrush	CASTI2	*Castilleja*	0	1	0	1
		marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	2	30	1	5
		sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	2	40	1	6
		thickstem aster	EUIN9	*Eurybia integrifolia*	0	16	0	2
		dwarf alpinegold	HUNA	*Hulsea nana*	0	5	0	3
		granite prickly phlox	LIPU11	*Linanthus pungens*	0	40	0	20
		Pacific lupine	LULE2	*Lupinus lepidus*	0	40	0	7
		beardtongue	PENST	*Penstemon*	0	1	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -grass-grasslike					**10**	**75**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	15	0	3
		squirreltail	ELEL5	*Elymus elymoides*	10	60	2	12

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -shrubs					**75**	**390**		
		greenleaf manzanita	ARPA6	*Arctostaphylos patula*	0	30	0	2
		rubber rabbitbrush	ERNAS2	*Ericameria nauseosa ssp. nauseosa var. speciosa*	60	140	10	40
		oceanspray	HODI	*Holodiscus discolor*	5	100	2	15
		antelope bitterbrush	PUTR2	*Purshia tridentata*	10	120	1	10

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Trees					**0**	**12**		
		whitebark pine	PIAL	*Pinus albicaulis*	0	5	0	2
		Jeffrey pine	PIJE	*Pinus jeffreyi*	0	3	0	1
		mountain hemlock	TSME	*Tsuga mertensiana*	0	5	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	10	60	75
Forb	20	81	172
Shrub/Vine	75	250	390
Tree	0	4	12
Total:	105	395	649

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	2%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	2%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	1%	5%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	1%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	0%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	26%	68%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	15%	60%		**Tree Snags** per Acre**			
Surface Fragments > 3"	18%	60%		Hard Snags***			
Bedrock	15%	25%		Soft Snags***			
Water	0%	0%					
Bare Ground	10%	20%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	%	%	0%	25%				
> 0.5 - < 1 feet	0%	10%	0%	14%				
> 1 - <= 2 feet	0%	5%	1%	8%	30%	65%	0%	1%
> 2 - < 4.5 feet					0%	2%	0%	1%
> 4.5 - <= 13 feet							0%	3%
> 13 - < 40 feet							2%	6%

< 40 - >= 80 feet								
> 80 - < 120 feet								
>= 120 feet								

Overstory:
Canopy cover ranges from 1 to 6 percent with large spaces between clumps of trees. Canopy cover is evenly distributed between white bark pine (Pinus albicaulis), Jeffrey pine (Pinus jeffreyi), and mountain hemlock (Tsuga mertensiana) all making up 1 to 2 percent of the total.

Understory:
The understory is dominated by shrubs, with forbs and grasses accounting for only a small amount of the total vegetative cover. Rubber rabbit brush averages about 20 percent, but can be as high as 40 percent. Oceanspray (Holodiscus discolor) and granite prickly phlox (Linanthus pungens) account for another 20 percent of the shrub cover. Antelope bitterbrush (Purshia tridentata) and Greenleaf manzanita (Arctostaphylos patula) make up about 5 percent of the understory cover. Most widespread forbs include sulphur-flowered buckwheat (Eriogonum umbellatum), marumeaf buckwheat (Eriogonum marifolium), and pacific lupine (Lupinus lepidus). Grass species include squirreltail (Elymus elymoides) and western needlegrass (Achnatherum occidentale).

Barren patches with few shrubs, forbs and grasses - Community Phase 1.2
This post-fire regeneration community was not encountered, but would most likely be dominated by fire-adapted species such as Greenleaf manzanita which can resprout after fire and its seeds are scarified by heat. Antelope bitterbrush does not resprout after fire but will germinate from wind blown seed. There will be open cover in burned areas with scattered grasses and forbs. Trees may establish in the open areas during this time.

Community Phase Pathway 1.2a
With time and growth a mixed scrubland develops with scattered trees (Community 1.1).

Ecological Site Interpretations

Animal Community:
This scrubland community provides forage and cover for a variety of wildlife species. Antelope bitterbrush is a highly preferred forage species by mule deer. These shrub fields fulfill important habitat requirements for small mammals including montane vole, deer mice, mountain cottontail, chipmunks, and ground squirrels. Non-game birds like Clark’s nutcracker and the dark-eyed junco find key nesting environment on this site.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This ecological site provides beautiful vistas and hiking opportunities.

Wood Products:
Not applicable, trees growing on this ecological site are not of sufficient quality for wood products.

Other Products:

Other Information:
Many of the dominate shrubs on this site have known ethno-botanical uses including treating burns and sores, pain relief, chronic diseases, as well as, other medical applications.

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Glaciated Mountain Slopes	R022BI204CA	This rangeland site is dominated by pinemat manzanita.
Alpine Slopes	R022BI207CA	This rangeland site is sparsely vegetated by lupine and mountain hemlock.

Similar Sites:

Site Name	Site ID	Site Narrative
Cryic Pyroclastic Cones	R022BI208CA	This site has some similar species but is more diverse and is found on cinder cones on the eastern part of the park.

State Correlation:
This site has been correlated with the following states:

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

789266
789267
789330- modal pit and site location

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	4 E
Section:	32
Datum:	NAD83
Zone:	10
Northing:	4483073
Easting:	622952
General Legal Description:	The site location is about 0.3 mile northwest from the highest point of Loomis Peak, on the summit.
Latitude Degrees:	

Latitude Minutes:

Latitude Seconds:

Latitude Decimal:

Longitude Degrees:

Longitude Minutes:

Longitude Seconds:

Longitude Decimal:

Universal Transverse Mercator (UTM) system: NAD83104483073622952

Relationship to Other Established Classifications:

Other References:

Archer, Amy J. 2000. Holodiscus discolor. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/[2009, December 8].

Gucker, Corey L. 2007. Pinus jeffreyi. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, December 10].

Howard, Janet L. 2002. Pinus albicaulis. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, December 10].

Tirmenstein, D. 1999. Chrysothamnus nauseosus. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, December 8].

Wilken, Dieter and Julie Burgher. Ed. "Greenleaf Manzantia Arctostaphylos patula E. Green. Plant Guide. 13 May 2006. USDA. 8 December 2009. http://plants.usda.gov/plantguide/pdf/pg_arpa6.pdf

Zlatnik, Elena. 1999. Purshia tridentata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, December 8].

Site Description Approval:

Author	Date	Approval	Date
Erin Hourihan, Marchel Munnecke	4/23/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Frigid Sandy Flood Plains

/ *Alnus incana ssp. tenuifolia - Salix* / *Elymus glaucus - Anaphalis margaritacea*
(/ mountain alder - willow / blue wildrye - pearly everlasting)

Site ID: R022BI213CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by a B type stream channel system.
Slopes: 4 to 8
Landform: Flood plains
Soils: Poorly drained, very deep, and formed in alluvium from redeposited debris flows or volcanic rock.
Temp regime: Frigid.
MAAT: to 40 to 44 degrees F (4 to 7 degrees C).
MAP: 45 to 75 inches (1,143 to 1,905 mm).
Soil texture: Extremely gravelly ashy sand and ashy fine sand
Surface fragments: 0 to 80 percent gravel, 0-20 percent larger rock fragments.
Vegetation: Several montane riparian plant communities are present with a high cover of willow and mountain alder community types.

Physiographic Features

This ecological site is found on flood plains, between 5,860 and 6,350 feet in elevation. Slopes range from 0 to 8 percent.

Landform: (1) Flood plain

	Minimum	Maximum
Elevation (feet):	5860	6350

Slope (percent):	0	8
Water Table Depth (inches):	0	60
Flooding:		
Frequency:	Occasional	Frequent
Duration:	Brief	Long
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Negligible	Very high
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation during the winter months in the form of snow. The mean annual precipitation ranges from 45 to 75 inches (1,143 to 1,905 mm) and the mean annual temperature ranges from 40 to 44 degrees F (4 to 7 degrees C). The frost free (>32F) season is 60 to 85 days. The freeze free (>28F) season is 75 to 190 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	40.0	44.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This ecological site encompasses a B type stream channel and the associated flood plains and terraces.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Riverine	Upper Perennial	Unconsolidated Bottom

Stream Types:
(RosGen Narrative)

B4,B4a,B4c-This stream is a single-thread channel that is moderately entrenched, it gets out of bank infrequently. It has a moderate width to depth ratio and moderate sinuosity. Its slope is typically in the range of 2 to 3.9 percent, but it can range from 4 to 9.9 percent (a modifier) or be less than 2 percent (c modifier). It is a gravel-bottom stream.

B5,B5a,B5c-This stream is a single-thread channel that is moderately entrenched, it gets out of bank infrequently. It has a moderate width to depth ratio and moderate sinuosity. Its slope is typically in the range of 2 to 3.9 percent, but it can range from 4 to 9.9 percent (a modifier) or be less than 2 percent (c modifier). It is a sand-bottom stream.

Representative Soil Features

Typic Endoaquents and Typic Psammaquents soil components are associated with this site. These soils formed in alluvium from volcanic debris flows. They are very deep, poorly drained, and minimally developed. A thin layer of fresh organic material overlays coarsely textured C horizons. The surface textures are extremely gravelly ashy sand and ashy fine sand. The Typic Endoaquents have several C horizons with ashy sand textures containing very or extremely gravelly modifiers. The Typic Psammaquents have a thin buried A horizon from 4 to 5 inches. There are several stratified C horizons with alternating ashy coarse sand and ashy sand textures. The AWC is low to very low in the upper 60 inches of soil.

This ecological site has been correlated with the following map units and soil components:

Map Unit/ Component /Component percent
111 Typic Endoaquents/ 5
132 Typic Endoaquents/ 2
133 Typic Endoaquents/ 30
138 Typic Endoaquents/ 10
139 Typic Endoaquents/ 1
154 Typic Endoaquents/ 2
161 Typic Psammaquents/ 95
163 Typic Endoaquents/ 1

Parent Materials:
Kind: Alluvium
Origin: Volcanic rock or debris flows

Surface Texture: (1)Extremely gravelly ashy sand
(2)Ashy Fine sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	80

Surface Fragments > 3" (% Cover):	0	20
Subsurface Fragments <=3" (% Volume):	0	50
Subsurface Fragments > 3" (% Volume):	0	30

Drainage Class: Poorly drained To Poorly drained
Permeability Class: Rapid To Very rapid

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.1	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	1.4	3.0

Plant Communities

Ecological Dynamics of the Site

This ecological site is found in flood plains on recent stratified alluvium. This site covers a broad range of B type channels within a limited area, and may be defined as several ecological sites in the future. Intermittent sections of these streams have C type channels. "C" type channel are less entrenched, with greater channel sinuosity and generally have more developed floodplains. Please refer to ecological site R022BI210CA for more information on stream dynamics associated with C type channels.

The site typically supports a "B" type channel according to the Rosgen classification scheme. A "B" type channel is a moderately entrenched, riffle dominated channel with infrequently spaced scour pools. The channel has moderate sinuosity, a moderate gradient with less than 4% slope, and a width to depth ratio greater than 12. A “B” type channel is a sediment-limited system and while bedrock and boulder channels are relatively stable, the channel on this site supports unstable gravel-bottom (B4) and sand bottom (B5) reaches that have high erosion potential. The sensitivity to disturbance is high for both B4 and B5 types (Rosgen, 1994).

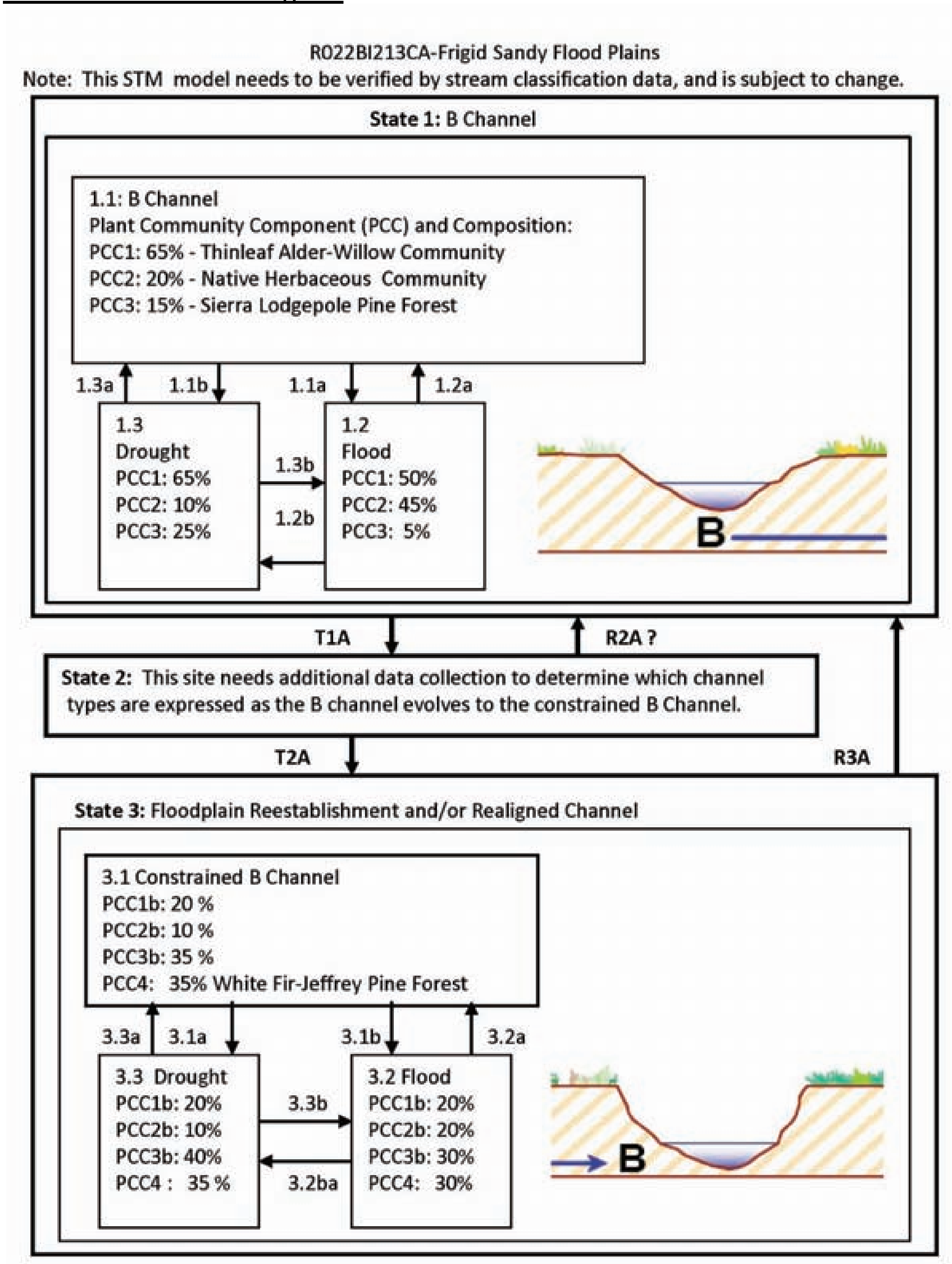
Portions of this ecological site exhibit an altered state due to recent burial by volcanic deposits from Lassen Peak. A succession of eruptions in 1915 of Lassen Peak created an area referred to as the Devastated Area as debris flows blanketed the area with 6 to 30 feet of material. Most of the area now supports upland vegetation in various stages of recovery, but some stream corridors have developed. This site occurs where stream flows have cut new channels through the sediments. Vegetative recovery on these volcanic deposits is slow, because of the low nutrient availability and high porosity of the undeveloped soils. However, along water courses and in areas of shallower debris deposits, vegetation reestablishes sooner. Please refer to the Jeffrey pine-Mixed Fir Ecological Site Description (F022BI106CA) for more information regarding forest dynamics and succession within the upland community.

Another area where this site is correlated is upstream from a small lake. The stream channel transitions in a short distance from a constrained B channel into to a less entrenched C type channel as the stream crosses the old lake terrace. This area is also affected by a small dam. The higher lake levels, due to the dam, submerge the stream channel near the lake and reduce stream velocity for a short distance upstream. This allows finer sediments to accumulate and changes the form of the stream channel. The channel in this area is broader, shallower, and less entrenched than a B type channel. It has several C type channel characteristics, but sections also braid with multiple channels that resemble a D type channel. This area is dominated by shining willow (Salix lucida). Because of limited extent and variable channel characteristics this area is included with this ecological site.

Vegetation exerts a moderate controlling influence on the stream dynamics of B channels. The plant communities along this channel occur in distinct zones related to variable water table depth and disturbance events. A thinleaf alder (Alnus incana ssp. tenuifola)/willow (Salix spp.) community occurs along the streambank, a pioneer forb community is on point bars and fresh deposits and a Sierra lodgepole pine (Pinus contorta var. murrayana) forest is present just above the banks, on rarely used floodplains. The most common willows along the stream channels are Lemmon's willow (Salix lemmonii) and shining willow (Salix lucida). The understory is dominated by graminoids and various forbs including western needlegrass (Achnatherum occidentale), Idaho bentgrass (Agrostis idahoensis), California brome (Bromus carinatus), carex (Carex spp.), slender hairgrass (Deschampsia elongata), squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), meadow barley (Hordeum brachyantherum), mountain rush (Juncus arcticus ssp. littoralis), meadow fescue (Schedonorus pratensis), pearly everlasting (Anaphalis margaritacea), and cinquefoil (Potentilla sp.).

This ecological site is a complex of riparian plant communities that are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community type composition as a result of disturbance, rather than focusing on the succession of one plant community. Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram

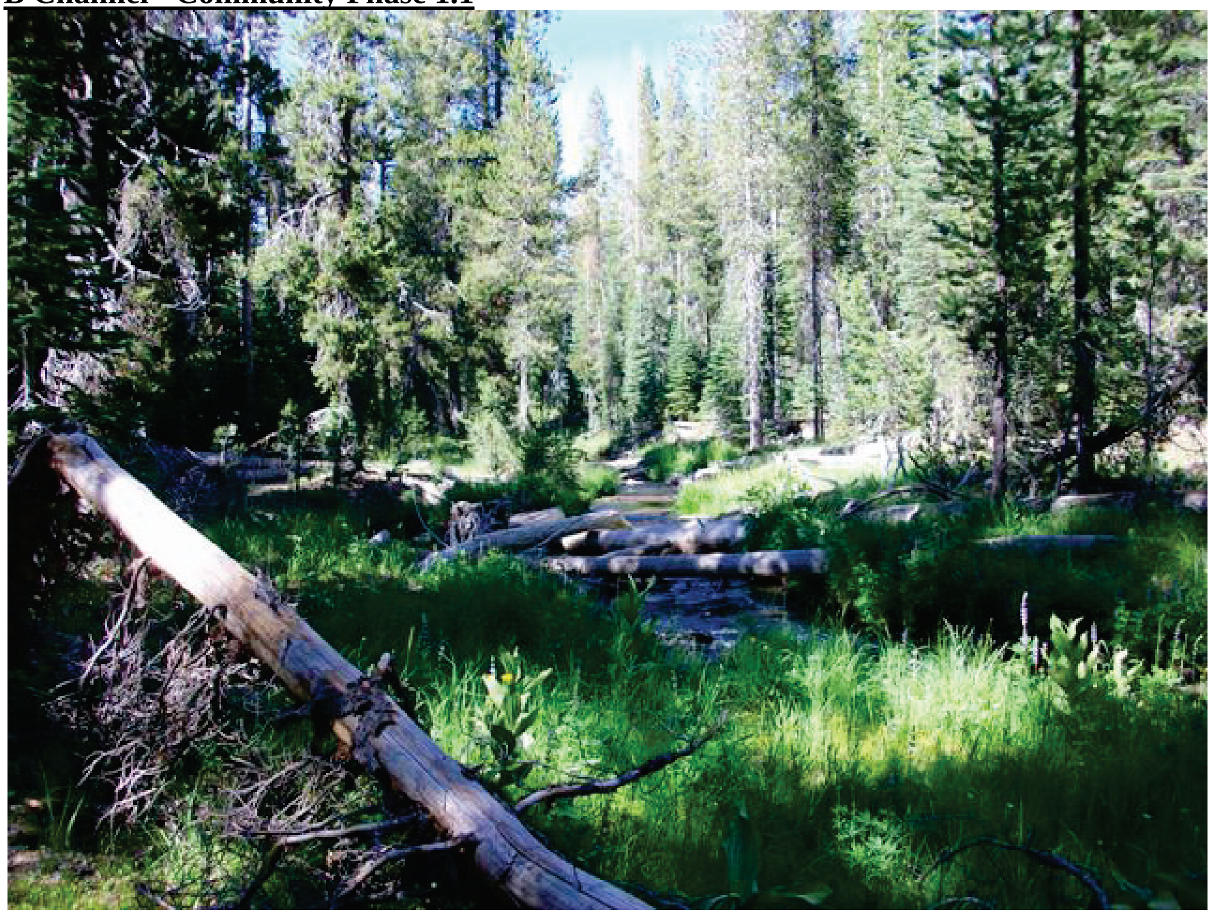


B Channel - State 1

This state is a single thread B type channel found on the deep, coarse volcanic deposits erupted from Lassen Peak or in alluvium. B channels are considered moderately entrenched and have a moderate to high width to depth ratio. Sinuosity is moderate, resulting in a riffle-dominated channel with infrequently spaced scour pools. B type channels are sediment-limited systems but this site supports unstable gravel-bottom (B4) and sand bottom (B5) reaches that have high erosion potential. The sensitivity to disturbance is high for both B4 and B5 types and vegetation exerts a moderate controlling influence on stream dynamics.

Obligate wetland species dominate the site in the undisturbed community phase. A shrub community of thinleaf alder/ willow is found on the stream banks of the active channel and the floodplain. A pioneer plant community of native herbs is found on recently exposed substrate, generally along the stream channel, but may also be found on upper side channels. The adjacent upland habitat is coniferous forest of Sierra lodgepole pine.

B Channel - Community Phase 1.1



Sandy Flood Plains 2


Sandy Flood plains

The plant community along the B channel occurs in distinct zones related to variable water table depth and disturbance events. Approximately 65% of the total vegetation is a thinleaf alder/willow community that forms a continuous stringer immediately adjacent to the stream where the water table stays relatively high year round. Both thinleaf alder and Lemmon’s willow are flood and shade tolerant and act as an important stabilizing component of the streambank. These shrubs produce copious amounts of seeds in the fall and winter and seeds germinate immediately after dispersal when conditions are favorable. Germination and seedling establishment is optimal on exposed mineral substrate. Thinleaf alder may also reproduce vegetatively through spreading underground rhizomes or suckers, but Lemmon’s willow does not have this capacity. Both species can re-sprout vigorous following a top cut or fire.

