USDA Natural Resources
Conservation Service

Ecological site F006XY709OR
Mesic Xeric Foothills 20-25 PZ

Last updated: 9/11/2023
Accessed: 02/09/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 006X–Cascade Mountains, Eastern Slope

Stretching from northern Washington to southern Oregon, MLRA6 encompasses the mountain slopes, foothills, elevated plateaus and valleys on the eastern slopes of the Cascade mountains. This MLRA is a transitional area between the Cascade Mountains to the west and the lower lying Columbia Basalt Plateau to the east. Situated in the rain shadow of the Cascade Crest, this MLRA receives less precipitation than portions of the cascades further west and greater precipitation than the basalt plateaus to the east. Geologically, the majority of the MLRA is dominated by Miocene volcanic rocks, while the northern portion is dominated by Pre-Cretaceous metamorphic rocks and the southern portion is blanketed with a thick mantle of ash and pumice from Mount Mazama. The soils in the MLRA dominantly have a mesic, frigid, or cryic soil temperature regime, a xeric soil moisture regime, and mixed or glassy mineralogy. They generally are moderately deep to very deep, well drained, and loamy or ashy. Biologically, the MLRA is dominated by coniferous forest, large expanses of which are dominated by ponderosa pine, Douglas-fir or lodgepole pine. Areas experiencing cooler and moister conditions include grand fir, white fir, and western larch while the highest elevations include pacific silver fir, subalpine fir and whitebark pine. Economically, timber harvest and recreation are important land uses in these forests. Historically, many of these forests would have experienced relatively frequent, low and mixed severity fire favoring the development of mature forests dominated by ponderosa pine or Douglas-fir. In the southern pumice plateau forests, less frequent, higher severity fire was common and promoted the growth of large expanses of lodgepole pine forests.

LRU notes

This unit is characterized by ash mantled lava flows and glacial outwash plains on lower mountain slopes and foothills of the East Cascades in Oregon. Vegetation is largely dominated by forests of ponderosa pine with transitional dry mixed conifer forests where Douglas-fir and grand fir are sub dominant occurring in areas with greater effective precipitation. Historically, these forests have been influenced by a fire regime whereby frequent to moderately frequent, low and mixed severity fires would have favored the development of open stands of mature ponderosa pine. The climate of this unit is cool and dry with a predominately xeric soil moisture regime and frigid soil temperature regime. Geologically, underlying lithologies are dominated by Quaternary and late Tertiary basalt and basaltic andesite as well as mixed grain sediments deposited during Pleistocene glacial retreat. Unlike the nearby pumice plateau, this unit lacks the coarse pumice fragments that dominate the soil profile and cooler temperatures that favor lodgepole pine. This unit is south of the climate influences of the Columbia gorge and therefore does not support woodlands of Oregon white oak.

Classification relationships

Forested Plant Associations of the Oregon East Cascades (Simpson 2007):
CPC733 - Pinus ponderosa-Calocedrus decurrens/Arctostaphylos patula

Plant Associations of the Commercial Forest of the Warm Springs Indian Reservation (Marsh 1987):
PIPO/PUTR-ARPA - Pinus ponderosa /Purshia Tridentata - Arctostaphylos patula

Landfire Biophysical Setting (Landfire 2007):
0710531 - Northern Rocky Mountain Ponderosa Pine Woodland and Savanna

Ecological site concept

This site represents a warm ponderosa pine site in the foothills of the Eastern Cascades of Oregon. An overstory dominated by ponderosa pine (Pinus ponderosa) with a lesser components of incense cedar (Calocedrus decurrens), occasional sub-canopy Douglas-fir (Pseudotsuga menziesii) and a shrub understory of greenleaf manzanita (Arctostaphylos patula) largely characterize the visual aspect of this reference plant community. Occupying a dry, warm ponderosa pine elevation band, this site transitions into ponderosa-bitterbrush (Purshia tridentata) and Oregon white oak (Quercus garryana) communities at its lower elevations and Douglas-fir, grand fir (Abies grandis) – white fir (Abies concolor) communities at its upper elevations. In comparison to adjacent warm, dry ponderosa pine forest types with a bitterbrush dominated understory, this site receives greater precipitation (20 to 25 in) creating conditions favorable to the less drought tolerant Douglas-fir. In comparison to other sites with ponderosa pine overstories and manzanita dominated shrub layers, this site has a mesic, rather than frigid or cryic, soil temperature regime allowing for the persistence of incense cedar. While this site may occasionally host minor tree species in the understory such as grand fir and western larch (Larix occidentalis), unlike sites where these species may become dominant overtime, this site receives lower precipitation and has a more frequent fire rotation. Mixed and low severity fire were historically a critical element of the disturbance regime of this site, acting to thin crowded understories and allow mature fire-resistant ponderosa pine and Douglas-fir stands to attain an open, savanna-like appearance.