Streambanks anchored by these shrubs are stable and can withstand relatively severe spring runoff and flooding. As alder and willow thickets develop after floods finer fluvial deposits are trapped within the extensive root networks, facilitating soil development. In addition, thinleaf alder improves soil fertility through the addition of nitrogen to the soil from nitrogen-fixing root nodules and a nitrogen-rich leaf litter. The improved soil texture and fertility enables establishment and retention of an understory dominated by sedges. The extensive root mats formed by the sedge component further stabilizes the streambank.

Drought and flood are the primary forces that drive transitions between the alternate community phases. A lower water table from prolonged drought facilitates encroachment of the upland community on the floodplain and an associated reduction in the thinleaf alder/ willow community. Conversely, a flood destroys sections of the riparian shrub community within the active channel and favors establishment of the pioneering native herb community that colonizes recently exposed substrate and provides valuable forage and habitat for wildlife.

Plant Community Component (PCC) and Composition:

PCC1: (65%)- Thinleaf Alder-Willow Community
This is the plant community along the banks. Thinleaf alder (Alnus incana ssp. tenuifola) is the most common shrub but Lemmon’s willow (Salix lemmonii) and shining willow (Salix lucida) are occasionally present. Sedge (Carex spp.), willowherb (Epilobium spp.), fowl mannagrass (Glyceria striata), and field horsetail (Equisetum arvense) are present as well as scattered forbs listed in PCC2.

PCC2: (20%)-Native Herbaceous Community
This Plant community is found on point bars and floodplains. Common species are common

yarrow (Achillea millefolium), Idaho bentgrass (Agrostis idahoensis), pearly everlasting (Anaphalis margaritacea), rosy pussytoes (Antennaria rosea), aster (Aster sp.), sedge (Carex sp.), cryptantha (Cryptantha sp.), slender hairgrass (Deschampsia elongate), squirreltail (Elymus elymoides), blue wildrye(Elymus glaucus), field horse tail (Equisetum arvense), meadow barley (Hordeum brachyantherum), rush (Juncus sp.), mountain rush (Juncus articus ssp. littoralis), dwarf mountain ragwort (Senecio fremontii), and cinquefoil (Potentilla spp.).

PCC 3: (15%)- Sierra Lodgepole Pine Forest
This moist lodgepole pine forest is present on rarely flooded floodplain. Sierra lodgepole pine (Pinus contorta ssp. murrayana) is dominant and provides 15-45 percent cover over a grassy understory. Some of the species listed in PCC2 are also in the understory. Common plants are western needlegrass (Achnatherum occidentale), California brome (Bromus carinatus), squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), (Eriogonum pyrolifolium), groundsmoke (Gayophytum sp.), meadow barley (Hordeum brachyantherum), (mountain rush (Juncus articus ssp. littoralis), Pacific lupine (Lupinus lepidus), bearded melicgrass (Melica aristata), and gooseberry (Ribes sp.).

Community Phase Pathway 1.1a
This pathway is created when a flood scours the channel of existing vegetation, depositing a layer of sediment and initiating regeneration.

Community Phase Pathway 1.1b
This pathway is created by natural processes that cause the site to become drier, usually several years of drought.

<u>Flood - Community Phase 1.2</u>
This community phase develops after a major flood event. The plant community components remain the same, as described in Community phase 1.1, but the proportion of each community type shifts after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing large quantities of sediment in other areas. The destruction of sections of the thinleaf alder/willow community in the channel is accompanied by a 25% increase in the herbaceous pioneer community as early seral grasses like squirreltail and herbs quickly colonize the recently exposed substrate. Some of the adjacent Sierra lodgepole pine community may also be destroyed by the flood and decline to only 5%.

Estimate of plant community component composition in this phase:

PCC1: 50%
PCC2: 45%
PCC3: 5%

Community Phase Pathway 1.2a
This pathway is created with time and allows for the recovery of the plant communities after the flood event.

Community Phase Pathway 1.2b
This pathway is created with prolonged periods of drought.

Drought - Community Phase 1.3
This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates encroachment of the upland Sierra lodgepole pine forest on the floodplain and an associated reduction in the Native Herbaceous Community.

Estimate of plant community component composition in this phase:

PCC1: 65%
PCC2: 10%
PCC3: 25%

Community Phase Pathway 1.3a
This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Community Phase Pathway 1.3b
This pathway is created when a flood causes bank erosion and sediment deposition.

Transition - T1A
This transition can occur naturally as the "B" type channel in State 1 down-cuts through the deep coarse volcanic deposits erupted from Lassen Peak. The channel on this site supports gravel-bottom (B4), and sand bottom (B5) reaches which have high erosion potentials. Bank erosion is a natural river adjustment process and can as the result of mass wasting, liquification, freeze-thaw, fluvial entrainment, and ice scour. The coarse colluvial and alluvial deposits in the valley bottom are gradually eroded through these processes.

This transition can be initiated by a disturbance that alters the hydrology of the site including channel realignment and/or confinement, culvert installations, and road construction. Such alterations straightened the channel, eliminating its ability to meander. This increases the shear stress along the stream bank, which accelerates stream bank erosion, thereby increasing sediment supply and decreasing sediment transport capacity. As the channel straightens it has a shorter course down the valley, creating a steeper gradient. The stream may adjust by headcutting into the base level of the channel until it establishes a new gradient through the meadow. As the stream bed is lowered, so is the water table in the meadow. The new larger and steeper channel can contain more flow, reducing the frequency of flooding and the extent of the floodplain, creating terraces.

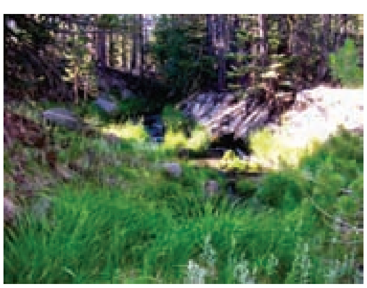
Disturbances such as cattle grazing and/or the seeding of non-native grass for forage that impacts the vegetation along the stream bank can cause a similar entrenchment of the channel but through a different mechanism. When cattle reduce vegetation and trample the exposed stream banks, the resulting erosion also leads to eventual straightening and headcutting of the channel. Likewise, when non-native grasses displace the native riparian sedges and rushes, the stabilizing root mats that help prevent erosion are also removed.

Stream Channel Succession - State 2

B type channels can become unstable due to disturbances which impact the stream bank vegetation, change the flow regime, or alter the channel morphology. Overgrazing and excessive trampling by livestock can seriously reduce streambank stability. Additional stream classification data is required to determine which channel types are expressed as the B channel evolves in response to disturbance. Continued disturbance can entrench the stream. The Rosgen Stream Succession Scenario #6 diagram is displayed below. In this possible succession scenario, the “B” type channel in State 1 down-cuts into an entrenched low gradient “G” type channel that naturally begins to widen over time into an entrenched “Fb” type channel. The plant community components associated with these possible successional channel types is not known. However, deeply incised “G” and “Fb” channels generally lose the wetland obligate species and become dominated by upland grass, shrub and/or forest plant communities. As the water table lowers at the site, the adjacent conifer community of Sierra lodgepole pine and white fir would encroach and reduce the thinleaf alder and mixed willow riparian community. Upland grass species like blue wildrye and western neeedlegrass would begin to dominate the native herbaceous community. Eventually, a new entrenched “B” type channel may form that resembles the original “B” type channel. The entrenched channel still supports some wetland plant communities but it is constrained by terraces which have a upland plant communities.

Stream Succession - Community Phase 2.1

Rosgen Stream Succession Scenario #6



Transitional Stream Channel

Transition - T2A
This transition occurs when continued sediment deposition in the broadly entrenched “Fb” type channel allows riparian vegetation to reestablish on the new floodplain. The vegetation increases channel stability and eventually channel sinuosity returns creating a new “B” type channel that is more entrenched and constrained than the original “B” channel.

Restoration Pathway - R2A
Additional stream classification data is required to determine which channel types are expressed in State 2 as the B channel evolves in response to disturbance. Without this data it is not possible to identify the restoration pathway for the intermediate phase of the stream succession scenario.

Constrained B Channel - State 3
The constrained B Channel on this ecological site has further downcut through the deep, coarse volcanic deposits erupted from Lassen Peak. As sediment deposition in the broadly entrenched “F” type channel continued, the vegetation increases channel stability and eventually channel sinuosity returns and a new meandering channel will develop that has similar morphological features of the original B channel but is constrained by the old floodplain, which is now a hydrologically disconnected dry terrace.

The obligate wetland species that dominate the site in the undisturbed community phase, have been reduced under the drier conditions, so that the riparian shrub community of thinleaf alder/ willow along the stream banks of the active channel now occupies only 20% of the total vegetation. The pioneer plant community of native herbs persists on recently exposed substrate, but may have more non-natives and a greater proportion of upland grasses than sedges. The adjacent upland Sierra lodgepole pine and mixed conifer forest is now the dominate vegetation.

Constrained B channel - Community Phase 3.1

Constrained B Channel

The constrained B channel has similar morphological features of the original B channel, but the floodplain is now a hydrologically disconnected dry terrace. The water table is much lower and the adjacent upland Sierra lodgepole pine and mixed conifer forest is now the dominate vegetation.

This community phase has the three plant community components of Community Phase 1.1, but the species composition has changed to include non-native species such as Kentucky bluegrass (Poa pratensis), common dandelion (Taraxicum officinale), common mullein (Verbascum thapsus), and rat-tail fescue (Vulpia myuros). The proportion of these community components has also shifted as the stream channel incised through the debris flow or glacial deposits, creating a dry terrace that supports much more upland forest (PCC4). The riparian communities are now confined to a smaller area within the new floodplain so that the thinleaf alder community/willow (PCC1b) now occupies only 20% of the total vegetation and the herbaceous community (PCC2b) comprises only 10%. The sedges along the channel have been replaced by grasses because of lower water tables. The Sierra lodgepole pine forest (PCC3b) occupies more area on the dry terrace and the adjacent White Fir-Jeffrey Pine Forest (PCC4) has encroached so that upland vegetation may eventually occupy 70% of the formerly riparian vegetation.

PCC1b: (20%) - Thinleaf Alder-Willow Community
This plant community along exist along the active stream banks. Thinleaf alder (Alnus incana ssp. tenuifola) is the most common shrub but Lemmon’s willow (Salix lemmonii) and shining willow (Salix lucida) are occasionally present. Sedge (Carex spp.), willowherb (Epilobium spp.), fowl mannagrass (Glyceria striata), and field horsetail (Equisetum arvense) are present as well as scattered forbs listed in PCC2b.

PCC2b: (10%) - Herbaceous Community
This plant community is found on point bars and floodplains. Common species are common yarrow (Achillea millefolium), Idaho bentgrass (Agrostis idahoensis), pearly everlasting (Anaphalis margaritacea), rosy pussytoes (Antennaria rosea), aster (Aster sp.), sedge (Carex sp.), cryptantha (Cryptantha sp.), slender hairgrass (Deschampsia elongata), squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), field horse tail (Equisetum arvense), meadow barley (Hordeum brachyantherum), rush (Juncus sp.), mountain rush (Juncus articus ssp. littoralis), dwarf mountain ragwort (Senecio fremontii), and cinquefoils (Potentilla spp.).

PCC3b: (35%) - Sierra Lodgepole Pine Forest
This moist lodgepole pine forest is present on upper floodplains or low terraces. Sierra lodgepole pine (Pinus contorta ssp. murrayana) is dominant and provides 15-45 percent cover over a grassy understory. Some of the species listed in PCC2b are also in the understory. Common plants are western needlegrass (Achnatherum occidentale), California brome (Bromus carinatus), squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), (Eriogonum pyrolifolium), groundsmoke (Gayophytum sp.), meadow barley (Hordeum brachyantherum), mountain rush (Juncus articus ssp. littoralis), Pacific lupine (Lupinus lepidus), bearded melicgrass (Melica aristata), and gooseberry (Ribes sp.)

PCC4: (35%) - White fir-Jeffrey Pine Forest
This forest community is present on upper terraces. It is dominated by white fir (Abies concolor) and Jeffrey pine (Pinus jeffreyi), with some Sierra lodgepole pine (Pinus contorta ssp. murrayana). The understory has moderate cover of grasses and forbs. Common plants are western needlegrass (Achnatherum occidentale), California brome (Bromus carinatus), squirreltail (Elymus elymoides), groundsmoke (Gayophytum sp.), and Kentucky bluegrass (Poa pratensis). Once this community has established on the terraces, it is less involved with the riparian stream dynamics and more influenced by forest dynamics which involve forest pathogens and fire. Please refer to the White Fir-Jeffrey Pine Ecological Site Description (F022BI103CA) or the Jeffrey pine- Fir Forest Ecological Site Description (F022BI106CA) for more information regarding forest dynamics and succession. At higher elevations California red fir replaces white fir on this landscape position (F022BI115CA). A Quaking aspen (Populus tremuloides)- Sierra lodgepole pine (Pinus contorta ssp. murrayana) ecological site (F022BI105CA) is adjacent to the riparian corridor at lower elevations on broad valleys.

The production data in the table below is a compilation of all the community types. ESIS does not currently support multiple tables for several community types in one phase. To identify species by plant community component refer to the narrative above rather than the table.

Community Phase Pathway 3.1a
This pathway is created by natural processes that cause the meadow to become drier. Several years of drought may cause this.

Community Phase Pathway 3.1b
This pathway is created when a flood creates erosion and deposition, leaving barren soil for early successional species to establish.

Constrained B channel Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre		Foliar Cover Percent	
					Low	High	Low	High
1 -Forbs					**0**	**49**		
		common yarrow	ACMI2	*Achillea millefolium*	0	15	0	3
		western pearly everlasting	ANMA	*Anaphalis margaritacea*	0	6	0	2
		rosy pussytoes	ANRO2	*Antennaria rosea*	0	1	0	1
		aster	ASTER	*Aster*	0	5	0	1
		cryptantha	CRYPT	*Cryptantha*	0	2	0	2
		willowherb	EPILO	*Epilobium*	0	1	0	1
		field horsetail	EQAR	*Equisetum arvense*	0	7	0	2
		groundsmoke	GAYOP	*Gayophytum*	0	1	0	1
		Pacific lupine	LULE2	*Lupinus lepidus*	0	3	0	1
		cinquefoil	POTEN	*Potentilla*	0	2	0	2
		dwarf mountain ragwort	SEFR3	*Senecio fremontii*	0	6	0	2

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre		Foliar Cover Percent	
					Low	High	Low	High
1 -Grass/ grasslike					**6**	**239**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	34	0	18
		Idaho bentgrass	AGID	*Agrostis idahoensis*	0	6	0	3
		California brome	BRCA5	*Bromus carinatus*	0	6	0	3
		sedge	CAREX	*Carex*	0	65	0	20
		slender hairgrass	DEEL	*Deschampsia elongata*	0	6	0	2
		squirreltail	ELEL5	*Elymus elymoides*	3	34	1	18
		blue wildrye	ELGL	*Elymus glaucus*	3	20	1	5
		fowl mannagrass	GLST	*Glyceria striata*	0	20	0	6

Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
		meadow barley	HOBR2	*Hordeum brachyantherum*	0	18	0	6
		mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	3	30	1	10

Shrub/Vine

					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**
1 -Shrubs					**960**	**6413**		
		thinleaf alder	ALINT	*Alnus incana ssp. tenuifolia*	900	2600	10	27
		Lemmon's willow	SALE	*Salix lemmonii*	60	900	1	12
		shining willow	SALU	*Salix lucida*	0	2913	0	40

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	6	115	239
Forb	0	30	49
Shrub/Vine	960	2800	6413
Total:	966	2945	6701

Flood - Community Phase 3.2

This community phase develops after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing sediment in other areas. Since the channel is constrained, the old flood plain is now a hydrologically disconnected terrace with a much lower water table. Flooding destroys large sections of the thinleaf alder/willow community in the channel but the herbaceous pioneer community reestablishes and expands on the newly exposed substrates. Some of the upland Sierra lodgepole pine and mixed conifer forest community is destroyed on the dry terrace, but upland vegetation still dominates the formerly riparian vegetation.

Estimate of plant community component composition in this phase:

PCC1b: 20%
PCC2b: 20%
PCC3b: 30%
PCC4: 30%

Community Phase Pathway 3.2a

This pathway is created with time and allows for the recovery of the plant communities after a flood event.

Community Phase Pathway 3.2b
This pathway is created when the site becomes drier due to drought or other causes.

<u>Drought - Community Phase 3.3</u>
This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates further encroachment of the upland Sierra lodgepole pine and adjacent mixed conifer forest on the floodplain, so that upland vegetation may eventually occupy 75% of the formerly riparian vegetation. The thinleaf alder/willow community is able to persist as does the herbaceous community, but the species composition likely shifts to favor grasses over sedges and some non-natives.

Estimate of plant community component composition in this phase:

PCC1b: 20%
PCC2b: 10%
PCC3b: 40%
PCC4 : 35%

Community Phase Pathway 3.3a
This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Community Phase Pathway 3.3b
This pathway is created when a flood leaves barren soil from erosion or deposition, allowing the pioneer plant community to increase in area.

Restoration Pathway - R3A
The processes that have altered this stream system may be natural or human-influenced. If the primary reason for channel adjustment is a result of natural erosion through the debris or glacial deposits, the channel should be fairly well readjusted and left alone. However, if human caused disturbance has caused the erosion, then restoration procedures should be considered.

The goal of restoration is to return the channel to its full potential, which is defined as the best channel condition, based on quantifiable morphological characteristics of that stream type. For a constrained B channel the goal is to raise the water table, increase the channel sinuosity, and re-establish riparian vegetation on the stream banks to reduce bank erosion. Each segment of the stream channel should be surveyed to determine the evolutionary stages of channel adjustment and evaluate the potential for natural recovery. If natural recovery does not seem likely, a thorough stream departure analysis can determine the feasibility of restoration, anticipate response to future changes in management, and develop appropriate restoration designs.

Ecological Site Interpretations

Animal Community:
This site provides valuable wildlife resources such as water and cover. Thinleaf alder and willow communities often serve as travel corridors for big game animals such as deer and many bird species utilize these riparian corridors for nesting and brood rearing. Overhanging alder and willow branches provide shade and cover for salmonids. In addition, wildlife and livestock depend on the leaves, stems, and seeds of Nebraska sedge, tufted hairgrass, and other various grasses and sedges as forage. The sedges and bunchgrasses provide nesting habitat for waterfowl and cover and forage for small mammals.

Plant Preference by Animal Kind:

Hydrology Functions:
The hydrological function of the flood plain is to provide a catchment for water, sediments, and nutrients. Floodplains may also provide water storage, which is slowly released down the drainage throughout the year.

Recreational Uses:
These streams provide scenic hiking corridors with wildlife viewing, fishing and photographic opportunities.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Tephra Over Slopes And Flats	F022BI103CA	This is a white fir- Jeffrey pine forest, found on the hillslopes around the streams.
Frigid Sandy Loam Debris Flow On Stream Terraces	F022BI105CA	This is a quaking aspen- Sierra lodgepole pine site found adjacent to this riparian site in some areas.
Frigid Debris Flow Gentle Slopes	F022BI106CA	This developing forest site is associated with the Devastated Area, which this riparian site flows through in some areas.
Frigid And Cryic Gravelly Slopes	F022BI115CA	This California red fir site is on the hillslopes surrounding this site at higher elevations.
Frigid Coarse Glaciolacustrine Gentle Slopes	F022BI117CA	This California red fir-Sierra lodgepole pine site is found at higher elevations on glaciolucustrine deposits adjacent to this site.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Loamy Flood Plains	R022BI210CA	This site is lower in elevation and is associated with a C type channel.

Frigid Gravelly Flood Plains	R022BI215CA	This site is lower in elevation, a larger stream, and associated with a C/D type channel.

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
The following NRCS vegetation plots have been used to describe this ecological site:

789139- Type location
789259

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	4 E
Section:	14
Datum:	NAD83
Zone:	10
Northing:	4487581
Easting:	627919
General Legal Description:	The type location is about 0.36 miles south-southeast of Hot Rock, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104487581627919

Relationship to Other Established Classifications:

Other References:
Bestelmeyer, Brandon T.; Brown, Joel R.; Havstad, Kris M.; Alexander, Robert; Chavez, George; and Herrick Jeffrey E.; 2003. Development and Use of State-and-Transition Models for Rangelands. Journal of Range Management, Vol. 56, No. 2 (Mar., 2003), pp. 114-126. Allen Press and Society for Range Management. Stable URL: http://www.jstor.org/stable/4003894

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Stringham, T.K., W.C. Krueger, and P.L. Shaver. 2003. State and Transition Modeling: An Ecological Process Approach. J. Range Manage 56: 106-113.

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USDA, NRCS. 2003. National Range and Pasture Handbook. Available online at: http://www.glti.nrcs.usda.gov/technical/publications/nrph.html

Weixelman, Dave; Weis, Sue; Linton, Fletcher; and Swartz, Heather; 2007. DRAFT: Condition Checklist for Fens in the Montane and Subalpine Zones of the Sierra Nevada and Southern Cascade Ranges, CA.

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	4/23/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Pyroclastic Flow

/ / *Penstemon davidsonii - Hulsea nana*
(/ / Davidson's penstemon - dwarf alpinegold)

Site ID: R022BI214CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 5 to 60 percent.
Landform: Pyroclastic flow in hanging valleys.
Soils: Very deep and excessively drained, soils formed in pyroclastic flows and fall deposits from the Chaos Crags. High percentage of subsurface gravels.
Temp regime: Cryic.
MAAT: 40 degrees F (4.4 degrees C).
MAP: 71 to 119 inches (1,803 to 3,023 mm).
Soil texture: Very gravelly ashy loamy coarse sand.
Surface fragments: 70 to 80 percent subangular fine and medium gravel and 0 to 18 percent cobbles and stones.
Vegetation: Low cover of prostrate alpine forbs such as marumleaf buckwheat (Eriogonum marifolium), dwarf alpinegold (Hulsea nana), Davidson's penstemon (Penstemon davidsonii), Nevada dustymaiden (Chaenactis nevadensis), cobwebby Indian paintbrush (Castilleja arachnoidea), and Mt. Hood pussypaws (Cistanthe umbellata var. umbellata).

Physiographic Features

This ecological site is found between Lassen Peak and Chaos Crags on pyroclastic flow in a hanging valley. The elevation ranges from 6,710 and 8,630 feet. Slopes range from 5 to 60.

Landform:	(1) Pyroclastic flow in hanging valley
	(2) Mountain

	Minimum	Maximum
Elevation (feet):	6710	8630
Slope (percent):	5	60
Water Table Depth (inches):		
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Low	Low
Aspect:	North East West	

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 71 to 119 inches (1,803 to 3,023 mm) and the mean annual temperature is 40 degrees F (4.4 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 65 to 185 days.

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

	Minimum	Maximum
Frost-free period (days):	50	85
Freeze-free period (days):	65	185
Mean annual precipitation (inches):	71.0	119.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

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

Wetland Description: System	Subsystem	Class

Representative Soil Features

This ecological site is associated with hanging valleys which were buried with pumiceous pyroclastic flow and fall deposits from the Chaos Crags. The Vitrandic Cryorthents soil component is associated with this site. These soils are very deep and excessively drained. The A and AC horizons are from 0 to 4 and 4 to 9 inches respectively, and have very gravelly ashy loamy coarse sand textures with 1 percent clay and 45 to 50 percent gravels. The C horizon has ashy course sand or ashy loamy coarse sand textures with 36 to 75 percent gravels. Below 30 inches there are 2 to 10 percent cobbles and 0 to 2 percent stones. This site has very low to low AWC.

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

Map Unit Component, Percent
174 Vitrandic Cryorthents, 60

Parent Materials:
Kind: Pyroclastic flow
Origin: Volcanic rock

Surface Texture: (1)Very gravelly ashy loamy coarse sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	70	80
Surface Fragments > 3" (% Cover):	0	18
Subsurface Fragments <=3" (% Volume):	35	85
Subsurface Fragments > 3" (% Volume):	0	20

Drainage Class: Excessively drained To Excessively drained
Permeability Class: Rapid To Rapid

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.1	7.3

Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.58	3.28

Plant Communities

Ecological Dynamics of the Site

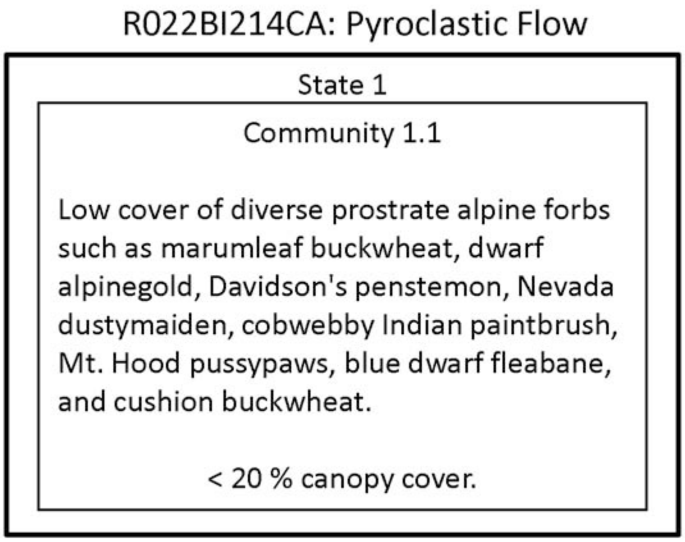
This ecological site is very sparsely vegetated with about 12 percent cover of compact forbs and stunted trees. Western white pine (Pinus monticola) accounts for approximately 2 percent of the total cover.

The ecological dynamics of this site are strongly affected by the relatively undeveloped soil. The soil on this site is very coarse, has very low available water holding capacity (AWC) and contains very little organic matter. In addition to the soil having very low AWC the plants on this site must also contend with high winds and extreme temperatures. Plants in these alpine environments are small, close to the ground and widely spaced with large patches of bare soil and rock in between (Billings and Mooney 1968). The relative lack of vegetation on this site compounds the effects of microenvironments. Small differences in micro-topography can make large differences in soil temperature, depth of thaw, wind effects, snow drifting, and the resulting protection of buds and leaves (Billings and Mooney 1968). The trees growing here are stunted, twisted and shrubby. Adaptations that make life on such a harsh site possible.

Species growing here are adapted to stressful environments. Plants like buckwheat (Eriogonum spp.) are slow growers because poor nutrient availability. This is a common characteristic of stress-tolerant plants. Plants are less susceptible to fluctuations in nutrient level when adapted to lower nutrient levels (Chapin and Bliss 1989).

This site has a simple 1 box state and transition model since it is not dependent upon disturbance for regeneration, and will take centuries or more to develop a significant tree canopy.

State and Transition Diagram



Natural State - State 1

This is the natural state for this ecological site.

Compact forbs and stunted trees - Community Phase 1.1

Pyroclastic Flow Ecological Site

Unique assemblages of prostrate alpine forbs are found across this site. Common species include marumleaf buckwheat (Eriogonum marifolium), dwarf alpinegold (Hulsea nana), Davidson's penstemon (Penstemon davidsonii), Nevada dustymaiden (Chaenactis nevadensis), cobwebby Indian paintbrush (Castilleja arachnoidea), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), squirreltail (Elymus elymoides), blue dwarf fleabane (Erigeron elegantulus), cushion buckwheat (Eriogonum ovalifolium), rockcress (Arabis sp.), silverleaf phacelia (Phacelia hastata), Pringle's bluegrass (Poa pringlei), Shasta knotweed (Polygonum shastense), and Suksdorf's silene (Silene suksdorfii).

This site produces very little biomass due to the relatively short growing season and harsh conditions. Reproduction of the species growing on this ecological site is also slow, which in turn makes the successional process very slow. Early successional species generally have long term seed viability, so a large number of individuals can germinate when conditions are favorable (Bazzaz 1979).

Species have different life strategies that allow for survival on site with relatively undeveloped soil and limited resources. The buckwheat species have a large amount of fine root biomass which increases its ability to take up nutrients and water in a limiting environment (Chapin and Bliss 1989). Knotweed species invest very little in a fine root system and have a large taproot. This means there is less surface area for nutrient and water uptake, but the taproot provides a reserve on nutrients for stressful years (Chaplin and Bliss 1989). The other co-dominate species dwarf alpine gold utilize rhizomes, horizontal underground stems, to assists new cohorts (Wilken 1975). These thickened secondary roots also allow for nutrient storage, similar to the strategy employed by knotweed species.

Compact forbs and stunted trees Plant Species Composition:

	Forb				**Annual Production in Pounds Per Acre**		**Foliar Cover Percent**	
Group	**Group Name**	**Common Name**	**Symbol**	**Scientific Name**	**Low**	**High**	**Low**	**High**
1 -Forbs					**0**	**61**		
		cobwebby Indian paintbrush	CAAR11	*Castilleja arachnoidea*	0	6	0	3
		Nevada dustymaiden	CHNE	*Chaenactis nevadensis*	0	4	0	2
		Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0	4	0	2
		marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	0	25	0	6
		dwarf alpinegold	HUNA	*Hulsea nana*	0	9	0	5
		silverleaf phacelia	PHHA	*Phacelia hastata*	0	4	0	2
		Shasta knotweed	POSH	*Polygonum shastense*	0	4	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Tree					**0**	**4**		
		western white pine	PIMO3	*Pinus monticola*	0	4	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Forb	5	34	61
Tree	0	2	4
Total:	5	36	65

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	0%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	10%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	0%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	1%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	0%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	1%	10%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	70%	80%		**Tree Snags** per Acre**			
Surface Fragments > 3"	10%	35%		Hard Snags***			
Bedrock	15%	25%		Soft Snags***			
Water	0%	0%					
Bare Ground	1%	10%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full

integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	**Grasses/Grasslike**		**Forbs**		**Shrubs/Vines**		**Trees**	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet								
> 0.5 - < 1 feet								
> 1 - <= 2 feet								
> 2 - < 4.5 feet							0%	1%
> 4.5 - <= 13 feet							0%	1%
> 13 - < 40 feet							0%	2%
< 40 - >= 80 feet								
> 80 - < 120 feet								
>= 120 feet								

Overstory:
There may be up to 2 percent cover of overstory western white pine.

Understory:
The production and canopy cover data in the table above are from ocular estimates.

Ecological Site Interpretations

Animal Community:
This ecological site provides habitat for species like the gray-crowned rosy finch, pika and golden mantled ground squirrel.

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This ecological site provides scenic vistas.

Wood Products:
none

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Upper Cryic Slopes	F022BI124CA	This is a mountain hemlock-whitebark pine forest site.
Alpine Slopes	R022BI207CA	This rangeland site is sparsely vegetated with lupine and scattered mountain hemlocks.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:

This site has been correlated with the following states:

Inventory Data References:

The following NRCS vegetation plot was used to describe this ecological site:

789388- type location

Type Locality:

State:	CA
County:	Shasta
Township:	31 N
Range:	4 E
Section:	27
Datum:	NAD83
Zone:	10
Northing:	4485809
Easting:	626567
General Legal Description:	The type location is about 2.13 miles west of the Emigrant Pass/Devastated Area parking lot in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator	NAD83104485809626567

(UTM) system:

Relationship to Other Established Classifications:

Other References:

Bazzaz, F.A. “The Physiological Ecology of Plant Succession.” Annual Review of Ecology and Systematics 10 (1979): 351-371.

Billings, W. D. and H.A. Mooney. “The Ecology of Artic and Alpine Plants.” Biol. Rev. 43 (1968): 481-529.

Chapin, David M. and L. C. Bliss. “Seedling growth, Physiology, and Survivorship in a Subalpine, Volcanic Environment.” Ecology 70 (1989):1325-1334.

Wilken, Dieter H. “A Systemation Study of the Genus Hulsea (Asteraceae).” Brittonia 27 (1975): 228-244.

Site Description Approval:

Author	Date	Approval	Date
Erin Hourihan, Marchel Munnecke	8/24/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Frigid Gravelly Flood Plains

Populus balsamifera ssp. trichocarpa / *Alnus incana ssp. tenuifolia* - *Salix lucida* / *Calamagrostis canadensis* - *Artemisia douglasiana*
(black cottonwood / mountain alder - shining willow / bluejoint reedgrass - Douglas' sagewort)

Site ID: R022BI215CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by a C-D type stream channel system.
Slopes: 2 to 6 percent
Landform: Flood plains
Soils: Very deep, somewhat poorly to poorly drained soils that formed in recent alluvium from volcanic rocks.
Temp regime: Frigid.
MAAT: 42 degrees F (6 degrees C).
MAP: 49 to 53 inches (1,244 to 1,346 mm).
Soil texture: Loamy very fine sand.
Surface fragments: 0 to 80 percent gravels, 0 to 32 percent larger rock fragments.
Vegetation: Several riparian plant communities are present with willow, thinleaf alder, black cottonwood, and forbs and grasses.
Note: This is a high velocity stream channel compared to other riparian steam channel ecological sites in Lassen Volcanic National Park.

Physiographic Features

This site is associated with moderate sized C and D type stream channels, and includes the valley bottom from the stream channel across the floodplains and lower terraces. This site is presently mapped between 5,280 and 5,520 feet in elevation, but may exist outside the park in a broader elevation zone. Slopes range from 2 to 6 percent.

This site has a seasonal water table that fluctuates from 13 to 80 inches from March to June. The water table may be below 80 inches, in drier areas of this site, late in the year.

Landform:	(1) Flood plain	
	Minimum	Maximum
Elevation (feet):	5280	5520
Slope (percent):	0	6
Water Table Depth (inches):	13	80
Flooding:		
Frequency:	Rare	Occasional
Duration:	Brief	Long
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	South East West	

Climatic Features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 49 to 53 inches (1,244 to 1,346 mm) and the mean annual temperature is 42 degrees F (6 degrees C). The frost free (>32F) season is 70 to 90 days. The freeze free (>28F) season is 85 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	70	90
Freeze-free period (days):	85	200
Mean annual precipitation (inches):	49.0	53.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is associated with a perennial stream, which transitions between Rosgen C and D channel types.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Riverine	Lower Perennial	Unconsolidated Bottom

Stream Types:
(RosGen Narrative)

C3,C3b,C3c--This stream is a single-thread channel that is slightly entrenched, it typically gets out of bank two years out of three. It has a moderate to high width to depth ratio and high sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier) or be less than 0.1 percent (c- modifier). It is a cobble-bottom stream.

C4,C4b,C4c--This stream is a single-thread channel that is slightly entrenched, it typically gets out of bank two years out of three. It has a moderate to high width to depth ratio and high sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier) or be less than 0.1 percent (c- modifier). It is a gravel-bottom stream.

D3,D3b-This stream has multiple channels which can change location annually. It has a very high width/depth ratio and low sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier). It is a cobble-bottom stream.

D4,D4b,D4c--This stream has multiple channels which can change location annually. It has a very high width/depth ratio and low sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier) or be less than 0.1 percent (c- modifier). It is a gravel-bottom stream.

Representative Soil Features

The Aeric Endoaquents soil component is associated with this site and consists of very deep, somewhat poorly drained soils that formed in recent alluvium from volcanic rocks. There is about 3 inches of fresh organic material over several C horizons. The surface texture is loamy very fine sand with gravelly or cobbly sandy subsurface textures. The size of rock fragments tends to increase with depth. This site has very low AWC in the upper 60 inches of soil.

To a minor extent the Aquandic Humaquepts- flood plains soil component is associated with this site. It consists of very deep, poorly drained soils that formed in alluvium from volcanic rocks. The A horizons have a stony mucky ashy loam texture with medium subsurface textures and a high percentage of rock fragments. Redoximorphic features including masses of oxidized iron and gleyed soil colors are present 7 inches below the surface.

Although not directly correlated to this ecological site, the Humic Haploxerands, stream terrace soil component is found on the adjacent stream terraces and is associated with the white fir forest ecological site F022BI110CA, which is similar to PCC4 in State 3. The Humic Haploxerands, stream terrace component consists of very deep, moderately well and well drained soils that formed in ash influenced alluvium from volcanic rocks. The surface texture is gravelly medial sandy loam. Subsurface textures with increasing depth are medial fine sandy loam, gravelly medial fine sandy loam, extremely stony medial loamy coarse sand, and ashy stones.

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

DMU Component percent
160 Aeric Endoaquents 45
160 Aquandic Humaquepts floodplains 5

Parent Materials:
Kind: Alluvium
Origin: Volcanic rock

Surface Texture: (1) Loamy very fine sand

Subsurface Texture Group: Sandy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	80
Surface Fragments > 3" (% Cover):	0	32
Subsurface Fragments <=3" (% Volume):	0	85
Subsurface Fragments > 3" (% Volume):	0	40

Drainage Class: Poorly drained To Somewhat poorly drained
Permeability Class: Moderate To Moderately rapid

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	4.5	6.5
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	0.35	3.92

Plant Communities

Ecological Dynamics of the Site

This site is associated with alluvial deposits from Holocene age stream processes, and a Rosgen "C" type channel. These channels are in lower gradient, glacially carved U shaped valleys, where deposition occurs to form flood plains. The alluvial deposits and channel migration are restricted to the valley floors. As the channels migrate in the confined corridors, former channels are buried with overbank deposits from subsequent channel courses and typically form soil profiles with coarser channel deposits under finer overbank deposits. As down cutting occurred (likely due to uplift) the streams cut down into the original flood plain surfaces and transformed them into stream terraces and formed new flood plains at the lower channel level (NRCS, 2010).

Undisturbed, this site supports a "C" type channel according to the Rosgen classification scheme. A "C" type channel is a slightly entrenched single thread meandering channel with a well defined floodplain. The channel has moderate to high sinuosity and a low gradient with less than 2% slope, but can have gradients up to 3.9 (b modifier). These channel types generally have a width to depth ratio greater than 12, which means they are wide and shallow. They are often found in broad valleys with well developed alluvial floodplain terraces and such channels typically flood over bank two years out of three. In an undegraded state, a 50 year flood event should overflow onto the floodplain.

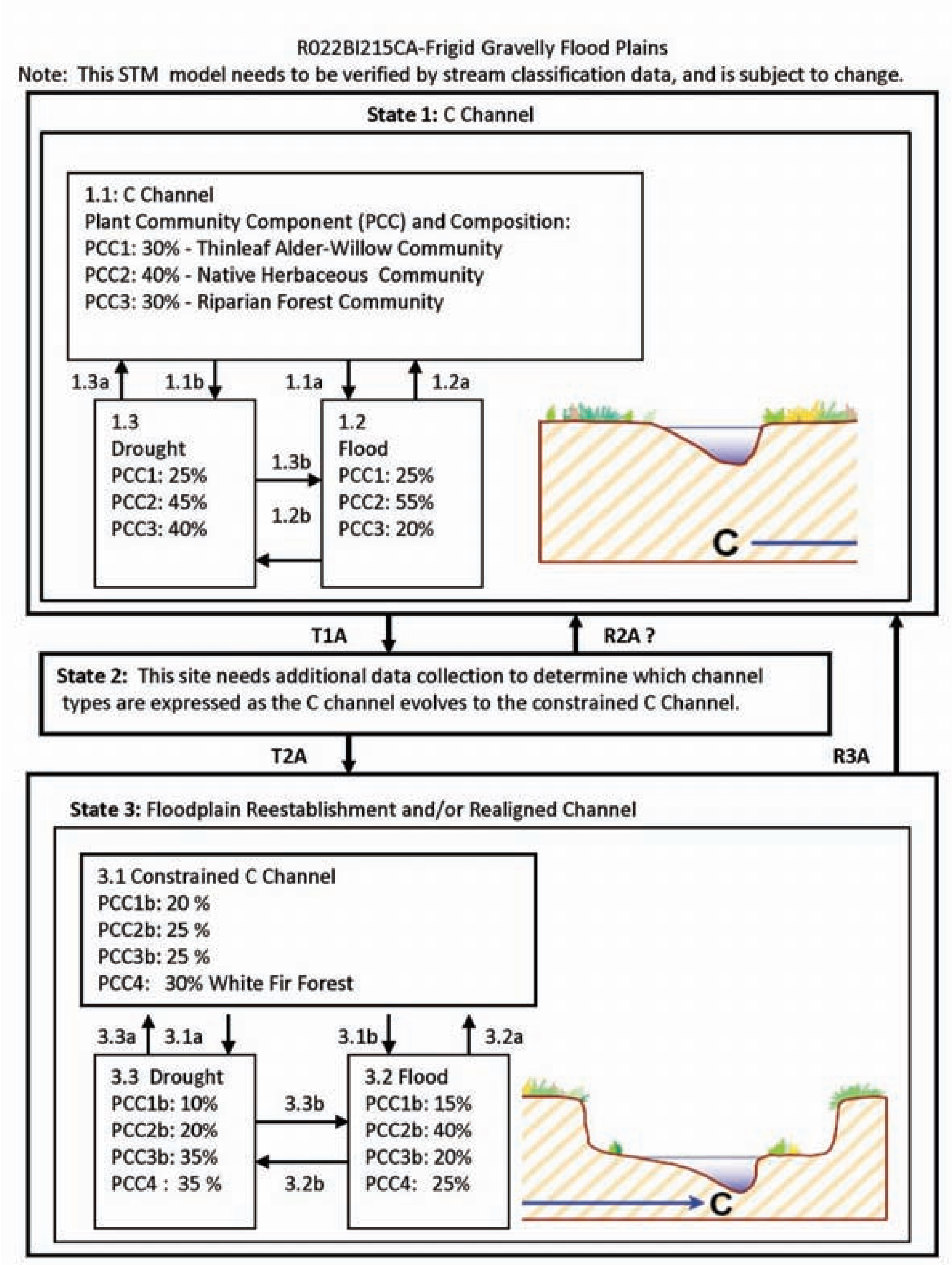
C type channels are constantly in the process or transporting and storing sediments from upstream sources or bank erosion. As the particle size of the channel bottom material decreases, the sediment supply generally increases and so does the erosion potential. The channel on this site supports cobble- bottom (C3), gravel-bottom (C4), reaches which have moderate to very high erosion potentials, respectively. The sensitivity to disturbance is very high for both C4 types, and moderate for C3. Vegetation exerts a very high controlling influence on stream dynamics in all three types (Rosgen, 1994).

A "D" type stream channel has multiple channels which can change location annually. It has a very high width/depth ratio and low sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier). This site has a gravel-bottom or cobble bottom stream. The D type channel develops in this site when sediment accumulation is greater than the streams sediment transport capacity. This often occurs in areas where there is a reduction in the stream gradient. Large flood events or landslides deposit sediments in these zones. After these events, the channel will braid through the new material until it reestablishes a single thread channel.

The plant communities along the channel occur in distinct zones related to variable water table depth and disturbance events. There is a broad floodplain on this site with several topographic levels. A Sierra lodgepole pine- black cottonwood forest is present on the upper level floodplain. Terraces have developed as the channel incises through sediments. A white fir forest is present on these terraces. A shrub community comprised of thinleaf alder or a mix of thinleaf alder and Lemmon's willow dominates the site in an undisturbed state. The riparian shrub community requires seasonal flooding and a water table that normally remains within 3 feet of the surface. Both thinleaf alder and Lemmon's willow are flood and shade tolerant and act as an important stabilizing component of the streambank. Streambanks anchored by these shrubs are stable and can withstand relatively severe spring runoff and flooding. As alder and willow thickets develop after floods finer fluvial deposits are trapped within the extensive root networks, facilitating sediment accumulation. Thus the coarse channel deposits of cobble, gravel or sand, where thinleaf alder and willow typically establish, eventually develop a loam or sandy loam surface soil texture from overbank deposits overlaying the coarser channel deposits. In addition, thinleaf alder improves soil fertility through the addition of nitrogen to the soil from nitrogen-fixing root nodules and a nitrogen-rich leaf litter. The finer sediment (overbank deposits) and increased fertility enables establishment and retention of a native herbaceous community that provides valuable forage and habitat for wildlife.

This ecological site is a complex of riparian plant communities that are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community component composition as a result of disturbance, rather than focusing on the succession of one plant community. Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram



C Channel - State 1

This state is a single thread C type channel set in a broad valley bottom with gentle slopes associated with Holocene alluvial deposits. C channels are considered slightly entrenched and have a moderate to high width to depth ratio. Sinuosity is moderate to high, resulting in a well-defined meandering channel. The slope is low gradient and point bar formation and riffle/pool morphology are common features. C channels tend to be wide and shallow with a well-defined floodplain and may have alluvial terraces of abandoned floodplains.

This state was not observed. Most of this stream channel exhibits State 2 or State 3 channel characteristics.

C Channel - Community Phase 1.1

The plant communities associated with this site occur in distinct zones related to variable water table depth and disturbance events. Approximately 30% of the total vegetation is a Thinleaf Alder-Willow community that forms a continuous stringer immediately adjacent to the stream where the water table stays relatively high year round. Thinleaf alder, Lemmon’s willow, and shining willow are flood and shade tolerant and act as an important stabilizing component of the streambank. These shrubs produce copius amounts of seeds in the fall and winter and seeds germinate immediately after dispersal when conditions are favorable. Germination and seedling establishment is optimal on exposed mineral substrate. Thinleaf alder may also reproduce vegetatively through spreading underground rhizomes or suckers, but the willows do not have this capacity. These shrub species can re-sprout vigorous following a top cut or fire.

Streambanks anchored by these shrubs are stable and can withstand relatively severe spring runoff and flooding. As alder and willow thickets develop after floods finer fluvial deposits are trapped within the extensive root networks, facilitating soil development. Thinleaf alder improves soil fertility through the addition of nitrogen to the soil from nitrogen-fixing root nodules and a nitrogen-rich leaf litter.