This is a provisional ecological site that groups characteristics at a broad scale with little to no field verification and is subject to extensive review and revision before final approval. All data herein was developed using existing information and literature and should be considered provisional and contingent upon field validation prior to use in conservation planning.

Associated sites

F006XB800OR	**Frigid Xeric Foothills 20-30 PZ** Adjacent upslope positions, frigid soil temperature regime, CEVE common
F006XY710OR	**Mesic Xeric Foothills 14-20 PZ** Adjacent downslope positions, ARPA less common
R006XB208OR	**Shallow Slopes 14-20 PZ** Shallow soils, south aspects, non-forested plant community

Similar sites

F006XB802OR	**Mesic Xeric North Slopes 15-25 PZ** Occupying steep north slopes, lower precipitation, PSME common
F006XY710OR	**Mesic Xeric Foothills 14-20 PZ** Lower precipitation, lower elevations
F006XB800OR	**Frigid Xeric Foothills 20-30 PZ** Higher precipitation, frigid soil temperature regime, CADE less common

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa*
Shrub	(1) *Purshia tridentata* (2) *Arctostaphylos patula*
Herbaceous	(1) *Festuca idahoensis*

Physiographic features

This site is largely found occupying benches and side slopes of the foothills of the Eastern Cascades in Oregon. Its

range is largely restricted to areas north of Black Butte, mainly on the Confederated Tribes of the Warm Springs reservation. Elevations commonly range from 2,500 to 3,500 feet (750 to 1,050 m). Slopes are most often nearly level to 12 percent but can be as steep as 40 percent. This site is found on all aspects. This site is not subject to ponding or flooding and no water table is present within 100 inches of the soil surface.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Bench (2) Foothills > Hillside or mountainside
Flooding frequency	None
Ponding frequency	None
Elevation	2,500–3,500 ft
Slope	0–12%
Ponding depth	0 in
Water table depth	100 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	2,500–3,500 ft
Slope	0–40%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The average annual precipitation ranges from 20 to 25 inches (500 to 625 mm) which occurs mainly between the months of November and June, mostly in the form of rain and snow. The average annual air temperature ranges from 45 to 46 degrees Fahrenheit (7 to 8 °C) and the frost-free period ranges from 80 to 110 days. Soil temperature regime is mesic, soil moisture regime is xeric. The graphs below are populated from the closest available weather station to representative site locations and are provided to indicate general climate patterns.

Table 4. Representative climatic features

Frost-free period (characteristic range)	80-110 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	20-25 in
Frost-free period (average)	95 days
Freeze-free period (average)	
Precipitation total (average)	22 in