Drought and flood are the primary forces that drive transitions between alternate community phases. A lower water table from prolonged drought facilitates encroachment of the upland community on the floodplain and an associated reduction in the thinleaf alder/Lemmon’s willow community. Conversely, a flood destroys sections of the thinleaf alder community within the active channel and favors establishment of the pioneering native herb community that colonizes recently exposed substrate and provides valuable forage and habitat for wildlife.

Data was not collected for this state, but species composition within the communities components may be similar to the plant community components described in State 2, Community Phase 2.1. Prior to channel incision, this area would have had a higher water table across the valley floor. There may have been areas with more sedges and willows.

PCC1: 30 % - Thinleaf Alder-Willow Community

This community is found along the stream channel on the banks and relatively stable point bars. Thinleaf alder (Alnus incana ssp. tenuifolia) dominates this community with Lemmon's willow (Salix lemmonii), and shining willow (Salix lucida) present in smaller amounts. Within the patches of shrubs the canopy cover is dense with little understory. However, along the channel or in canopy openings fringed willowherb (Epilobium ciliatum), seep monkeyflower (Mimulus guttatus), purple monkeyflower (Mimulus lewisii), bugle hedgenettle (Stachys ajugoides), American vetch (Vicia americana), bluejoint (Calamagrostis canadensis), fowl mannagrass (Glyceria striata), and common rush (Juncus effuses) may be present as well as other species listed in PCC2.

PCC2: 40% - Native Herbaceous Community
This community is found on gravel bars and other recently disturbed areas. It is a mix of early successional species. There is a high cover of exposed gravels and rock. Canopy cover is very low after disturbance, but can gradually increase to about 50 percent cover. Common plants are common yarrow (Achillea millefolium), western pearly everlasting (Anaphalis margaritacea), Douglas' sagewort (Artemisia douglasiana), Indian paintbrushes (Castilleja spp.), Douglas' thistle (Cirsium douglasii), fringed willowherb (Epilobium ciliatum), groundsmokes (Gayophytum spp.), streambank bird's-foot trefoil (Lotus oblongifolius), bentgrass (Agrostis sp.), smallwing sedge (Carex microptera), sedge (Carex sp.), tufted hairgrass (Deschampsia cespitosa), blue wildrye (Elymus glaucus), swordleaf rush (Juncus ensifolius) rush (Juncus sp.), and bluegrass (Poa sp.).

PCC3: 30% - Riparian Forest Community
This plant community is found on rarely flooded floodplains. The overstory is a mix of Sierra lodgepole pine (Pinus contorta var. murrayana) and black cottonwood (Populus balsamifera ssp. trichocarpa), and quaking aspen (Populus tremuloides). The understory is dominated by grasses such as western needlegrass (Achnatherum occidentale), California brome (Bromus carinatus), blue wildrye (Elymus glaucus), and squirrel tail (Elymus elymoides). Other species from PCC2 may be present as well.

Community Phase Pathway 1.1a
This pathway is created when a flood scours the channel of existing vegetation and deposits a layer of sediment, initiating regeneration.

Community Phase Pathway 1.1b
This pathway is created by natural processes that cause the site to become drier, usually several years of drought.

Flood - Community Phase 1.2
This community phase develops after a major flood event. The plant community components remain the same, as described in Community phase 1.1, but the proportion of each community type shifts after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing large quantities of sediment in other areas. The destruction of sections of the thinleaf alder community in the channel is accompanied by a dramatic increase in the herbaceous pioneer community. After the flood the early seral grasses like squirrel tail and herbs quickly colonize the recently exposed substrate and within a season the herbaceous community may comprise over half (55%) of the total riparian vegetation.

Estimate of plant community component composition in this phase:
PCC1: 25%

PCC2: 55%
PCC3: 20%

Drought - Community Phase 1.3
This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates encroachment of the upland Sierra lodgepole pine- black cottonwood forest on the floodplain, and an associated reduction in the thinleaf alder/ willow community.

Estimate of plant community component composition in this phase:

PCC1: 25%
PCC2: 45%
PCC3: 40%

Community Phase Pathway 1.3a
This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Community Phase Pathway 1.3b
This pathway is created when a flood scours the channel of existing vegetation and deposits a layer of sediment, initiating regeneration.

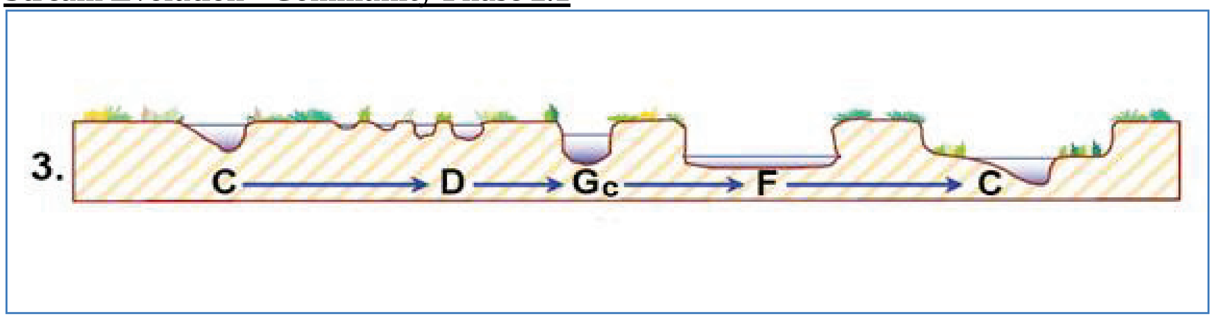
Transition - T1A
This transition can occur naturally as the “C” type channel in State 1 down-cuts through the valley bottom. The channel on this site supports cobble-bottom (C3) and gravel-bottom (C4) reaches which have moderate to very high erosion potentials, respectively. Bank erosion is a natural river adjustment process and can as the result of mass wasting, liquification, freeze-thaw, fluvial entrainment, and ice scour. The glacial outwash and alluvial deposits in the U-shaped valley bottom are gradually eroded through these processes.

This transition can also be initiated by a disturbance that alters the hydrology of the site or impacts the vegetation along the stream bank. Alterations that can affect the hydrology of this site include channel realignment and/or confinement, culvert installations, and road construction. Such alterations straightened the channel, eliminating its ability to meander. This increases the shear stress along the stream bank, which accelerates stream bank erosion, thereby increasing sediment supply and decreasing sediment transport capacity. As the channel straightens it has a shorter course down the valley, creating a steeper gradient. The stream may adjust by headcutting into the base level of the channel until it establishes a new gradient. As the stream bed is lowered, so is the water table. The new larger and steeper channel can contain more flow, reducing the frequency of flooding and the extent of the floodplain, creating terraces. Cattle grazing and/or the seeding of non-native grass for forage can cause a similar entrenchment of the channel but through a different mechanism. When cattle reduce vegetation and trample the exposed stream banks, the resulting erosion also leads to eventual straightening and headcutting of the channel. Likewise, when non-native grasses displace the native riparian sedges and rushes, the stabilizing root mats that help prevent erosion are also removed.

Stream Evolution - State 2

Additional stream classification data is required to determine which channel types are expressed as the C channel evolves in response to disturbance. In a possible succession scenario, the “C” type channel in State 1 fills with sediment, and the flows disperses into multiple braided channels typical of a “D” type channel. As flow concentrates into one main channel, it will down-cut into an entrenched low gradient “Gc” type channel. The unstable “Gc” type channel naturally begins to widen over time into an entrenched “F” type channel. The plant community components associated with these possible successional channel types is not known. The “D” type channel has a broad area that is frequently flooded, with high cover of exposed gravels and cobbles and patches pioneer plants. Deeply incised “Gc” and “F” channels generally lose the wetland obligate species and become dominated by upland grass, shrub and/or forest plant communities. As the water table lowers at the site, the adjacent white fir forest community can encroach and the thinleaf alder and mixed willow community declines. Upland grass species like blue wildrye and western neeedlegrass would begin to dominate the native herbaceous community.

Stream Evolution - Community Phase 2.1



Rosgen Stream Succession Scenario 3

The Rosgen Stream Succession Scenario #3 above displays a possible channel evolution pathway for this site. Sections of this site are presently braided exhibiting a “D” type channel. However, stream classification data is needed to determine the actual stream evolution process occurring on this site.

Braided “D” channels are unstable systems, with poor lateral bank stability. They tend to carry large amounts of bedload gravels and cobbles. The constantly moving channels make it difficult to design stream crossings or implement restoration.

When flow begins to concentrate into a main channel a “D” channel may evolve into a “Gc” type channel. A “Gc” type channel is an unstable, gully-like, entrenched channel which will naturally begin to widen over time into an entrenched “F” type channel. The broadly entrenched “F” type channel allows for sediment deposition, which builds point bars and floodplains with a meandering channel. As riparian vegetation begins to reestablish on the new floodplains, channel stability increases, and an entrenched “C” type channel with a developed floodplain and a meandering channel will eventually develop within the entrenched “F” type channel. This new entrenched “C” type channel may resemble the original “C” type channel with wetland plant communities, but it will be constrained by terraces to the lower floodplain area. The old floodplain becomes a terrace, disconnected from flood events. The terrace has a lower seasonal water table which supports a greater proportion of upland plant communities.

Transition - T2A

This transition occurs when continued sediment deposition in the broadly entrenched “F” type channel allows the riparian vegetation to reestablish on the new floodplain. The vegetation increases channel stability and eventually channel sinuosity returns and a new meandering channel will develop that is constrained by the old floodplain.

Restoration Pathway - R2A

Additional stream classification data is required to determine which channel types are expressed in State 2 as the C channel evolves in response to disturbance. Without this data it is not possible to identify the restoration pathway for the intermediate phase of the stream succession scenario.

Constrained C Channel - State 3

This C Channel has re-established a floodplain and natural sinuosity. It is constrained by the old flood plain, which is now a hydrologically disconnected terrace.

Constrained C Channel - Community Phase 3.1

Gravelly Flood Plains, Kings Creek


Gravelly Flood Plains

The composition of the plant communities has shifted primarily, because the stream channel incised through deposits creating a terrace with an upland plant community (PCC4). The riparian communities are confined to a smaller area within the new floodplain. In some areas, the sedges associated with the Lemmon's willow- thinleaf alder community (PCC2) have been replaced by grasses because of lower water tables. Non-native species may be present.

PCC1b: 20 %
Thinleaf Alder- Willow Community
This community is found along the stream channel on the banks and relatively stable point bars. Thinleaf alder (Alnus incana ssp. tenuifolia) dominates this community with Lemmon's willow (Salix lemmonii), and shining willow (Salix lucida) present in smaller amounts. Within the patches of shrubs the canopy cover is dense with little understory. However, along the channel or in canopy openings fringed willowherb (Epilobium ciliatum), seep monkeyflower (Mimulus guttatus), purple monkeyflower (Mimulus lewisii), bugle hedgenettle (Stachys ajugoides), American vetch (Vicia americana), bluejoint (Calamagrostis canadensis), fowl mannagrass (Glyceria striata), and common rush (Juncus effuses) may be present as well as other species listed in PCC2b.

PCC2b: 25 %
Herbaceous Community
This community is found on gravel bars and other recently disturbed areas. It is a mix of early successional species. There is a high cover of exposed gravels and rock. Canopy cover is very low after disturbance, but can gradually increase to about 50 percent cover. Common plants are common yarrow (Achillea millefolium), western pearly everlasting (Anaphalis margaritacea), Douglas' sagewort (Artemisia douglasiana), Indian paintbrushes (Castilleja spp.), Douglas' thistle (Cirsium douglasii), fringed willowherb (Epilobium ciliatum), groundsmokes (Gayophytum spp.), streambank bird's-foot trefoil (Lotus oblongifolius), bentgrass (Agrostis sp.), smallwing sedge (Carex microptera), sedge (Carex sp.), tufted hairgrass (Deschampsia cespitosa), blue wildrye (Elymus glaucus), swordleaf rush (Juncus ensifolius), rush (Juncus sp.), and bluegrass (Poa sp.).

PCC3b: 25 %
Riparian Forest Community
This plant community is found on rarely flooded floodplains and low terraces. The overstory is a mix of Sierra lodgepole pine (Pinus contorta var. murrayana) and black cottonwood (Populus balsamifera ssp. trichocarpa), with some white fir (Abies concolor) and quaking aspen (Populus tremuloides). The understory is dominated by grasses such as western needlegrass (Achnatherum

occidentale), California brome (Bromus carinatus), blue wildrye (Elymus glaucus), and squirrel tail (Elymus elymoides). Other species from PCC2b and PCC4 may be present as well.

PCC4: 30%
White fir forest
This forest is present on the upper terraces. These terraces are high above the stream channel so there is a lower water table, and the area is no longer utilized as a floodplain. However, large flood events or log jams may cause portions of terraces to calve into the stream channel. White fir (Abies concolor) is able to establish forests in the drier more stable landform. Sierra lodgepole pine (Pinus contorta var. murrayana) and incense cedar (Calocedrus decurrens) may be present in small amounts. Ecological succession is less influenced by riparian processes at this point and it is more influenced by forest dynamics such as fire and pest infestations. Please refer to the white fire ecological site F022BI110CA for more information on forest dynamics. The understory is relatively sparse, having an average of 10 percent cover. Grasses generally dominate with a few forbs and shrubs. Common plants include: needlegrass (Achnatherum spp.), California brome (Bromus carinatus), Orcutt's brome (Bromus orcuttianus), Brainerd's sedge (Carex brainerdii), Ross' sedge (Carex rossii), whitethorn ceanothus (Ceanothus cordulatus), squirreltail (Elymus elymoides), naked buckwheat (Eriogonum nudum), spreading groundsmoke (Gayophytum diffusum) and Sierra gooseberry (Ribes roezlii).

The species composition in the tables below is a compilation of PCC1b, PCC2b, and PCC3b. Please refer to the plant community description above for composition by plant community component. Production data is based on ocular estimates, actual weights were not collected.

Community Phase Pathway 3.1a
This pathway is caused by natural processes that cause the site to become drier, such as several years of drought.

Community Phase Pathway 3.1b
This pathway is created when a flood creates erosion and deposition, leaving barren soil for early successional species to establish.

Constrained C Channel Plant Species Composition:

Forb					Annual Production in Pounds Per Acre		Foliar Cover Percent	
Group	Group Name	Common Name	Symbol	Scientific Name	Low	High	Low	High
1 -Native forbs					**16**	**105**		
		common yarrow	ACMI2	*Achillea millefolium*	3	10	1	3
		western pearly everlasting	ANMA	*Anaphalis margaritacea*	3	13	1	4
		Douglas' sagewort	ARDO3	*Artemisia douglasiana*	10	40	3	8
		Indian paintbrush	CASTI2	*Castilleja*	0	3	0	1
		Douglas' thistle	CIDO2	*Cirsium douglasii*	0	6	0	2
		fringed willowherb	EPCI	*Epilobium ciliatum*	0	6	0	2

		groundsmoke	GAYOP	*Gayophytum*	0	2	0	1
		streambank bird's-foot trefoil	LOOB2	*Lotus oblongifolius*	0	2	0	1
		seep monkeyflower	MIGU	*Mimulus guttatus*	0	10	0	4
		purple monkeyflower	MILE2	*Mimulus lewisii*	0	3	0	1
		bugle hedgenettle	STAJ	*Stachys ajugoides*	0	8	0	2
		American vetch	VIAM	*Vicia americana*	0	2	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Grass/grasslike					**11**	**99**		
		bentgrass	AGROS2	*Agrostis*	2	25	1	10
		California brome	BRCA5	*Bromus carinatus*	0	8	0	2
		bluejoint	CACA4	*Calamagrostis canadensis*	3	25	1	7
		smallwing sedge	CAMI7	*Carex microptera*	0	6	0	2
		sedge	CAREX	*Carex*	3	25	1	7
		tufted hairgrass	DECE	*Deschampsia cespitosa*	0	3	0	1
		blue wildrye	ELGL	*Elymus glaucus*	3	8	1	2
		fowl mannagrass	GLST	*Glyceria striata*	0	4	0	1
		common rush	JUEF	*Juncus effusus*	0	1	0	3
		swordleaf rush	JUEN	*Juncus ensifolius*	0	1	0	3
		rush	JUNCU	*Juncus*	0	1	0	3
		bluegrass	POA	*Poa*	0	1	0	3

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Shrubs					**900**	**2820**		
		thinleaf alder	ALINT	*Alnus incana ssp. tenuifolia*	900	2000	10	20
		Lemmon's willow	SALE	*Salix lemmonii*	0	120	0	2
		shining willow	SALU	*Salix lucida*	0	700	0	10

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High

1 -Trees				**0**	**57**		
	white fir	ABCO	*Abies concolor*	0	3	0	1
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0	24	0	12
	black cottonwood	POBAT	*Populus balsamifera ssp. trichocarpa*	0	30	0	10
	quaking aspen	POTR5	*Populus tremuloides*	0	10	0	2

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	11	45	99
Forb	16	50	105
Shrub/Vine	900	1800	2820
Tree	0	12	57
Total:	927	1907	3081

Flood - Community Phase 3.2

This community phase develops after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing large quantities of sediment in other areas. The plant community components remain the same, as described in Community phase 2.1, but the proportion of each community components shifts. The destruction of sections of the thinleaf alder community in the channel is accompanied by a dramatic increase in the herbaceous pioneer community. However since the channel is constrained, the old flood plain is now a hydrologically disconnected terrace. With a lowered water table, the upland community gradually replaces the thinleaf alder /willow and may eventually occupy 25% of the formerly riparian vegetation.

Estimate of plant community component composition in this phase:

PCC1b: 15%
PCC2b: 40%
PCC3b: 20%
PCC4: 25%

Community Phase Pathway 3.2a

This pathway is created with time and allows for the recovery of the plant communities after a flood event.

Community Phase Pathway 3.2b

This pathway is created when the site becomes drier due to drought or other causes.

Drought - Community Phase 3.3

This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates encroachment of the upland white fir forest on the terrace, and nearly eliminates the thinleaf alder/willow community.

Estimate of plant community component composition in this phase:

PCC1b: 10%
PCC2b: 20%
PCC3b: 35%
PCC4 : 35%

Community Phase Pathway 3.3a
This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Community Phase Pathway 3.3b
This pathway is created when a flood leaves barren soil from erosion or deposition, allowing the pioneer plant community to increase in area.

Restoration Pathway - R3A
The processes that have altered this stream system may be natural or human-influenced. If the primary reason for channel adjustment is a result of natural erosion through alluvial deposits as a result of uplift, the channel should be fairly well readjusted and left alone. However, if human caused disturbance has caused the erosion, then restoration procedures should be considered.

The goal of restoration is to return the channel to its full potential, which is defined as the best channel condition, based on quantifiable morphological characteristics of that stream type. For a constrained C channel the goal is to raise the water table, increase the channel sinuosity, and re-establish riparian vegetation on the stream banks to reduce bank erosion. Each segment of the stream channel should be surveyed to determine the evolutionary stages of channel adjustment and evaluate the potential for natural recovery. If natural recovery does not seem likely, a thorough stream departure analysis can determine the feasibility of restoration, anticipate response to future changes in management, and develop appropriate restoration designs.

Ecological Site Interpretations

Animal Community:
This site provides valuable wildlife resources such as water and cover. Thinleaf alder and willow communities often serve as travel corridors for big game animals such as deer and many bird species utilize these riparian corridors for nesting and brood rearing. Overhanging alder and willow branches provide shade and cover for salmonids. In addition, wildlife and livestock depend on the leaves, stems, of various grasses and sedges as forage.

Plant Preference by Animal Kind:

Hydrology Functions:
The hydrological function of the flood plain is to provide a catchment for water, sediments, and

nutrients. Floodplains may also provide water storage, which is slowly released down the drainage throughout the year.

Recreational Uses:
These streams provide scenic hiking corridors with wildlife viewing, fishing and photographic opportunities.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Humic Loamy Gentle Slopes	F022BI110CA	This is a white fir forest found on the older terraces and nearby hillslopes.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Loamy Flood Plains	R022BI210CA	This site is associated with smaller C type channels, which do not display a D type channel succession.
Frigid Sandy Flood Plains	R022BI213CA	This site is associated with smaller B type channels.

State Correlation:
This site has been correlated with the following states:

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

CA789245- Type location
CA789 Kings Creek

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	6 E
Section:	19
Datum:	NAD83
Zone:	10
Northing:	4477748
Easting:	639353
General Legal Description:	The type location is about 0.38 miles north of Kelly Camp, just inside the Lassen Volcanic National Park boundary.
Latitude Degrees:	

Latitude Minutes:

Latitude Seconds:

Latitude Decimal:

Longitude Degrees:

Longitude Minutes:

Longitude Seconds:

Longitude Decimal:

Universal Transverse Mercator (UTM) system: NAD83104477748639353

Relationship to Other Established Classifications:

Other References:

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Site Description Approval:

Author	Date	Approval	Date
Marchel Munnecke	9/17/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Active Hydrothermal Areas (Complex)

Abies magnifica - Tsuga mertensiana / / Carex - Pteridium aquilinum var. pubescens
(California red fir - mountain hemlock / / carex - hairy brackenfern)

Site ID: R022BI216CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Slopes: 10 to 80 percent, but generally 15 to 65 percent.
Landform: Actively eroding mountain slopes and debris flows within the hydrothermally altered area of Brokeoff Volcano.
Soils: Shallow to very deep, well to somewhat poorly drained soils that formed in wet debris flow or colluvium and residuum.
Temperature Regime: Frigid.
MAAT: 38 and 42 degrees F (3.3 and 5.5 degrees C).
MAP: 63 to 119 inches (1,600 mm to 3,023 mm).
Soil texture: Clay loam and gravelly sandy loam.
Surface fragments: 2 to 30 percent gravel and 8 to 13 percent cobbles and stones.
Vegetation: During periods of stability patches of California red fir (Abies magnifica), mountain hemlock (Tsuga mertensiana) and western white pine (Pinus monticola) establish. There is fair cover of grasses and forbs such as western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides), mountain monardella (Monardella odoratissima), lupine (Lupinus sp.) and hairy brackenfern (Pteridium aquilinum var. pubescens).

This site is an actively eroding mountain slope-debris flow complex. The actively eroding mountain slopes are shallow, steep, and dry, while the debris flow deposits are generally deep and in valley bottoms where there is more water availability. The erosion process is active enough that this complex is best described together than as separate sites, even though the actively eroding mountain slope and debris deposits have different site potentials they are only intermittently stable.

Physiographic Features

This ecological site is found in the hydrothermally altered area of Brokeoff Volcano on actively eroding mountain slopes and debris flows. This site is found between 5,680 and 8,570 feet in elevation. Slopes range from 10 to 80 percent, but are generally between 15 and 65 percent.

The wetter positions in this site may have a water table at the surface from March to May, which drops below 60 inches by August.

Landform:	(1) Debris flow
	(2) Mountain slope

	Minimum	Maximum
Elevation (feet):	5680	8570
Slope (percent):	10	80
Water Table Depth (inches):	0	
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	High	Very high
Aspect:	South East West	

Climatic Features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 63 to 119 inches (1,600 mm to 3,023 mm) and the mean annual temperature is between 38 and 42 degrees F (3.3 and 5.5 degrees C). The frost free (>32 degrees F) season is 60 to 85 days. The freeze free (>28 degrees F) season is 80 to 195 days.

There are no representative climate stations for this ecological site.

	Minimum	Maximum
Frost-free period (days):	60	85

Freeze-free period (days):	80	195
Mean annual precipitation (inches):	63.0	119.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

Wetland Description: System	Subsystem	Class

Representative Soil Features

This site is associated with the Aquic Dystroxerepts, Debris Flows and Typic Dystroxerepts soil components. Aquic Dystroxerepts, Debris Flows consist of very deep, somewhat poorly drained soils that formed in wet debris flow material from hydrothermally altered volcanic rocks. Aquic Dystroxerepts, Debris Flows have up to 2 inches of fresh organic material on the surface in more stable areas. The A horizon is about three inches thick with a clay loam texture. The subsurface horizons are medium to fine textured. Clay ranges from 30 to 34 percent. The buried soil is sometimes encountered at depths of 2 feet or more. Redoximorphic features are present at 9 inches. The Typic Dystroxerepts component consists of shallow to deep, well drained soils that formed in colluvium and residuum from hydrothermally altered volcanic rocks on actively eroding mountain slopes. The Typic Dystroxerepts have a 1 inch A horizon with a gravelly sandy loam texture, with gravelly or parargravelly loam and clay loam subsurface textures. Depth to a paralithic contact ranges from 10 to 60 inches. Permeability is moderately slow, but the paralithic bedrock is impermeable.

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

Map Unit Component /Component percent %
119 Aquic Dystroxerepts, Debris Flows /11
119 Typic Dystroxerepts /10

Parent Materials:

Kind: Debris flow deposits, Colluvium, Residuum
Origin: Hydrothermically altered volcanic rock

Surface Texture: (1)Gravelly sandy loam
(2)Clay loam
Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	2	30
Surface Fragments > 3" (% Cover):	8	13
Subsurface Fragments <=3" (% Volume):	0	44
Subsurface Fragments > 3" (% Volume):	0	25

Drainage Class: Poorly drained To Well drained
Permeability Class: Moderately slow To Impermeable

	Minimum	Maximum
Depth (inches):	10	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	3.5	5.0
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	2.7	4.5

Plant Communities

Ecological Dynamics of the Site

This site is associated with debris flows caused by geothermal springs and the head cutting of the upper tributaries of Mill Creek. The wet and/or undercut slope material slumps and calves away, and collects in drainage bottoms. Portions of the deposits become stable for periods of time, until more material from above and/or stream channel down cutting remobilizes it from below.

This ecological site could be considered a process within the surrounding red fir forest site (F022BI113CA) if these slumps occur because factors related to soil stability in the Diamondpeak soil component. The Diamondpeak soils are mapped around these areas, and may have tendencies to calve away when adjacent to unstable areas. However, due to the long time scale of persistence and re-vegetation on these debris flows, the debris flows were created as an independent ecological site.

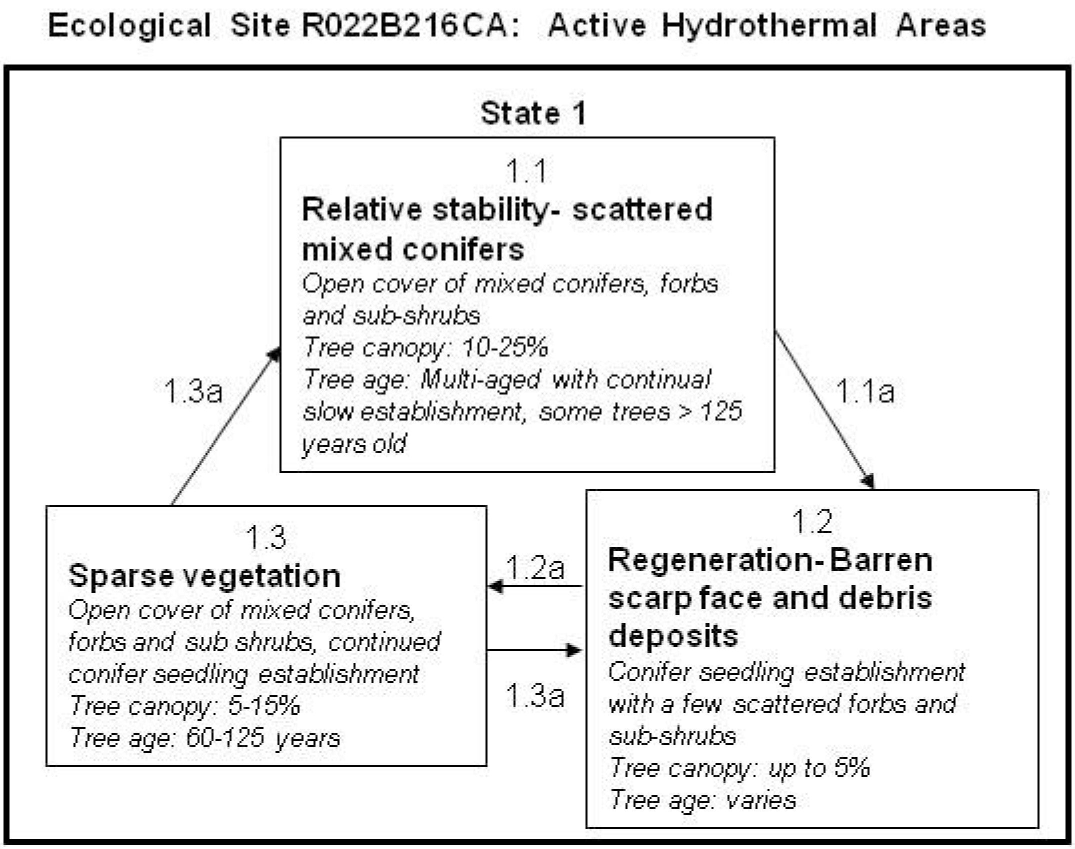
This ecological site is correlated to two soil components associated with the debris flows. The Aquic Dystroxerepts, Debris Flows component is the debris flow material found in the valley bottoms. This material is several feet deep, and the buried soil may be encountered beneath. The Typic Dystroxerepts component is the soil that remains on the actively eroding mountain slope. This soil, is similar to the Diamondpeak soil, but has lost the upper portion of the soil.

There is a combination of processes going on and variability in potential plant communities that establish on the slump faces and debris flow deposits. In deposits that remain stable for a time, California red fir (Abies magnifica), mountain hemlock (Tsuga mertensiana), and western white pine (Pinus monticola) grow fairly tall and develop into small patches of forest. In most areas, the debris flow is unstable and constantly readjusting with very little vegetation. In some areas logs in debris flows have held back material long enough for the forest to develop, but when the logs rot or erode away, the stable area may remobilize. Within the jumbled debris are small drainages and moist flats with sedges (Carex spp.) and thinleaf alder (Alnus incana ssp. tenuifolia). The Loamy Seeps ecological site (R022BI209CA) is similar to the wet areas within the debris deposits. Refer to this site (R022BI209CA) for more detailed information on plant species and ecological dynamics within the wet deposits. The actively eroding mountain slope, where the debris material originated from is a harsh environment for conifer regeneration due low soil fertility, low water availability, and wind exposure. The trees remain stunted and grow openly for a long period after disturbance.

Lab data was not collected on the soil within the debris flow, but they may share some soil characteristics with the Diamondpeak soils. The Diamondpeak soils have been hydrothermally altered, and have 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, which can affect surface pH and mineralogy. Hydrogen sulfide (H_2S), carbon dioxide (CO_2), hydrogen gas (H_2), nitrogen (N), and helium (He) are some of the chemicals found in the thermal springs. They react with oxygen and other elements to form the variety of chemicals that can be found in the steam deposits.

The following State and Transition Model is a simplified example of the debris flow regeneration process. In actuality, this site is much more complex with multiple plant communities and pathways. More research is needed to fully describe this ecological site.

State and Transition Diagram



Natural State - State 1
State 1 represents the natural conditions for this ecological site.

Relative stability - Community Phase 1.1

Relative stability-scattered mixed conifers

This site has the potential to develop patches of open California red fir-mixed conifer forest. Within the patches canopy cover may be up to 35 percent, but across the slope canopy cover is low, 5 to 25 percent.
The debris flow material and the scarp face develop at different paces. The debris flow deposits, when stable, can develop tree patches earlier than the scarp face. The scarp face has shallower soils on steep exposed slopes, lose water quickly to drainage and evaporation. Mountain hemlock is common at the upper elevations of the site, while California red-fir and western white pine are more common at the lower elevations of this site.

Community Phase Pathway 1.1a
1.1a If this site experiences a slide or severe fire this community returns to the regeneration community (Community 1.2).

Relative stability Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Forbs					**0**	**235**		
		lupine	LUPIN	*Lupinus*	0	13	0	1
		mountain monardella	MOOD	*Monardella odoratissima*	0	6	0	2
		hairy brackenfern	PTAQP2	*Pteridium aquilinum var. pubescens*	0	216	0	28

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Grass/ grasslike					**0**	**30**		
		western needlegrass	ACOC3	*Achnatherum occidentale*	0	6	0	2
		sedge	CAREX	*Carex*	0	15	0	5
		squirreltail	ELEL5	*Elymus elymoides*	0	6	0	2
		blue wildrye	ELGL	*Elymus glaucus*	0	3	0	1

Shrub/Vine

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Shrubs					**0**	**20**		
		pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	0	20	0	2

Tree

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Trees					**3**	**21**		
		California red fir	ABMA	*Abies magnifica*	0	4	0	2
		western white pine	PIMO3	*Pinus monticola*	0	2	0	1
		mountain hemlock	TSME	*Tsuga mertensiana*	3	15	1	5

Annual Production by Plant Type:

Annual Production (lbs/AC)

Plant Type	Low	Representative Value	High
Grass/Grasslike	0	11	30
Forb	0	41	235
	0	8	20
Shrub/Vine			
Tree	3	8	21
Total:	3	68	306

Structure and Cover:

Soil Surface Cover

Cover Type	Minimum	Maximum		Wood Type	Minimum	Maximum	Predominant Decomposition Class*
Basal Cover - Grass/ Grasslike	0%	2%		Downed wood, fine-small (<0.40\" diameter; 1-hour fuels)			
Basal Cover - Forb	0%	3%		Downed wood, fine-medium (0.40-0.99\" diameter; 10-hour fuels)			
Basal Cover - Shrub/ Vine	0%	1%		Downed wood, fine-large (1.00-2.99\" diameter; 100-hour fuels)			
Basal Cover - Tree	0%	3%		Downed wood, coarse-small (3.00-8.99\" diameter; 1000-hour fuels)			
Non-Vascular Plants	0%	0%		Downed wood, coarse-large (>9.00\" diameter; 10000-hour fuels)			
Biological Crust	0%	0%		Tree Snags** (Hard***)			
Litter	50%	90%		Tree Snags** (Soft***)			
Surface Fragments > 0.25" and <= 3"	2%	30%		**Tree Snags** per Acre**			
Surface Fragments > 3"	8%	13%		Hard Snags***			
Bedrock	3%	8%		Soft Snags***			
Water	0%	0%					
Bare Ground	5%	20%					

* Decomposition Classes: N - no or little integration with the soil surface; I - partial to nearly full integration with the soil surface.

** >4\" diameter at 4.5' above ground and >6' height--if less diameter OR height use applicable down wood type; for pinyon and juniper, use 1.0'above ground.

*** Hard - tree is dead with most or all of bark intact; Soft - most of bark has sloughed off.

Structure of Canopy Cover

Height Above Ground	Grasses/Grasslike		Forbs		Shrubs/Vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 feet	0%	5%			%	%		
> 0.5 - < 1 feet	0%	4%			0%	2%		
> 1 - <= 2 feet	0%	1%	0%	21%				
> 2 - < 4.5 feet			0%	5%			1%	11%
> 4.5 - <= 13 feet							0%	10%
> 13 - < 40 feet							5%	15%
< 40 - >= 80 feet							2%	8%
> 80 - < 120 feet							1%	3%
>= 120 feet								

Overstory:

Patches of California red fir and mountain hemlock may are .5 acres or so in size, with 70 to 80 feet tall trees. There are several younger strata of trees, since there is continual seedling establishment.

Overstory canopy cover ranges from 15 to 24 percent. California red fir and mountain hemlock dominate, with a small amount of western white pine.

Understory:

The understory varies due to soil characteristics and water availability. Common understory species on drier, stable slump material are western needlegrass (Achnatherum occidentale), sedge (Carex spp.), squirreltail (Elymus elymoides), mountain monardella (Monardella odoratissima), lupine (Lupinus sp.) and hairy brackenfern (Pteridium aquilinum var. pubescens). On the slump faces there is low cover of pinemat manzanita (Arctostaphylos nevadensis). In wetter slump material hydrophytic vegetation is present including a mix of sedges, forbs and grasses.

Debris flow - Community Phase 1.2

Landslide- barren slump face and debris deposits

This phase is characterized by barren scarp face and debris deposits created by a recent debris flow. Geothermal springs may arise in new locations which can trigger new debris flows. Active slumping and slope failures within existing landslide features also create barren conditions. The barren slopes and debris deposits slowly establish vegetation. This process may be similar to primary succession, but some organic matter and soil structure persists in these soils. Stable areas within the debris flow deposits may establish vegetation sooner than the upper slopes which lost the upper soil layers. The debris deposits are in the valley bottom where water and organic matter accumulates. The upper slopes are steep, droughty and exposed, loosing water rapidly. Organic matter rolls down the barren slopes or is deposited elsewhere by wind.

The plants have higher survival rates after a period of physical and biological weathering of the debris material. Once plants pioneer into the debris material, they begin to accumulate organic matter and provide limited shade.

The intact forests adjacent to the landslide provide seeds for colonization. Wind and animals disperse seed across the landslide. Data was not collected on this community. Forbs and grasses may establish along with mountain hemlock and California red fir seedlings. Mountain hemlock and California red fir seedlings have higher survival rates in partial shade, which is limited on this site at first, so trees may be slow to establish.

Community Phase Pathway 1.2a
1.2a This pathway is followed with time and growth in the absence of disturbance. During periods of stability vegetation continues to establish and increase in cover (Community 1.3).

Sparse vegetation - Community Phase 1.3
This community has sparse vegetative cover of small mountain hemlock and California red fir with scattered forbs and grasses. The stable areas on the debris deposits have fair cover of hairy brakenfern, mountain monardella, and lupines. The upper slopes have dispersed patches of pinemat manzanita.

Community Phase Pathway 1.3a
1.3a. With time and slope stability, canopy cover continues to increase and develops into Community 1.1.

Community Phase Pathway 1.3b
In the event of a landslide Community 1.2. develops.

Ecological Site Interpretations

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.

Mountain hemlock forests provide cover and forage for wildlife species. Some birds eat the mountain hemlock seeds. In some areas the understory provides decent forage (Tesky, 1992).

Deer browse the new growth of confers in the spring. Birds forage for insects in the foliage of mature conifers.

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).

Plant Preference by Animal Kind:

Hydrology Functions:

Recreational Uses:
This area is unstable and not recommended for recreational uses.

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).

If harvested, mountain hemlock is usually sold with western hemlock. The wood is moderately strong and used as small lumber, pulp, interior finish, cabinetry, crates, flooring and ceilings (Tesky, 1992).

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Very Deep Loamy Slopes	F022BI113CA	This red fir site is associated with the Diamondpeak soils adjacent to this site.
Moderately Deep Fragmental Slopes	R022BI203CA	This is a woolly mule-ears dominated rangeland found in the hydrothermally altered area.
Loamy Seeps	R022BI209CA	This is a wet meadow site found in nearby drainages.

Similar Sites:

Site Name	Site ID	Site Narrative

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
The following NRCS data plots were used to describe this ecological site:

789343
789901- type location

Type Locality:

State:	CA
County:	Shasta
Township:	30 N
Range:	4 E
Section:	15
Datum:	NAD83

Zone:	10
Northing:	4479662
Easting:	624582
General Legal Description:	The type location is about 0.7 miles north-northeast of the Sulphur Works parking lot, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104479662624582

Relationship to Other Established Classifications:

Other References:

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Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	10/27/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Frigid Lacustrine Flat

/ / *Carex nebrascensis - Carex vesicaria*
(/ / Nebraska sedge - blister sedge)

Site ID: R022BI217CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by shared water table and/or small E type stream channel.
Slopes: Generally between 0 to 3 percent.
Landform: Relict glacial lakes and lake terraces.
Soils: Very deep, poorly to very poorly drained soils that formed in volcanic ash over glaciolacustrine deposits or in stream channel alluvium over glaciolacustrine deposits. There are stratified layers of fine and coarse sediments. Gleyed soil colors are present below the organic horizons.
Temp regime: Frigid.
MAAT: 41 to 44 degrees F (5.0 to 6.6 degrees C).
MAP: 37 to 65 inches (940 to 1,651 mm).
Soil texture: Herbaceous peat and herbaceous mucky slightly decomposed plant material.
Surface fragments: 0
Vegetation: Several graminoid meadow communities.

Physiographic Features

This ecological site is found on wet meadows that formed on relict glacial lakes and lake terraces. The elevation range for this site is from 5,960 and 6,760 feet. Slopes are between 0 and 3 percent.

This area is frequently flooded and/ or ponded during this time. The water table remains at or near the surface throughout the year in the wetter areas of the meadow. In topographically higher or drier areas of the meadow, the water table may drop to below 55 inches during October, November, and December.

Landform: (1) Glacial lake (relict)
(2) Lake terrace

	Minimum	Maximum
Elevation (feet):	5960	6760
Slope (percent):	0	3
Water Table Depth (inches):	0	60
Flooding:		
Frequency:	Rare	Frequent
Duration:	Brief	Long
Ponding:		
Depth (inches):	1	6
Frequency:	Rare	Frequent
Duration:	Brief	Long
Runoff Class:	High	Very high
Aspect:	No Influence on this site	

Climatic Features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 37 to 65 inches (940 to 1,651 mm) and the mean annual temperature ranges from 41 to 44 degrees F (5.0 to 6.6 degrees C). The frost free (>32F) season is 60 to 85 days. The freeze free (>28F) season is 75 to 190 days.

	Minimum	Maximum
Frost-free period (days):	60	85
Freeze-free period (days):	75	190
Mean annual precipitation (inches):	37.0	65.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is associated with palustrine emergent wetlands that occasionally have an E or a C type stream channel, which enters or exits the lake basin. This site is also associated with upland areas that do not have wetland characteristics.

Wetland Description:	System	Subsystem	Class
(Cowardin System)	Palustrine	N/A	Aquatic Bed
	Palustrine	N/A	Emergent Wetland

Representative Soil Features

This site is associated with the Histic Humaquepts, Lake Sediments and Histic Humaquepts, Frequently Flooded soil components. The Histic Humaquepts, Lake Sediments component consists of very deep, poorly drained soils that formed in volcanic ash over glaciolacustrine deposits. The Histic Humaquepts, Frequently Flooded component consists of very deep, very poorly drained soils that formed in stream channel alluvium over glaciolacustrine deposits. These soils have several organic horizons of herbaceous peat and herbaceous muck that ranges in total depth from 5 to 14 inches. There is fair amount of organic material but the soil pits do not meet the organic soil depth criteria of 16 inches (40 cm) to be considered a fen. These soils have stratified layers of fine and coarse sediments. Textures include ashy silt loams, ashy coarse sandy loams, and ashy loamy sand, among others. The AWC is moderate in the upper 60 inches of soil. There are gleyed colors below the organic horizons. Free water can occur in the coarse textured horizons, creating an artesian aquifer.

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

DMU Component percent
105 Histic Humaquepts, Lake Sediments 1
130 Histic Humaquepts, Lake Sediments 55
130 Histic Humaquepts, Frequently Flooded 30
148 Histic Humaquepts, Lake Sediments 2
148 Histic Humaquepts, Frequently Flooded 1

Parent Materials:

Kind: Volcanic ash over glaciolacustrine deposits, Alluvium

Origin: Volcanic rock

Surface Texture:

Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	0
Surface Fragments > 3" (% Cover):	0	0

Subsurface Fragments <=3" (% Volume):	0	50
Subsurface Fragments > 3" (% Volume):	0	0

Drainage Class: Poorly drained To Very poorly drained
Permeability Class: Moderately slow To Moderate

	Minimum	Maximum
Depth (inches):	60	
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	5.6	7.3
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	4.7	9.07

Plant Communities

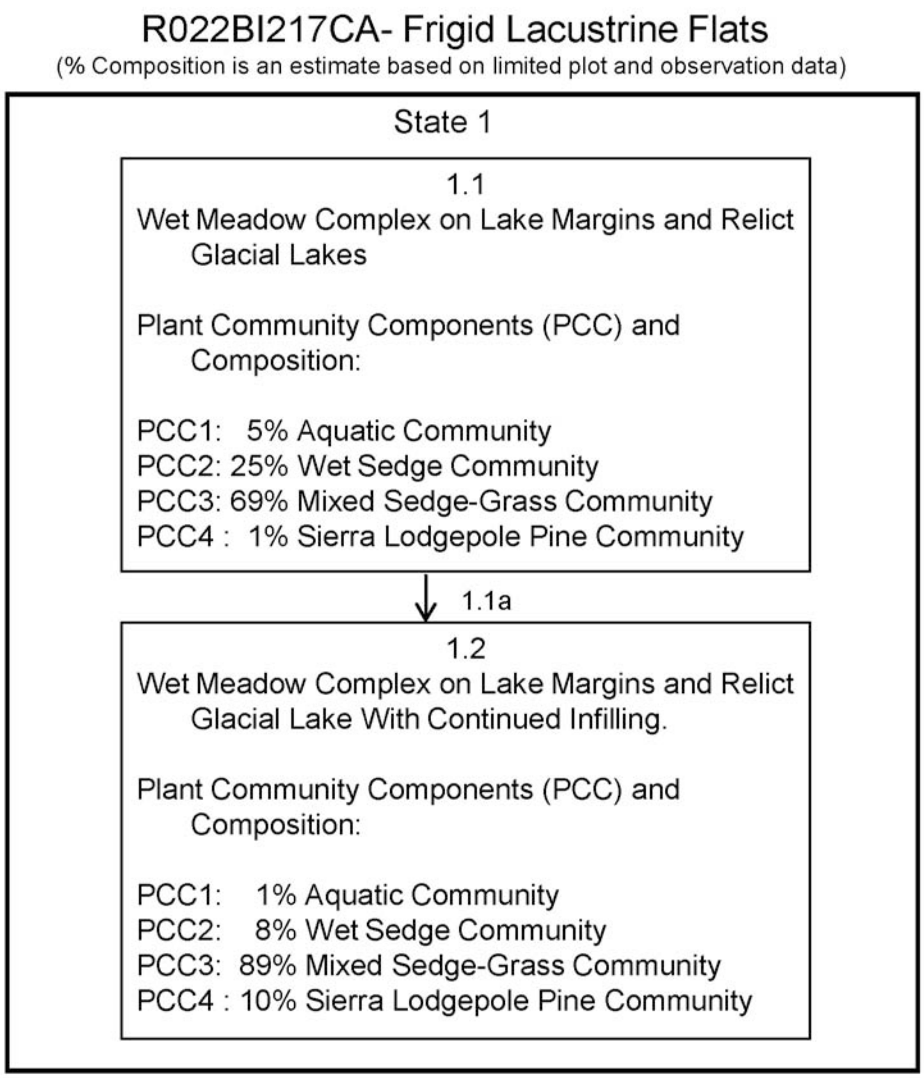
Ecological Dynamics of the Site

This ecological site is found in meadows and along channels in relict glacial lakes. These lakes formed from glacial melt water that allowed fine clay and silts to settle out. There are course textured layers intermixed with fine layers. The coarse layers may have been deposits from stream channel alluvium, wave action or difference in melt water velocities over time. Finer sediments are often above coarser buried profiles that represent the different depositional environments as the lakes filled in (NRCS, 2010). They have experienced gradual lowering of lake levels, because of reduced water input since post glacial melt water filled these basins. Infilling of these lakes is also occurring from continued lacustrine sediment deposition and accumulation of organic matter. Aquatic and emergent palustrine plant communities establish in shallow areas near shore. The vegetation produces organic matter from dead plant material and live root mats. Vegetation also traps sediment with leaves and roots. The lake margins fill with material that eventually supports drier meadow communities. Over time vegetation continues to expand into the shallow lakes and areas of open water diminish. The degree of infill is related to the size and depth of the lake. This process also occurs on shallow inlets of larger lakes. The seasonal fluctuation of lake levels determines the growing season and distribution of vegetation. These lakes and meadows receive water form upstream channels and have outlet channels. The water flow goes subsurface through the meadow or mixes with the open water of the lake. In larger drainages a defined stream channel may dissect the meadow on its' course to the lake, but the composition and spatial distribution of the majority of plant communities is related more to lake levels than to stream channel dynamics.