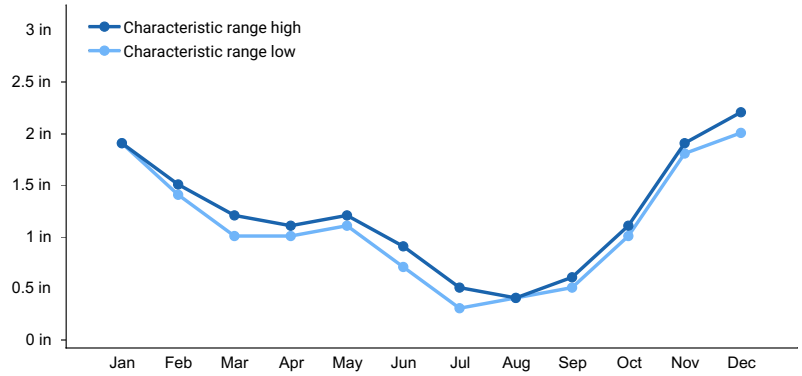


Figure 1. Monthly precipitation range

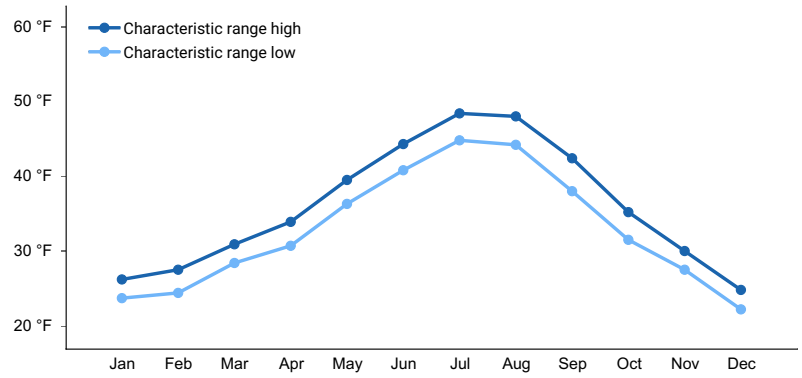


Figure 2. Monthly minimum temperature range

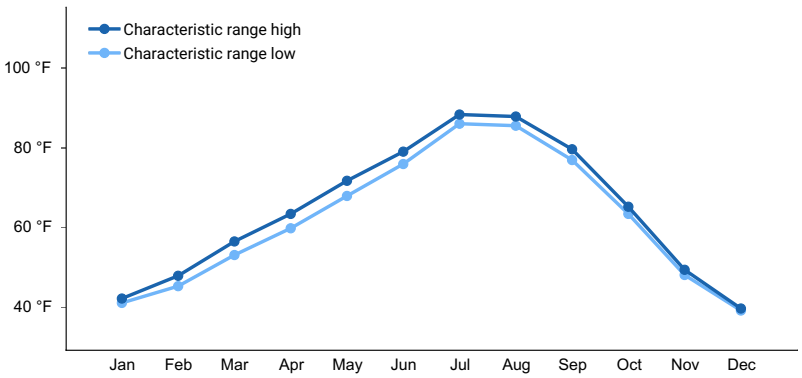


Figure 3. Monthly maximum temperature range

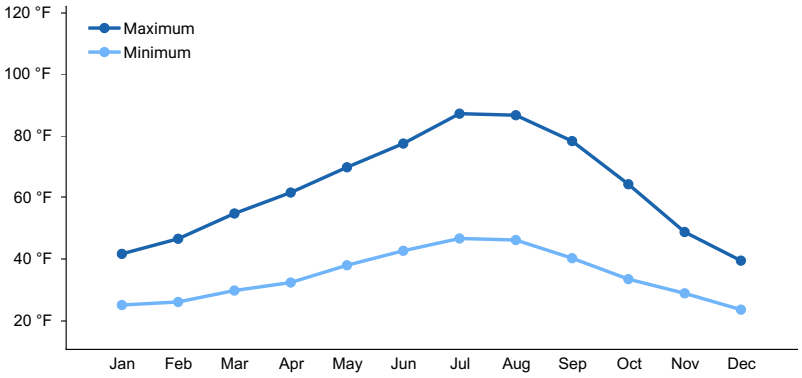


Figure 4. Monthly average minimum and maximum temperature

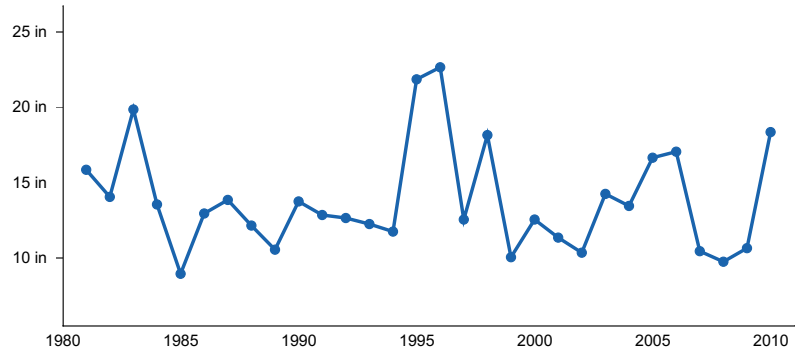


Figure 5. Annual precipitation pattern

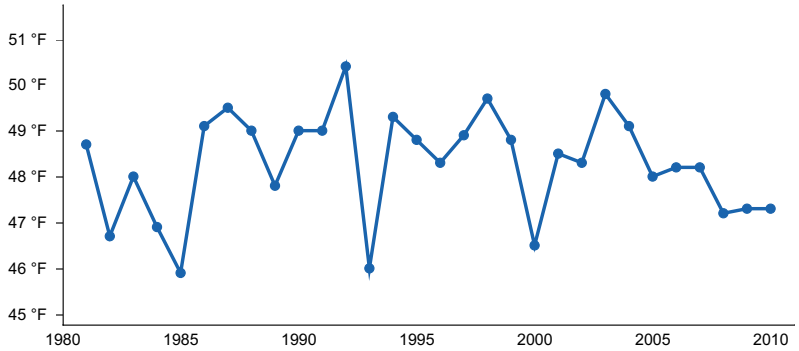


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SISTERS [USC00357857], Sisters, OR
- (2) DUFUR [USC00352440], Dufur, OR

Influencing water features

This site is not influenced by water from a wetland or stream.

Wetland description

N/A

Soil features

The soils that typify this site concept are moderately deep to very deep over paralithic bedrock. These are primarily well drained, volcanic soils with surface layers with components of volcanic ash over colluvium and residuum derived from basalt, andesite and sedimentary rock. Surface soil textures are commonly loams. These soils sometimes contain substantial cobbles and stones in the upper surface layer. Volcanic ash will increase water holding capacity and productivity of these soils while rock fragments will decrease water holding capacity. Taxonomic classification of these soils is predominately Vitrandic Argixerolls (Grassland soils with influences of volcanic materials). See Hehe and Teewee (high precipitation phases) for representative soils associated with this site concept.

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Colluvium–volcanic rock (3) Residuum–volcanic rock (4) Colluvium–sedimentary rock (5) Residuum–sedimentary rock

Surface texture	(1) Loam (2) Very cobbly loam (3) Very stony loam