Nebraska sedge (Carex nebrascensis), Northwest Territory sedge (Carex utriculata) and/or blister sedge (Carex vesicaria) dominate this site. Tufted hairgrass (Deschampsia cespitosa) is more prevalent in drier areas. Willows (Salix spp.) are generally restricted to the perimeter of the meadow or are along a stream channel. A moist lodgepole pine site is found on drier lake terraces. See the Sierra lodgepole pine/California false hellebore - blue wildrye (F022BI108CA) ecological site for more information regarding this forest site. In the open water, aquatic plants such as yellow pond-lily (Nuphar lutea) and watershield (Brasenia schreberi) may be present.

This ecological site is a complex of riparian plant community components that are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community component composition as a result of gradual infilling, rather than focusing on the succession of one plant community after disturbance. Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and Transition Diagram



State 1 - State 1

This state is the reference state and is similar to the historic condition for this site. Altered states were not observed for this ecological site. The relict glacial lakes are all in different stages of infilling of sediment and vegetation. This process could be considered an eventual evolution to a new state, but it is described in this ecological site as a continuum within this state.

Wet Meadow Complex - Community Phase 1.1

Frigid Lacustrine Flats

This community phase has four associated plant community components. They are listed below from wettest, PCC1 the Aquatic Community, to driest. Open water is present, but not included at a community component. There may be a large deep lake associated with this site, such as Snag Lake in Lassen Volcanic Park, or just a small area of open water as in Cameron Meadow in the photo above. Not all plant communities found in these meadows are described in this ecological site, just the dominant components.

PCC1: 5% Aquatic Community

This community exists in open water. This area remained covered in standing water through most of the year. The soil may be exposed at the end of summer in very dry years. Yellow pond-lily (Nuphar lutea) is often present. Pondweeds (Potamogeton sp.), watershield (Brasenia schreberi) and other aquatic species may be present. Data was not collected for this community component.

PCC2: 25% Wet Sedge Community

The Wet Sedge Community forms the boundary between open water and emergent palustrine vegetation. This community has standing water for most of the season. Northwest Territory sedge (Carex utriculata) and/or blister sedge (Carex vesicaria) form an almost monotypic community. It is difficult to distinguish these two sedges. They sometimes grow together or in separate niches. Blister sedge may be present in areas which have quicker draw down of water. These sedges are able to withstand total inundation for several months, and produce dense rhizamotous root mats. Spikerush (Eleocharis sp.), small floating mannagrass (Glyceria borealis), and mosses may be present.

PCC3: 69% Mixed Sedge-Grass Community

This community dominates most of these meadows. It is seasonally ponded and saturated for shorter durations than PCC2, but the water table remains high through the growing season. There is variation between sites as to dominant species. Nebraska sedge Carex nebrascensis), capitate sedge (Carex capitata), mountain rush (Juncus arcticus ssp. littoralis), and Howell's rush and (Juncus howellii) can have high cover. Nebraska sedge is a heavily rhizomatous wetland plant that can form almost monotypic stands. It can survive total inundation for 3 months (Hoag, 1998.). It is not generally found in areas where the water table drops to less than 1 meter below the surface late in the growing season. Tufted hairgrass (Deschampsia cespitosa) can be present throughout this community, but tends to increase at the drier margins. There is variety of forbs in this community but they generally have low cover, however tundra aster (Oreostemma alpigenum var. alpigenum) and western mountain aster (Symphyotrichum spathulatum var. spathulatum) may have up to 30 percent cover. Common graminoid species are slenderbeak sedge (Carex athrostachya), golden sedge (Carex aurea), bluejoint (Calamagrostis canadensis), Raynolds' sedge (Carex raynoldsii), sedges (Carex spp.), analogue sedge (Carex simulata), meadow barley (Hordeum brachyantherum), toad rush (Juncus bufonius), swordleaf rush (Juncus ensifolius), and Sierra rush (Juncus nevadensis). Other forbs are common yarrow (Achillea millefolium), willowherbs (Epilobium sp.) alpine gentian (Gentiana newberryi), tinker's penny (Hypericum anagalloides), ash penstemon (Penstemon cinicola), Lemmon's yampah (Perideridia lemmonii), Drummond's cinquefoil (Potentilla drummondii), sticky cinquefoil (Potentilla glandulosa), slender cinquefoil (Potentilla gracilis), Oregon saxifrage (Saxifraga oregano), Oregon checkerbloom (Sidalcea oregana ssp. spicata), longstalk clover (Trifolium longipes), and violet (Viola sp.).

PCC4: 1% Sierra Lodgepole Pine Community

This plant community is generally adjacent to this site in a distinct line around the meadow, but it is sometimes on dry positions within the meadow. Ecological site F022BI108CA describes the wet Sierra lodgepole pine forest that is found on adjacent higher stream and lake terraces. Please refer to ecological site F022BI108CA, for more information on ecological dynamics that affect the Sierra lodgepole pine forest. As forest cover increases more shade tolerant understory species are present. Grasses are mixed and include alpine bentgrass (Agrostis humilis), bluejoint (Calamagrostis Canadensis), blue wildrye (Elymus glaucus), alpine timothy (Phleum alpinum), muhly (Muhlenbergia spp.), and meadow barley (Hordeum brachyantherum). A variety of sedges (Carex spp.) may be present in small amounts. Other plants on this site are bigleaf lupine (Lupinus polyphyllus), monkeyflower (Mimulus spp.), sweetcicely (Osmorhiza berteroi), whitestem gooseberry (Ribes inerme), arrowleaf ragwort (Senecio triangularis), longstalk clover

(Trifolium longipes), and California false hellebore (Veratrum californicum var. californicum). Total understory production is around 800 to 1,000 pounds per acre.

The production data in the table below is a compilation of PCC2 and PCC3. ESIS does not currently support multiple tables for several community types in one phase. To identify species by plant community component refer to the narrative above rather than the table.

Community Phase Pathway 1.1a
This site continues to infill with organic matter and sediments.

Wet Meadow Complex Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Forbs					**12**	**297**		
		common yarrow	ACMI2	*Achillea millefolium*	0	5	0	2
		willowherb	EPILO	*Epilobium*	0	2	0	2
		alpine gentian	GENE	*Gentiana newberryi*	0	8	0	3
		tinker's penny	HYAN2	*Hypericum anagalloides*	0	1	0	1
		tundra aster	ORALA2	*Oreostemma alpigenum var. alpigenum*	12	140	2	20
		ash penstemon	PECI2	*Penstemon cinicola*	0	5	0	2
		Lemmon's yampah	PELE5	*Perideridia lemmonii*	0	4	0	2
		Drummond's cinquefoil	PODR	*Potentilla drummondii*	0	4	0	2
		sticky cinquefoil	POGL9	*Potentilla glandulosa*	0	4	0	2
		slender cinquefoil	POGR9	*Potentilla gracilis*	0	4	0	2
		Oregon saxifrage	SAOR2	*Saxifraga oregana*	0	4	0	2
		Oregon checkerbloom	SIORS	*Sidalcea oregana ssp. spicata*	0	2	0	1
		western mountain aster	SYSPS	*Symphyotrichum spathulatum var. spathulatum*	0	110	0	10
		longstalk clover	TRLO	*Trifolium longipes*	0	2	0	1
		violet	VIOLA	*Viola*	0	2	0	1

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Grass/grasslike					**275**	**1560**		
		smooth brome	BRIN2	*Bromus inermis*	0	6	0	2

slenderbeak sedge	CAAT3	*Carex athrostachya*	0	3	0	1
golden sedge	CAAU3	*Carex aurea*	0	4	0	2
capitate sedge	CACA13	*Carex capitata*	50	150	5	15
bluejoint	CACA4	*Calamagrostis canadensis*	0	10	0	2
Nebraska sedge	CANE2	*Carex nebrascensis*	120	300	10	25
Raynolds' sedge	CARA6	*Carex raynoldsii*	0	5	0	2
sedge	CAREX	*Carex*	10	100	3	8
analogue sedge	CASI2	*Carex simulata*	0	5	0	2
Northwest Territory sedge	CAUT	*Carex utriculata*	40	225	5	15
blister sedge	CAVE6	*Carex vesicaria*	40	300	5	20
tufted hairgrass	DECE	*Deschampsia cespitosa*	6	195	1	10
spikerush	ELEOC	*Eleocharis*	0	3	0	1
small floating mannagrass	GLBO	*Glyceria borealis*	0	5	0	2
meadow barley	HOBR2	*Hordeum brachyantherum*	0	5	0	2
mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	4	40	1	8
toad rush	JUBU	*Juncus bufonius*	0	10	0	5
swordleaf rush	JUEN	*Juncus ensifolius*	0	30	0	5
Howell's rush	JUHO	*Juncus howellii*	5	150	1	15
Sierra rush	JUNE	*Juncus nevadensis*	0	5	0	1

Wet Meadow Complex- Natural Infilling - Community Phase 1.2

This phase is similar to community phase 1.1, but the site is drier due to gradual infilling of the glacial lakes. These meadows have varying degrees of wetness and areas of open water depending upon the size and depth of the relict glacial lake. In some areas this site is found along delta of large lakes that may or may not be drying out over time. The Mixed Sedge-Grass Community increases with lower water tables at the expense of the Aquatic and Wet Sedge Communities. Since the water table is lower along the margins of the meadow, the Sierra Lodgepole Pine Community can establish in this area.

Estimate of Plant Community Components (PCC) and Composition:

PCC1: 1% Aquatic Community
PCC2: 8% Wet Sedge Community
PCC3: 89% Mixed Sedge-Grass Community
PCC4: 10% Sierra Lodgepole Pine Community

Ecological Site Interpretations

Animal Community:
This site provides valuable wildlife resources such as water and cover. In addition, wildlife and livestock depend on the leaves, stems, and seeds of Nebraska sedge, tufted hairgrass, and other various grasses and sedges as forage. The sedges and bunchgrasses provide nesting habitat for waterfowl and cover for small mammals.

Plant Preference by Animal Kind:

Hydrology Functions:
The hydrological function of this meadow is to provide a catchment for water, sediments, and nutrients. The meadow allows sediment from melting spring snow to settle out and trap nutrients in surface and subsurface flows. This meadow also provides water storage, which is slowly released down the drainage throughout the year.

Recreational Uses:
This site provide beautiful open vistas with opportunities for wildflower and wildlife viewing. Trails should be constructed on drier ground bordering the meadow.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Bouldery Glacially Scoured Ridges Or Headlands	F022BI102CA	This open red fir forest site is found on the hillslopes nearby.
Frigid Moist Sandy Lake Or Stream Terraces	F022BI108CA	This is a wet Sierra lodgepole pine site on stream and lake terraces adjacent to the meadows.
Frigid Sandy Loam Moraines Or Lake Terraces	F022BI112CA	This dense red fir- white fir forest is found on deeper soils on the nearby hillslopes.

Similar Sites:

Site Name	Site ID	Site Narrative
Frigid Alluvial Flat	R022BI202CA	This meadow is associated with stream alluvium and has significant water inflow from springs.
Cryic Lacustrine Flat	R022BI206CA	This site is also associated with relict glacial lakes but is cryic and has an E channel.

State Correlation:
This site has been correlated with the following states:

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

789308- Type location
789376
789378
789392

Type Locality:

State:	CA
County:	Lassen
Township:	30 N
Range:	6 E
Section:	3
Datum:	NAD83
Zone:	10
Northing:	4483390
Easting:	643879
General Legal Description:	The type location is about 1.1 miles north of Inspiration Point, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104483390643879

Relationship to Other Established Classifications:

Other References:

Bestelmeyer, Brandon T.; Brown, Joel R.; Havstad, Kris M.; Alexander, Robert; Chavez, George; and Herrick Jeffrey E.; 2003. Development and Use of State-and-Transition Models for Rangelands. Journal of Range Management, Vol. 56, No. 2 (Mar., 2003), pp. 114-126. Allen Press and Society for Range Management. Stable URL: http://www.jstor.org/stable/4003894

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Weixelman, Dave; Weis, Sue; Linton, Fletcher; and Swartz, Heather; 2007. DRAFT: Condition Checklist for Fens in the Montane and Subalpine Zones of the Sierra Nevada and Southern Cascade Ranges, CA.

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	10/27/2008	Kendra Moseley	1/13/2011

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION

ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Thermal Seeps

/ / *Carex subfusca - Veratrum californicum var. californicum*
(/ / brown sedge - California false hellebore)

Site ID: R022BI218CA

Major Land Resource Area: 022B-Southern Cascade Mountains

Site Concept:
Riparian Complex: Hydrologically connected by thermal springs and seeps.
Slopes: 4 to 30 percent.
Landform: Seeps on strath terrace.
Soils: Shallow to moderately deep, poorly drained soils that formed in geothermal spring alluvium from volcanic rocks. Duripan contact at 10 to 40 inches.
Temp regime: Frigid.
MAAT: 41 to 42 degrees F (6.1 to 7.3 degrees C).
MAP: 63 to 91 inches (1,600 to 2,300 mm).
Soil texture: Peaty silt loam and mucky silt loam.
Surface fragments: 0 percent surface rock fragments.
Vegetation: Several wet seep community types are present, that are dominated by graminoids and forbs.

Physiographic Features

This ecological site is found on seeps on strath terraces. It occurs between 5,660 and 6,760 feet in elevation, on 4 to 30 percent slopes.

Landform: (1) Strath terrace

	Minimum	Maximum
Elevation (feet):	5660	6760

Slope (percent):	4	30
Water Table Depth (inches):	0	7
Flooding:		
Frequency:	None	None
Duration:	None	None
Ponding:		
Depth (inches):		
Frequency:	None	None
Duration:	None	None
Runoff Class:	Very high	Very high
Aspect:	North East West	

Climatic Features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 63 to 91 inches (1,600 to 2,300 mm) and the mean annual temperature ranges from 41 to 42 degrees F (6.1 to 7.3 degrees C). The frost free (>32F) season is 70 to 90 days. The freeze free (>28F) season is 85 to 200 days.

There are no representative climate stations for this site.

	Minimum	Maximum
Frost-free period (days):	70	90
Freeze-free period (days):	85	200
Mean annual precipitation (inches):	63.0	91.0

Monthly precipitation (inches) and temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precip. Min.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precip. Max.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Temp. Min.	0	0	0	0	0	0	0	0	0	0	0	0
Temp. Max.	0	0	0	0	0	0	0	0	0	0	0	0

Climate Stations:

Influencing Water Features

This site is associated with small geothermal springs that eventually flow into larger perennial streams.

Wetland Description: System	Subsystem	Class

Representative Soil Features

The Typic Petraquepts soil component is associated with this site. Typic Petraquepts consists of shallow to moderately deep, poorly drained soils that formed in geothermal spring alluvium from volcanic rocks. The combined A horizons are 2 to 7 inches thick with peaty silt loam and mucky silt loam textures. The subsurface textures are ashy loam, gravelly ashy loams, or very gravelly ashy loam. Gleyed soil colors are present below the A horizons. Depth to duripan contact ranges from 10 to 40 inches.

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

DMU Component percent
164 Typic Petraquepts 10

Parent Materials:
Kind: Alluvium
Origin: Volcanic rock

Surface Texture: (1)Peaty Silt loam

Subsurface Texture Group: Loamy

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	0
Surface Fragments > 3" (% Cover):	0	0
Subsurface Fragments <=3" (% Volume):	7	30
Subsurface Fragments > 3" (% Volume):	0	0

Drainage Class: Poorly drained To Poorly drained
Permeability Class: Very slow To Very slow

	Minimum	Maximum
Depth (inches):	10	40
Electrical Conductivity (mmhos/cm):		
Sodium Absorption Ratio:		
Calcium Carbonate Equivalent (percent):		
Soil Reaction (1:1 Water):	6.5	8.0
Soil Reaction (0.01M CaCl2):		
Available Water Capacity (inches):	3.9	5.0

Plant Communities

Ecological Dynamics of the Site

This ecological site is associated with geothermal springs and seeps, and the plant communities that exist due to the presence of the springs. There are multiple hot springs associated with this site. Each spring has unique physical and biological characteristics. Most have steady flow throughout the year, which develop into small stream channels called rivulets or runnels that lack the banks, beds, and floodplains of larger streams. These streams eventually flow into larger perennial streams.

The soil associated with this site has two A horizons, which combined are 7 inches deep. The textures are peaty silt loam over mucky silt loam. Gravelly ashy loams and ashy loam textures are present at lower depths. Gleyed soil colors are present under the A horizons, which indicate saturated soil conditions for prolonged periods of time. A duripan is present at depths between 10 to 40 inches. Depth to the duripan, percent slope, microtopography, spring chemistry, and proximity to the spring determine the composition of vegetation.

This ecological site is unique and diverse, but has limited distribution. A significant amount of time is required to collect additional soil, vegetation, and hydrological data to fully understand this complex ecosystem. Several springs should be selected for geothermal water analysis. Additional soil-vegetation plots should be located in distinct zones associated with these springs. A more descriptive ecological site can be developed from this additional data.

Several plant communities are associated with these hot springs. They are mostly dominated by forb and graminoid species. When springs change their course, do to build up of plant material or sediment, it alters the distribution of plant communities. If an area becomes dry for a significant amount of time, it may eventually support an upland forest community. Shrub communities are not abundant, but thinleaf alder (Alnus incana ssp. tenuifolia) can be found along flowing channels. Data is insufficient to describe all the plant communities associated with this ecological site. The site where vegetation data was collected has a low flowing spring, and is in a concave depression. At this site there are two plant community components. One is in a wetter area and is dominated by hardstem bulrush, (Schoenoplectus acutus), chairmaker's bulrush (Schoenoplectus americanus), panicled bulrush (Scirpus microcarpus), field horsetail (Equisetum arvense), and smooth horsetail (Equisetum laevigatum). In slightly drier areas brown sedge (Carex subfusca), whitetip clover (Trifolium variegatum), and California false hellebore (Veratrum californicum var. californicum) are dominant, with a variety of other species.

At the source of active thermal springs there is diverse biological community. Most of these hot springs have neutral pH and low chloride concentrations. The hot springs are associated with the nearby steam vents, formed from vapor-dominated hydrothermal systems. Precipitation infiltrates over time through the rock, then vaporizes and rises to the surface (Thompson, 1985).

Hot springs have variable characteristics. Some springs form a mat of algal growth in the water and along the margins of the small stream. Hot springs ecology is a relatively new science, but studies conducted in Lassen Volcanic National Park indicate that several microbial communities are associated with specific hot spring characteristics. Microbes reside in thermal waters within specific zones of tolerance for temperature and acidity. A study in Cold Boiling Lake indicates that sulfur-metabolizing archaeans are present in the hottest zones (above 60 degrees C), with iron-oxidizing bacteria in cooler zones and photosynthetic algae and cyanobacteria in more moderate zones. Cold Boiling Lake is acidic however, so it's possible the microbial communities may differ for this site. Cyanobacteria and algae species form thin, dense green microbial mats. These mats are an ecosystem unto themselves with a diversity of organisms, each performing a specific task within the system. The cyanobacteria are on the surface of the mats and produce oxygen through photosynthesis. The oxygen filters into the lower layer where aerobic bacteria and archaea utilize it. The respiration between these organisms can deplete oxygen, creating an anoxic zone where purple sulfur bacteria reside. The purple sulfur bacteria use sulfide produced from sulfide-reducing bacteria (Wilson, et al., 2008 and Engleman, 2003).

This ecological site is a complex of communities, which are interrelated by hydrology. This is a relatively new concept for ecological sites. Additional studies are needed to describe additional plant communities and changes in plant community composition within the reference state or altered state (if there is one). A state and transition model (STM) has not been developed for this ecological site, due to lack of data and information. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

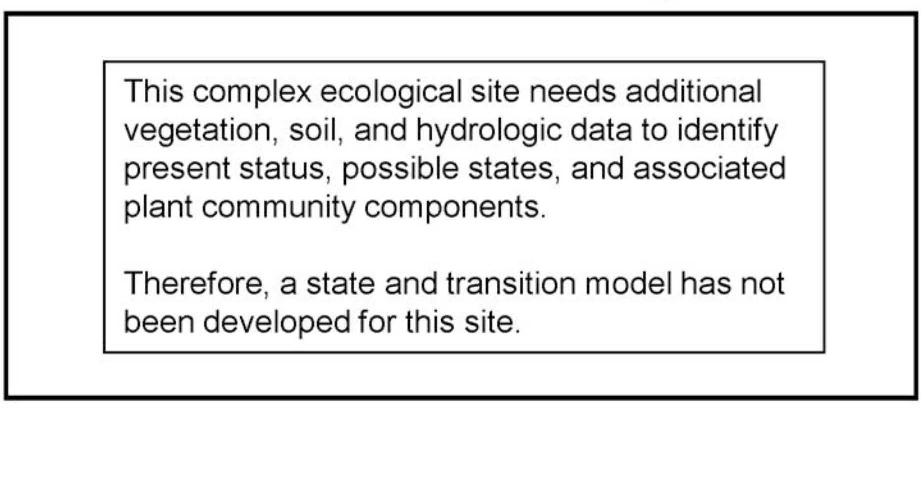
Thermal seeps - State 1

This state is presently the only state for this ecological site and it represents the current unaltered conditions.

However, disturbed areas were observed, which may represent an altered state due to diverted water flow or channel incision. There is insufficient data and knowledge at this time to determine if this area has crossed a threshold to an altered state. And if a threshold has been crossed, data is needed to determine the effect on the associated plant communities.

State and Transition Diagram

R022BI218CA-Thermal Seeps



Thermal seeps - Community Phase 1.1

Thermal Seeps

Altered Hydrology

Several plant communities are associated with this ecological site. Data was collected on two plant communities. The site where vegetation data was collected has a low flowing spring, and it is in a concave depression. This site was below a trail and may have some affect from water diversions presently or in the past. The flow begins to incise at the lower end of the depression.

The wetter plant community is dominated by hardstem bulrush (Schoenoplectus acutus), chairmaker's bulrush (Schoenoplectus americanus), panicled bulrush (Scirpus microcarpus), field horsetail (Equisetum arvense), and smooth horsetail (Equisetum laevigatum). This area remains saturated through most of the year.

The drier community has more diversity of species but is dominated by brown sedge (Carex subfusca), whitetip clover (Trifolium variegatum), and California false hellebore (Veratrum californicum var. californicum). Other graminoid species are bluejoint (Calamagrostis Canadensis), lakeshore sedge (Carex lenticularis), sedge (Carex sp.), fowl mannagras (Glyceria striata), meadow barley (Hordeum brachyantherum), mountain rush (Juncus arcticus ssp. littoralis), and Sandberg bluegrass (Poa secunda). Other forbs are common yarrow (Achillea millefolium), white marsh marigold (Caltha leptosepala), Douglas' thistle (Cirsium douglasii), fringed willowherb (Epilobium ciliatum), glaucus willowherb (Epilobium glaberrimum), scarlet fritillary (Fritillaria recurva), feathery false lily of the valley (Maianthemum racemosum ssp. racemosum), seep monkeyflower (Mimulus guttatus), Bolander's yampah (Perideridia bolanderi), Howell's yampah (Perideridia howellii), Sierra bog orchid (Platanthera dilatata var. leucostachys), slender cinquefoil (Potentilla gracilis),woodland buttercup (Ranunculus uncinatus), arrowleaf ragwort (Senecio triangularis), bugle hedgenettle (Stachys ajugoides), and American speedwell (Veronica americana).
The channel begins to incise in the middle of the drier community, indicating disturbance and a drop in the water table. The “Altered Hydrology” photo above shows a ditch which captures spring flow. Water has been diverted away from the vegetation to the right. Data was not collected on these plant communities, but it appears to be more productive growth where water has not been diverted.

Production data was not collected for this ecological site. “0” was entered in lieu of a null value for production in the table below.

Thermal seeps Plant Species Composition:

Forb

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Forbs					**0**	**0**		
		common yarrow	ACMI2	*Achillea millefolium*	0	0	0	1
		white marsh marigold	CALE4	*Caltha leptosepala*	0	0	0	1
		Douglas' thistle	CIDO2	*Cirsium douglasii*	0	0	1	4
		fringed willowherb	EPCI	*Epilobium ciliatum*	0	0	0	1
		glaucus willowherb	EPGL	*Epilobium glaberrimum*	0	0	0	1
		field horsetail	EQAR	*Equisetum arvense*	0	0	1	3
		smooth horsetail	EQLA	*Equisetum laevigatum*	0	0	3	8
		scarlet fritillary	FRRE	*Fritillaria recurva*	0	0	0	1

		Common Name	Symbol	Scientific Name	Low	High	Low	High
		feathery false lily of the valley	MARAR	*Maianthemum racemosum ssp. racemosum*	0	0	0	1
		seep monkeyflower	MIGU	*Mimulus guttatus*	0	0	0	1
		Bolander's yampah	PEBO2	*Perideridia bolanderi*	0	0	0	1
		Howell's yampah	PEHO5	*Perideridia howellii*	0	0	0	5
		Sierra bog orchid	PLDIL	*Platanthera dilatata var. leucostachys*	0	0	0	1
		slender cinquefoil	POGR9	*Potentilla gracilis*	0	0	0	1
		woodland buttercup	RAUN	*Ranunculus uncinatus*	0	0	0	1
		arrowleaf ragwort	SETR	*Senecio triangularis*	0	0	0	2
		bugle hedgenettle	STAJ	*Stachys ajugoides*	0	0	0	1
		whitetip clover	TRVA	*Trifolium variegatum*	0	0	8	20
		American speedwell	VEAM2	*Veronica americana*	0	0	0	1
		California false hellebore	VECAC2	*Veratrum californicum var. californicum*	0	0	10	25

Grass/Grasslike

Group	Group Name	Common Name	Symbol	Scientific Name	Annual Production in Pounds Per Acre Low	Annual Production in Pounds Per Acre High	Foliar Cover Percent Low	Foliar Cover Percent High
1 -Grass/grasslike					**0**	**0**		
		bluejoint	CACA4	*Calamagrostis canadensis*	0	0	3	6
		lakeshore sedge	CALE8	*Carex lenticularis*	0	0	1	5
		sedge	CAREX	*Carex*	0	0	10	15
		brown sedge	CASU6	*Carex subfusca*	0	0	30	60
		fowl mannagrass	GLST	*Glyceria striata*	0	0	0	3
		meadow barley	HOBR2	*Hordeum brachyantherum*	0	0	0	1
		mountain rush	JUARL	*Juncus arcticus ssp. littoralis*	0	0	0	3
		Sandberg bluegrass	POSE	*Poa secunda*	0	0	1	10
		hardstem bulrush	SCAC3	*Schoenoplectus acutus*	0	0	1	6
		chairmaker's bulrush	SCAM6	*Schoenoplectus americanus*	0	0	3	8
		panicled bulrush	SCMI2	*Scirpus microcarpus*	0	0	0	1

Ecological Site Interpretations

Animal Community:
Springs provide habitat for aquatic plants and animals and a water source for terrestrial animals. Such wetlands provide a source of food and cover for birds, reptiles, amphibians, and mammals and they may be occupied by endemic vertebrates or macroinvertebrates.

Plant Preference by Animal Kind:

Hydrology Functions:
This site is a source of geothermal ground water discharge.

Recreational Uses:
This area provides a unique experience to view the emergence and ecology of geothermal seeps and spring. Trails should be constructed carefully, so water flow is not diverted.

Wood Products:

Other Products:

Other Information:

Supporting Information

Associated Sites:

Site Name	Site ID	Site Narrative
Frigid Humic Loamy Gentle Slopes	F022BI110CA	This is a white fir- mixed conifer forest common on the nearby hillslopes.
Frigid Gravelly Sandy Loam Outwash-Stream Terraces	F022BI120CA	This is a moist Sierra lodgepole pine- white fir forest found near the springs.
Spring Complex	R022BI211CA	This site is associated with cold springs and heavy cover of thinleaf alder.

Similar Sites:

Site Name	Site ID	Site Narrative
Loamy Seeps	R022BI209CA	This thermal seep/spring site is associated with soil movement.

State Correlation:
This site has been correlated with the following states:

Inventory Data References:
The following NRCS vegetation plots have been used to describe this ecological site:

789285- Type location
789285B

Type Locality:

State:	CA
County:	Plumas
Township:	30 N
Range:	5 E
Section:	22
Datum:	NAD83
Zone:	10
Northing:	4478040
Easting:	635584
General Legal Description:	The type location is about 0.19 miles southeast of Drakesbad, in Lassen Volcanic National Park.
Latitude Degrees:	
Latitude Minutes:	
Latitude Seconds:	
Latitude Decimal:	
Longitude Degrees:	
Longitude Minutes:	
Longitude Seconds:	
Longitude Decimal:	
Universal Transverse Mercator (UTM) system:	NAD83104478040635584

Relationship to Other Established Classifications:

Other References:

Bestelmeyer, Brandon T.; Brown, Joel R.; Havstad, Kris M.; Alexander, Robert; Chavez, George; and Herrick Jeffrey E.; 2003. Development and Use of State-and-Transition Models for Rangelands. Journal of Range Management, Vol. 56, No. 2 (Mar., 2003), pp. 114-126. Allen Press and Society for Range Management. Stable URL: http://www.jstor.org/stable/4003894

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Wilson, Mark S.; Siering, Patricia L.; White, Christopher L.; Hauser, Michelle E.; and Bartles, Andrea N. (2008). Microbial diversity and dynamics in an acidic hotspring at Lassen Volcanic National Park. Environmental Microbiology, 56 (2), 292-305 (http://www.springerlink.com/content/371xh7144562w637)

Site Description Approval:

Author	Date	Approval	Date
Marchel M. Munnecke	3/23/2009	Kendra Moseley	1/13/2011

Tables

Table 1.-Correlated Ecological Sites

Ecological site ID	Ecological site name	Component name	Map symbol
F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes	Buttelake	100
		Buttewash	101
		Typic Xerorthents	108
		Typic Xerorthents, Tephra	203
F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands	Scoured	103
		Scoured	104
F022BI103CA	Frigid Tephra Over Slopes And Flats	Typic Haploxerands	141
		Humic Haploxerands	141
		Bearrubble	141
		Cragwash	142
		Sueredo	145
		Sueredo	146
		Summertown	147
		Typic Vitrixerands	153
		Vitrandic Xerorthents, Moraine	153
		Vitrandic Xerorthents, Moraine	154
		Typic Vitrixerands	154
		Typic Vitrixerands, Very Deep	157
		Typic Vitrixerands, Tephra Over Colluvium	159
		Humic Haploxerands, Outwash	162
		Sueredo	169

Table 1.-Correlated Ecological Sites - Continued

Ecological site ID	Ecological site name	Component name	Map symbol
F022BI104CA	Cryic Coarse Loamy Colluvial Slopes	Terracelake	116
		Xeric Vitricryands, Tephra Over Till	116
		Xeric Vitricryands, Colluvium	122
		Humic Xeric Vitricryands	144
F022BI105CA	Frigid Sandy Loam Debris Flow On Stream Terraces	Vitrandic Xerofluvents, Debris Flows	138
F022BI106CA	Frigid Debris Flow Gentle Slopes	Vitrandic Xerorthents, Debris Fan	111
		Vitrandic Xerofluvents	133
F022BI107CA	Frigid Moderately Deep Slopes	Cenplat	107
		Badgerflat	107
		Sunhoff	120
F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces	Typic Endoaquands	130
		Typic Endoaquands	139
		Typic Endoaquands	148
F022BI109CA	Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes	Ashbutte	102
		Prospectpeak	109

Table 1.-Correlated Ecological Sites - Continued

Ecological site ID	Ecological site name	Component name	Map symbol
F022BI110CA	Frigid Humic Loamy Gentle Slopes	Kingsiron	126
		Humic Haploxerands, Strath Terrace	127
		Humic Haploxerands, Colluvium	129
		Humic Haploxerands, Stream Terrace	160
		Humic Haploxerands, Outwash Terrace	166
		Juniperlake, bouldery	176
F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes	Shadowlake	115
		Xeric Vitricryands, Ash Over Cinders	122
		Terracelake	136
		Shadowlake	175
F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces	Juniperlake	104
		Juniperlake	105
		Humic Haploxerands, Lake Terrace	148
F022BI113CA	Frigid Very Deep Loamy Slopes	Diamondpeak	119
F022BI114CA	Frigid Very Deep Cinder Cone Or Shield Volcano Slopes	Vitrandic Xerorthents	102
		Bearrubble	110

Table 1.-Correlated Ecological Sites - Continued

Ecological site ID	Ecological site name	Component name	Map symbol
F022BI115CA	Frigid And Cryic Gravelly Slopes	Cenplat, ashy loamy sand	106
		Cascadesprings	112
		Emeraldlake	113
		Readingpeak	113
		Vitrandic Cryorthents, Debris Flows	132
		Andic Durixerepts	143
		Shadowlake	150
		Terracelake	150
		Terracelake	151
		Shadowlake	151
		Terracelake	152
		Shadowlake	152
		Xeric Vitricryands, Pyroclastic Surge	155
		Xeric Vitricryands, Pyroclastic Surge	156
F022BI117CA	Frigid Coarse Glaciolacustrine Gentle Slopes	Duric Vitraquands	139
		Vitrixerands	140
F022BI118CA	Frigid Landslide Undulating Slopes	Typic Dystroxerepts, Landslides	118
F022BI119CA	Low Precip Frigid Sandy Moraine Slopes	Buttelake	120

Table 1.-Correlated Ecological Sites - Continued

Ecological site ID	Ecological site name	Component name	Map symbol
F022BI120CA	Frigid Gravelly Sandy Loam Outwash-Stream Terraces	Humic Haploxerands, Stream Terrace	125
		Aquic Haploxerands	164
		Aquic Haploxerands	166
F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes	Dittmar	126
		Typic Vitrixerands, Unglaciated	158
		Typic Vitrixerands, Bouldery	159
		Scoured	169
F022BI122CA	Frigid Extremely Gravelly Sandy Landslides	Chaos	134
F022BI123CA	Frigid Flat Outwash Terraces	Vitrixerands, low elevation	168
F022BI124CA	Upper Cryic Slopes	Readingpeak	114
		Readingpeak	167
		Readingpeak	174
F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	Humic Haploxerands, Moist Lake Terrace	117
		Badgerwash	173
F022BI126CA	Cold Frigid Tephra Over Moraine Slopes	Badgerflat	172
R022BI200CA	Talus Slope	Talved	120

Table 1.-Correlated Ecological Sites - Continued

Ecological site ID	Ecological site name	Component name	Map symbol
R022BI201CA	Bedded Tephra Deposits	Typic Xerorthents, Tephra	202
		Typic Xerorthents, Welded	202
R022BI202CA	Frigid Alluvial Flat	Aquandic Endoaquepts	165
		Terric Haplohemists	165
		Aquandic Humaquepts	165
		Histic Humaquepts	165
R022BI203CA	Moderately Deep Fragmental Slopes	Brokeoff	119
R022BI204CA	Glaciated Mountain Slopes	Terracelake	113
		Acroph	150
		Acroph	151
		Acroph	152
R022BI205CA	Cirque Floor	Xeric Vitricryands, Cirque Floor	116
		Xeric Vitricryands, Cirque Floor	136
		Xeric Vitricryands, Cirque Floor	144
R022BI206CA	Cryic Lacustrine Flat	Aquandic Cryaquents	139
		Aquandic Cryaquents	163
		Vitrandic Cryofluvents	163
		Vitrandic Cryofluvents	175

Table 1.-Correlated Ecological Sites - Continued

Ecological site ID	Ecological site name	Component name	Map symbol
R022BI207CA	Alpine Slopes	Terracelake	114
		Emeraldlake	114
		Emeraldlake	149
		Terracelake	167
		Emeraldlake	167
		Emeraldlake	170
		Readingpeak	170
		Vitrandic Cryorthents, Debris Flows, high elevation	177
R022BI208CA	Cryic Pyroclastic Cones	Xeric Vitricryands, Bedrock	122
R022BI209CA	Loamy Seeps	Endoaquepts	119
R022BI210CA	Frigid Loamy Flood Plains	Aquandic Humaquepts, Flood Plains	125
R022BI211CA	Spring Complex	Aquepts	127
		Aquepts	164
		Typic Petraquepts, Bedrock	164
		Aquepts	171
		Typic Petraquepts, Bedrock	171
R022BI212CA	Windy Peak	Xeric Vitricryands	137

Table 1.-Correlated Ecological Sites - Continued

Ecological site ID	Ecological site name	Component name	Map symbol
R022BI213CA	Frigid Sandy Flood Plains	Typic Endoaquents	133
		Typic Endoaquents	138
		Typic Psammaquents	161
R022BI214CA	Pyroclastic Flow	Vitrandic Cryorthents	174
R022BI215CA	Frigid Gravelly Flood Plains	Aeric Endoaquents	160
R022BI216CA	Active Hydrothermal Areas	Aquic Dystroxerepts, Debris Flows	119
		Typic Dystroxerepts	119
R022BI217CA	Frigid Lacustrine Flat	Histic Humaquepts, Lake Sediments	130
		Histic Humaquepts, Frequently Flooded	130
R022BI218CA	Thermal Seeps	Typic Petraquepts	164

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
100:			
Buttelake	85	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Sunhoff	5	F022BI107CA	Frigid Moderately Deep Slopes
Buttewash	3	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Typic Xerorthents	2	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Badgerflat	2	F022BI126CA	Cold Frigid Tephra Over Moraine Slopes
Rock outcrop	2		
Talved	1	R022BI200CA	Talus Slope
101:			
Buttewash	85	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Badgerwash	8	F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces
Buttelake	5	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Humic Haploxerands, moist lake terrace	2	F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces
102:			
Ashbutte	65	F022BI109CA	Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes
Vitrandic Xerorthents	25	F022BI114CA	Frigid Very Deep Cinder Cone Or Shield Volcano Slopes
Prospectpeak	6	F022BI109CA	Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes
Rubble land	2		
Rock outcrop	2		
103:			
Scoured	75	F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Rock outcrop	10		
Juniperlake	10	F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces
Sunhoff	3	F022BI107CA	Frigid Moderately Deep Slopes
Typic Endoaquands	2	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
104:			
Scoured	55	F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands
Juniperlake	20	F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces
Rock outcrop	15		
Dittmar	5	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Rubble land	3		
Typic Endoaquands	2	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
105:			
Juniperlake	85	F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces
Scoured	5	F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands
Humic Haploxerands, lake terrace	4	F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces
Rock outcrop	3		
Typic Endoaquands	2	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
Histic Humaquepts, lake sediments	1	R022BI217CA	Frigid Lacustrine Flat
106:			
Cenplat ashy loamy sand	70	F022BI115CA	Frigid And Cryic Gravelly Slopes
Rock outcrop	8		
Badgerflat	7	F022BI107CA	Frigid Moderately Deep Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Sunhoff	5	F022BI107CA	Frigid Moderately Deep Slopes
Cascadesprings	5	F022BI115CA	Frigid And Cryic Gravelly Slopes
Buttelake	2	F022BI107CA	Frigid Moderately Deep Slopes
Buttewash	1	F022BI107CA	Frigid Moderately Deep Slopes
Rubble land	1		
Badgerwash	1	F022BI107CA	Frigid Moderately Deep Slopes
107:			
Badgerflat	40	F022BI107CA	Frigid Moderately Deep Slopes
Cenplat	35	F022BI107CA	Frigid Moderately Deep Slopes
Rock outcrop	10		
Buttelake	3	F022BI119CA	Low Precip Frigid Sandy Moraine Slopes
Dittmar	3	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Juniperlake	3	F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces
Scoured	3	F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands
Sunhoff	2	F022BI107CA	Frigid Moderately Deep Slopes
Rubble land	1		
108:			
Typic Xerorthents	80	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Buttewash	10	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Typic Xerorthents, tephra	5	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Humic Haploxerands, moist lake terrace	3	F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces
Buttelake	2	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
109:			
Prospectpeak	85	F022BI109CA	Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes
Bearrubble	10	F022BI114CA	Frigid Very Deep Cinder Cone Or Shield Volcano Slopes
Rubble land	3		
Rock outcrop	2		
110:			
Bearrubble	50	F022BI114CA	Frigid Very Deep Cinder Cone Or Shield Volcano Slopes
Rubble land	35		
Rock outcrop	10		
Scoured	3	F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands
Prospectpeak	2	F022BI109CA	Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes
111:			
Vitrandic Xerorthents, debris fan	95	F022BI106CA	Frigid Debris Flow Gentle Slopes
Typic Endoaquents	5	R022BI213CA	Frigid Sandy Flood Plains
112:			
Cascadesprings	85	F022BI115CA	Frigid And Cryic Gravelly Slopes
Terracelake	13	R022BI204CA	Glaciated Mountain Slopes
Emeraldlake	2	F022BI115CA	Frigid And Cryic Gravelly Slopes
113:			
Terracelake	35	R022BI204CA	Glaciated Mountain Slopes
Emeraldlake	25	F022BI115CA	Frigid And Cryic Gravelly Slopes
Readingpeak	20	F022BI115CA	Frigid And Cryic Gravelly Slopes
Rock outcrop	10		

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Rubble land	5		
Acroph	3	R022BI204CA	Glaciated Mountain Slopes
Cascadesprings	2	F022BI115CA	Frigid And Cryic Gravelly Slopes
114:			
Emeraldlake	25	R022BI207CA	Alpine Slopes
Terracelake	23	R022BI207CA	Alpine Slopes
Readingpeak	20	F022BI124CA	Upper Cryic Slopes
Rock outcrop	15		
Rubble land	12		
Acroph	3	R022BI207CA	Alpine Slopes
Xeric Vitricryands, cirque floor	2	R022BI205CA	Cirque Floor
115:			
Shadowlake	85	F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes
Terracelake	10	F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes
Xeric Vitricryands, cirque floor	5	R022BI205CA	Cirque Floor
116:			
Xeric Vitricryands, tephra over till	30	F022BI104CA	Cryic Coarse Loamy Colluvial Slopes
Terracelake	25	F022BI104CA	Cryic Coarse Loamy Colluvial Slopes
Xeric Vitricryands, cirque floor	15	R022BI205CA	Cirque Floor
Rock outcrop	15		
Humic Xeric Vitricryands	10	F022BI104CA	Cryic Coarse Loamy Colluvial Slopes
Acroph	5	R022BI207CA	Alpine Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
117:			
Humic Haploxerands, moist lake terrace	90	F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces
Typic Endoaquands	5	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
Buttewash	3	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Badgerwash	2	F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces
118:			
Typic Dystroxerepts, landslides	90	F022BI118CA	Frigid Landslide Undulating Slopes
Brokeoff	5	R022BI203CA	Moderately Deep Fragmental Slopes
Endoaquepts	5	R022BI209CA	Loamy Seeps
119:			
Diamondpeak	30	F022BI113CA	Frigid Very Deep Loamy Slopes
Brokeoff	25	R022BI203CA	Moderately Deep Fragmental Slopes
Endoaquepts	14	R022BI209CA	Loamy Seeps
Aquic Dystroxerepts, debris flows	11	R022BI216CA	Active Hydrothermal Areas
Typic Dystroxerepts	10	R022BI216CA	Active Hydrothermal Areas
Rock outcrop	5		
Badland	5		
120:			
Buttelake	65	F022BI119CA	Low Precip Frigid Sandy Moraine Slopes
Sunhoff	15	F022BI107CA	Frigid Moderately Deep Slopes
Talved	10	R022BI200CA	Talus Slope
Scoured	5	F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Rock outcrop	3		
Rubble land	2		
122:			
Xeric Vitricryands, colluvium	35	F022BI104CA	Cryic Coarse Loamy Colluvial Slopes
Xeric Vitricryands, ash over cinders	30	F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes
Xeric Vitricryands, bedrock	20	R022BI208CA	Cryic Pyroclastic Cones
Rock outcrop	10		
Rubble land	5		
125:			
Humic Haploxerands, stream terrace	55	F022BI120CA	Frigid Gravelly Sandy Loam Outwash-Stream Terraces
Aquandic Humaquepts, flood plains	40	R022BI210CA	Frigid Loamy Flood Plains
Aeric Endoaquents	3	R022BI210CA	Frigid Loamy Flood Plains
Riverwash	2		
126:			
Kingsiron	45	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Dittmar	20	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Rock outcrop	15		
Scoured	10	F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands
Rubble land	5		
Bearrubble	3	F022BI114CA	Frigid Very Deep Cinder Cone Or Shield Volcano Slopes
Aquepts	2	R022BI211CA	Spring Complex
127:			
Humic Haploxerands, strath terrace	65	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Aquepts	15	R022BI211CA	Spring Complex

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Dittmar	5	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Humic Haploxerands, colluvium	5	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Rock outcrop	5		
Aquandic Humaquepts, flood plains	4	R022BI210CA	Frigid Loamy Flood Plains
Endoaquepts	1	R022BI209CA	Loamy Seeps
129:			
Humic Haploxerands, colluvium	80	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Kingsiron	10	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Rubble land	3		
Rock outcrop	3		
Humic Haploxerands, strath terrace	2	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Aquepts	2	R022BI211CA	Spring Complex
130:			
Histic Humaquepts, lake sediments	55	R022BI217CA	Frigid Lacustrine Flat
Histic Humaquepts, frequently flooded	30	R022BI217CA	Frigid Lacustrine Flat
Typic Endoaquands	15	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
132:			
Vitrandic Cryorthents, debris flows	90	F022BI115CA	Frigid And Cryic Gravelly Slopes
Xeric Vitricryands, pyroclastic surge	3	F022BI115CA	Frigid And Cryic Gravelly Slopes
Typic Endoaquents	2	R022BI213CA	Frigid Sandy Flood Plains
Vitrandic Xerorthents, moraine	2	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rock outcrop	2		

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Typic Vitrixerands	1	F022BI103CA	Frigid Tephra Over Slopes And Flats
133:			
Vitrandic Xerofluvents	55	F022BI106CA	Frigid Debris Flow Gentle Slopes
Typic Endoaquents	30	R022BI213CA	Frigid Sandy Flood Plains
Vitrandic Xerofluvents	5	F022BI106CA	Frigid Debris Flow Gentle Slopes
Vitrandic Xerofluvents, debris flows	5	F022BI105CA	Frigid Sandy Loam Debris Flow On Stream Terraces
Vitrandic Xerorthents, debris fan	5	F022BI106CA	Frigid Debris Flow Gentle Slopes
134:			
Chaos	85	F022BI122CA	Frigid Extremely Gravelly Sandy Landslides
Rubble land	12		
Aquepts	3	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
136:			
Terracelake	45	F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes
Rock outcrop	20		
Xeric Vitricryands, cirque floor	15	R022BI205CA	Cirque Floor
Acroph	10	R022BI207CA	Alpine Slopes
Xeric Vitricryands, tephra over till	10	F022BI104CA	Cryic Coarse Loamy Colluvial Slopes
137:			
Xeric Vitricryands	75	R022BI212CA	Windy Peak
Rock outcrop rhyodacite	20		
Acroph	3	R022BI204CA	Glaciated Mountain Slopes
Terracelake	2	R022BI207CA	Alpine Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
138:			
Vitrandic Xerofluvents, debris flows	80	F022BI105CA	Frigid Sandy Loam Debris Flow On Stream Terraces
Typic Endoaquents	10	R022BI213CA	Frigid Sandy Flood Plains
Vitrixerands low elevation	9	F022BI123CA	Frigid Flat Outwash Terraces
Rock outcrop	1		
139:			
Duric Vitraquands	60	F022BI117CA	Frigid Coarse Glaciolacustrine Gentle Slopes
Typic Endoaquands	20	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
Aquandic Cryaquents	15	R022BI206CA	Cryic Lacustrine Flat
Vitrandic Cryofluvents	3	R022BI206CA	Cryic Lacustrine Flat
Typic Endoaquents	1	R022BI213CA	Frigid Sandy Flood Plains
Vitrixerands	1	F022BI117CA	Frigid Coarse Glaciolacustrine Gentle Slopes
140:			
Vitrixerands	90	F022BI117CA	Frigid Coarse Glaciolacustrine Gentle Slopes
Duric Vitraquands	10	F022BI117CA	Frigid Coarse Glaciolacustrine Gentle Slopes
141:			
Humic Haploxerands	40	F022BI103CA	Frigid Tephra Over Slopes And Flats
Typic Haploxerands	35	F022BI103CA	Frigid Tephra Over Slopes And Flats
Bearrubble	15	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rubble land	10		
142:			
Cragwash	85	F022BI103CA	Frigid Tephra Over Slopes And Flats

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Sueredo	7	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rubble land	3		
Aquepts	3	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
Rock outcrop	2		
143:			
Andic Durixerepts	95	F022BI115CA	Frigid And Cryic Gravelly Slopes
Cascadesprings	3	F022BI115CA	Frigid And Cryic Gravelly Slopes
Aquepts	2	R022BI211CA	Spring Complex
144:			
Xeric Vitricryands, cirque floor	55	R022BI205CA	Cirque Floor
Humic Xeric Vitricryands	30	F022BI104CA	Cryic Coarse Loamy Colluvial Slopes
Rock outcrop	5		
Terracelake	5	R022BI207CA	Alpine Slopes
Aquepts	3	R022BI211CA	Spring Complex
Shadowlake	2	F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes
145:			
Sueredo	85	F022BI103CA	Frigid Tephra Over Slopes And Flats
Vitrandic Cryorthents	5		
Cragwash	3	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rock outcrop	3		
Badgerflat	2	F022BI126CA	Cold Frigid Tephra Over Moraine Slopes
Aquepts	2	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
146:			
Sueredo	90	F022BI103CA	Frigid Tephra Over Slopes And Flats
Scoured	3	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Rock outcrop	3		
Vitrandic Cryorthents	3		
Vitrandic Xerorthents, debris fan	1	F022BI106CA	Frigid Debris Flow Gentle Slopes
147:			
Summertown	85	F022BI103CA	Frigid Tephra Over Slopes And Flats
Sueredo	7	F022BI103CA	Frigid Tephra Over Slopes And Flats
Humic Haploxerands, outwash	4	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rock outcrop	2		
Vitrandic Xerorthents, debris fan	2	F022BI106CA	Frigid Debris Flow Gentle Slopes
148:			
Humic Haploxerands, lake terrace	70	F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces
Typic Endoaquands	15	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
Juniperlake	5	F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces
Beaches	4		
Rubble land	3		
Histic Humaquepts, lake sediments	2	R022BI217CA	Frigid Lacustrine Flat
Histic Humaquepts, frequently flooded	1	R022BI217CA	Frigid Lacustrine Flat
149:			
Rubble land	45		
Rock outcrop cliffs	30		

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Emeraldlake	15	R022BI207CA	Alpine Slopes
Acroph	4	R022BI204CA	Glaciated Mountain Slopes
Terracelake	3	R022BI207CA	Alpine Slopes
Readingpeak	3	F022BI124CA	Upper Cryic Slopes
150:			
Shadowlake	40	F022BI115CA	Frigid And Cryic Gravelly Slopes
Terracelake	30	F022BI115CA	Frigid And Cryic Gravelly Slopes
Acroph	15	R022BI204CA	Glaciated Mountain Slopes
Rock outcrop	10		
Sueredo	2	F022BI103CA	Frigid Tephra Over Slopes And Flats
Aquepts	2	R022BI211CA	Spring Complex
Rubble land	1		
151:			
Terracelake	40	F022BI115CA	Frigid And Cryic Gravelly Slopes
Acroph	20	R022BI204CA	Glaciated Mountain Slopes
Shadowlake	15	F022BI115CA	Frigid And Cryic Gravelly Slopes
Rock outcrop	15		
Sueredo	5	F022BI115CA	Frigid And Cryic Gravelly Slopes
Rubble land	2		
Aquepts	2	R022BI211CA	Spring Complex
Vitrandic Cryorthents	1		
152:			
Terracelake	35	F022BI115CA	Frigid And Cryic Gravelly Slopes
Shadowlake	30	F022BI115CA	Frigid And Cryic Gravelly Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Acroph	15	R022BI204CA	Glaciated Mountain Slopes
Rock outcrop	10		
Vitrandic Cryorthents	4		
Sueredo	4	F022BI115CA	Frigid And Cryic Gravelly Slopes
Aquepts	2	R022BI211CA	Spring Complex
153:			
Typic Vitrixerands	50	F022BI103CA	Frigid Tephra Over Slopes And Flats
Vitrandic Xerorthents, moraine	45	F022BI103CA	Frigid Tephra Over Slopes And Flats
Vitrandic Cryorthents, debris flows	2	F022BI115CA	Frigid And Cryic Gravelly Slopes
Sueredo	2	F022BI103CA	Frigid Tephra Over Slopes And Flats
Vitrandic Xerorthents, debris fan	1	F022BI106CA	Frigid Debris Flow Gentle Slopes
154:			
Typic Vitrixerands	45	F022BI103CA	Frigid Tephra Over Slopes And Flats
Vitrandic Xerorthents, moraine	35	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rock outcrop	10		
Aquepts	3	F022BI105CA	Frigid Sandy Loam Debris Flow On Stream Terraces
Sueredo	3	F022BI103CA	Frigid Tephra Over Slopes And Flats
Typic Endoaquents	2	R022BI213CA	Frigid Sandy Flood Plains
Vitrandic Cryorthents, debris flows	2	F022BI115CA	Frigid And Cryic Gravelly Slopes
155:			
Xeric Vitricryands, pyroclastic surge	90	F022BI115CA	Frigid And Cryic Gravelly Slopes
Vitrandic Cryorthents, debris flows	5	F022BI115CA	Frigid And Cryic Gravelly Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Shadowlake	3	F022BI115CA	Frigid And Cryic Gravelly Slopes
Aquepts	2	R022BI211CA	Spring Complex
156:			
Xeric Vitricryands, pyroclastic surge	90	F022BI115CA	Frigid And Cryic Gravelly Slopes
Aquepts	5	R022BI211CA	Spring Complex
Shadowlake	5	F022BI115CA	Frigid And Cryic Gravelly Slopes
157:			
Typic Vitrixerands, very deep	90	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rock outcrop	7		
Typic Vitrixerands, unglaciated	3	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
158:			
Typic Vitrixerands, unglaciated	75	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Rock outcrop rhyodacite	20		
Typic Vitrixerands, very deep	5	F022BI103CA	Frigid Tephra Over Slopes And Flats
159:			
Typic Vitrixerands, bouldery	40	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Typic Vitrixerands, tephra over colluvium	35	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rubble land	15		
Rock outcrop	7		
Vitrandic Cryorthents	3		
160:			
Aeric Endoaquents	45	R022BI215CA	Frigid Gravelly Flood Plains
Humic Haploxerands, stream terrace	35	F022BI110CA	Frigid Humic Loamy Gentle Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Riverwash	15		
Aquandic Humaquepts, flood plains	5	R022BI215CA	Frigid Gravelly Flood Plains
161:			
Typic Psammaquents	95	R022BI213CA	Frigid Sandy Flood Plains
Riverwash	5		
162:			
Humic Haploxerands, outwash	95	F022BI103CA	Frigid Tephra Over Slopes And Flats
Vitrandic Xerorthents, debris fan	3	F022BI106CA	Frigid Debris Flow Gentle Slopes
Summertown	2	F022BI103CA	Frigid Tephra Over Slopes And Flats
163:			
Vitrandic Cryofluvents	65	R022BI206CA	Cryic Lacustrine Flat
Aquandic Cryaquents	30	R022BI206CA	Cryic Lacustrine Flat
Typic Endoaquands	2	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
Duric Vitraquands	1	F022BI117CA	Frigid Coarse Glaciolacustrine Gentle Slopes
Typic Endoaquents	1	R022BI213CA	Frigid Sandy Flood Plains
Aquepts	1	R022BI211CA	Spring Complex
164:			
Aquepts	35	R022BI211CA	Spring Complex
Typic Petraquepts, bedrock	25	R022BI211CA	Spring Complex
Aquic Haploxerands	20	F022BI120CA	Frigid Gravelly Sandy Loam Outwash-Stream Terraces
Typic Petraquepts	10	R022BI218CA	Thermal Seeps
Typic Dystroxerepts	4		
Aquic Dystroxerepts, debris flows	3		

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Aquandic Humaquepts, flood plains	1	R022BI210CA	Frigid Loamy Flood Plains
Badland	1		
Humic Haploxerands, strath terrace	1	F022BI110CA	Frigid Humic Loamy Gentle Slopes
165:			
Aquandic Humaquepts	35	R022BI202CA	Frigid Alluvial Flat
Histic Humaquepts	25	R022BI202CA	Frigid Alluvial Flat
Aquandic Endoaquepts	20	R022BI202CA	Frigid Alluvial Flat
Terric Haplohemists	15	R022BI202CA	Frigid Alluvial Flat
Humic Haploxerands, stream terrace	5	F022BI120CA	Frigid Gravelly Sandy Loam Outwash-Stream Terraces
166:			
Aquic Haploxerands	50	F022BI120CA	Frigid Gravelly Sandy Loam Outwash-Stream Terraces
Humic Haploxerands, outwash terrace	40	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Juniperlake bouldery	4	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Humic Haploxerands, strath terrace	3	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Aquepts	2	R022BI211CA	Spring Complex
Aquandic Humaquepts, flood plains	1	R022BI210CA	Frigid Loamy Flood Plains
167:			
Emeraldlake	35	R022BI207CA	Alpine Slopes
Readingpeak	20	F022BI124CA	Upper Cryic Slopes
Rock outcrop dacite	15		
Terracelake	15	R022BI207CA	Alpine Slopes
Rubble land	10		
Lava flows	5		

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
168:			
Vitrixerands low elevation	90	F022BI123CA	Frigid Flat Outwash Terraces
Vitrandic Xerofluvents, debris flows	5	F022BI105CA	Frigid Sandy Loam Debris Flow On Stream Terraces
Sueredo	4	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rock outcrop	1		
169:			
Sueredo	55	F022BI103CA	Frigid Tephra Over Slopes And Flats
Rock outcrop cliffs	20		
Scoured	15	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes
Rubble land	10		
170:			
Rock outcrop rhyodacite	35		
Emeraldlake	20	R022BI207CA	Alpine Slopes
Rubble land	18		
Readingpeak	15	R022BI207CA	Alpine Slopes
Terracelake	12	R022BI207CA	Alpine Slopes
171:			
Aquepts	50	R022BI211CA	Spring Complex
Typic Petraquepts, bedrock	35	R022BI211CA	Spring Complex
Shadowlake	5	F022BI115CA	Frigid And Cryic Gravelly Slopes
Endoaquepts	5	R022BI209CA	Loamy Seeps
Typic Endoaquands	5	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
172:			
Badgerflat	90	F022BI126CA	Cold Frigid Tephra Over Moraine Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Badgerwash	5	F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces
Cenplat	4	F022BI107CA	Frigid Moderately Deep Slopes
Typic Endoaquands	1	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
173:			
Badgerwash	90	F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces
Typic Endoaquands	8	F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces
Badgerflat	2	F022BI126CA	Cold Frigid Tephra Over Moraine Slopes
174:			
Vitrandic Cryorthents	60	R022BI214CA	Pyroclastic Flow
Readingpeak	20	F022BI124CA	Upper Cryic Slopes
Rock outcrop	10		
Terracelake	7	R022BI207CA	Alpine Slopes
Rubble land	3		
175:			
Shadowlake	75	F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes
Vitrandic Cryofluvents	15	R022BI206CA	Cryic Lacustrine Flat
Terracelake	5	F022BI115CA	Frigid And Cryic Gravelly Slopes
Aquandic Cryaquents	3	R022BI206CA	Cryic Lacustrine Flat
Aquepts	2	R022BI211CA	Spring Complex
176:			
Juniperlake bouldery	85	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Scoured	10	F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes

Table 2.-Correlated Ecological Sites by Map Unit Symbol

Map symbol: Component name	Component percent	Ecological site ID	Ecological site name
Humic Haploxerands, outwash terrace	3	F022BI110CA	Frigid Humic Loamy Gentle Slopes
Aquepts	1	R022BI211CA	Spring Complex
Endoaquepts	1	R022BI209CA	Loamy Seeps
177:			
Vitrandic Cryorthents, debris flows High Elevation	85	R022BI207CA	Alpine Slopes
Rubble land	12		
Rock outcrop	3		
200:			
Cinder land	100		
201:			
Lava flows	100		
202:			
Typic Xerorthents, tephra	85	R022BI201CA	Bedded Tephra Deposits
Typic Xerorthents, welded	10	R022BI201CA	Bedded Tephra Deposits
Rock outcrop	5		
203:			
Typic Xerorthents, tephra	90	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
Typic Xerorthents	10	F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes
205:			
Beaches	100		
W:			
Water	100		

Table 3.-Ecological Site ID, New and Old Ecological Site Names

Old Ecological Site Name as shown in Soil Survey of Lassen Volcanic National Park, California, 2010

Ecological Site ID	New Ecological Site Name	Old Ecological Site Name
F022BI100CA	Low Precip Frigid Sandy Tephra Gentle Slopes	Pinus jeffreyi-Abies concolor/Achnatherum occidentale ssp. occidentale-Elymus elymoides
F022BI102CA	Frigid Bouldery Glacially Scoured Ridges Or Headlands	Abies magnifica/Arctostaphylos nevadensis/Carex rossii-Penstemon gracilentus
F022BI103CA	Frigid Tephra Over Slopes And Flats	Abies concolor-Pinus jeffreyi/Arctostaphylos patula-Ceanothus velutinus
F022BI104CA	Cryic Coarse Loamy Colluvial Slopes	Tsuga mertensiana/Lupinus obtusilobus-Cistanthe umbellata var. umbellata
F022BI105CA	Frigid Sandy Loam Debris Flow On Stream Terraces	Pinus contorta var. murrayana-Populus tremuloides/Elymus glaucus
F022BI106CA	Frigid Debris Flow Gentle Slopes	Pinus jeffreyi-Abies/Achnatherum-Lupinus
F022BI107CA	Frigid Moderately Deep Slopes	Abies magnifica-Abies concolor/Chrysolepis sempervirens
F022BI108CA	Frigid Moist Sandy Lake Or Stream Terraces	Pinus contorta var. murrayana/Veratrum californicum var. californicum-Elymus glaucus
F022BI109CA	Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano Slopes	Abies magnifica-Pinus jeffreyi/Arctostaphylos nevadensis-Achnatherum occidentale
F022BI110CA	Frigid Humic Loamy Gentle Slopes	Abies concolor-Calocedrus decurrens/Ceanothus cordulatus/Achnatherum
F022BI111CA	Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes	Tsuga mertensiana-Abies magnifica/Lupinus obtusilobus-Eriogonum marifolium
F022BI112CA	Frigid Sandy Loam Moraines Or Lake Terraces	Abies magnifica-Pinus contorta var. murrayana/Penstemon gracilentus-Lupinus arbustus

Ecological Site ID	New Ecological Site Name	Old Ecological Site Name
F022BI113CA	Frigid Very Deep Loamy Slopes	Abies magnifica/Monardella odoratissima-Phlox diffusa
F022BI114CA	Frigid Very Deep Cinder Cone Or Shield Volcano Slopes	Abies magnifica-Pinus monticola/Arctostaphylos nevadensis-Chrysolepis sempervirens/Angelica breweri
F022BI115CA	Frigid And Cryic Gravelly Slopes	Abies magnifica-Pinus monticola/Arctostaphylos nevadensis/Achnatherum occidentale
F022BI117CA	Frigid Coarse Glaciolacustrine Gentle Slopes	Abies magnifica-Pinus contorta var. murrayana/Elymus elymoides
F022BI118CA	Frigid Landslide Undulating Slopes	Abies magnifica/Carex-Hieracium albiflorum
F022BI119CA	Low Precip Frigid Sandy Moraine Slopes	Abies concolor-Pinus jeffreyi/Chimaphila menziesii
F022BI120CA	Frigid Gravelly Sandy Loam Outwash-Stream Terraces	Abies concolor-Pinus contorta var. murrayana/Elymus glaucus
F022BI121CA	Frigid Shallow Or Moderately Deep Medial-Skeletal Slopes	Pinus jeffreyi/Arctostaphylos patula
F022BI122CA	Frigid Extremely Gravelly Sandy Landslides	Pinus jeffreyi-Abies concolor/Arctostaphylos patula
F022BI123CA	Frigid Flat Outwash Terraces	Abies concolor-Pinus contorta var. murrayana/Achnatherum occidentale
F022BI124CA	Upper Cryic Slopes	Tsuga mertensiana-Pinus albicaulis/Holodiscus discolor/Lupinus obtusilobus-Polygonum davisiae
F022BI125CA	Cold Frigid Tephra Over Outwash Plains Or Lake Terraces	Pinus contorta var. murrayana/Elymus elymoides
F022BI126CA	Cold Frigid Tephra Over Moraine Slopes	Pinus jeffreyi-Pinus contorta var. murrayana/Monardella odoratissima
R022BI200CA		Talus Slope
R022BI201CA		Bedded Tephra Deposits
R022BI202CA		Frigid Alluvial Flat
R022BI203CA		Moderately Deep Fragmental Slopes

Ecological Site ID	New Ecological Site Name	Old Ecological Site Name
R022BI204CA		Glaciated mountain slopes
R022BI205CA		Cirque floor
R022BI206CA		Cryic Lacustrine Flat
R022BI207CA		Alpine slopes
R022BI208CA		Cryic pyroclastic cones
R022BI209CA		Loamy Seeps
R022BI210CA	Frigid Loamy Flood Plains	Loamy Flood Plains
R022BI211CA		Spring Complex
R022BI212CA		Windy Peak
R022BI213CA	Frigid Sandy Flood Plains	Sandy Flood Plains
R022BI214CA		Pyroclastic Flow
R022BI215CA	Frigid Gravelly Flood Plains	Gravelly Flood Plains
R022BI216CA	Active Hydrothermal Areas (Complex)	Active Hydrothermal Areas
R022BI217CA		Frigid Lacustrine Flat
R022BI218CA		Thermal Seeps

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