Family particle size	(1) Loamy-skeletal (2) Fine-loamy
Drainage class	Well drained
Permeability class	Moderately slow to moderate
Depth to restrictive layer	20–80 in
Soil depth	20–80 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–15%
Available water capacity (0-40in)	3.4–5.2 in
Soil reaction (1:1 water) (0-40in)	5.6–6.5
Subsurface fragment volume <=3" (4-60in)	0–5%
Subsurface fragment volume >3" (4-60in)	25–50%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	Not specified
Soil depth	Not specified
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-40in)	1.9–6.2 in
Soil reaction (1:1 water) (0-40in)	5.6–7
Subsurface fragment volume <=3" (4-60in)	0–15%
Subsurface fragment volume >3" (4-60in)	10–50%

Ecological dynamics

Reference Plant community:

The reference native plant community under the natural disturbance regime, is characterized by an overstory composed of ponderosa pine, with a lesser component of incense cedar, and a sub-canopy dominated by greenleaf manzanita. The tendency for incense cedar to attain codominance in the overstory sets this forested plant community apart from other dry ponderosa sites, and may be a unique feature of this site within the Oregon Eastern Cascades (Simpson 2007). In addition to greenleaf manzanita, bitterbrush and snowbrush (*Ceanothus velutinus*) are common shrubs and Douglas-fir may occur in the sub-canopy. Herbaceous species usually do not make up a dominant proportion of vegetative cover but may include Idaho fescue (*Festuca idahoensis*), Ross' sedge (*Carex rossii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), prairie junegrass (*Koeleria macrantha*), Sandberg bluegrass (*Poa secunda*), arrowleaf balsamroot (*Balsamorhiza sagittata*) and tailcup lupine (*Lupinus caudatus*).

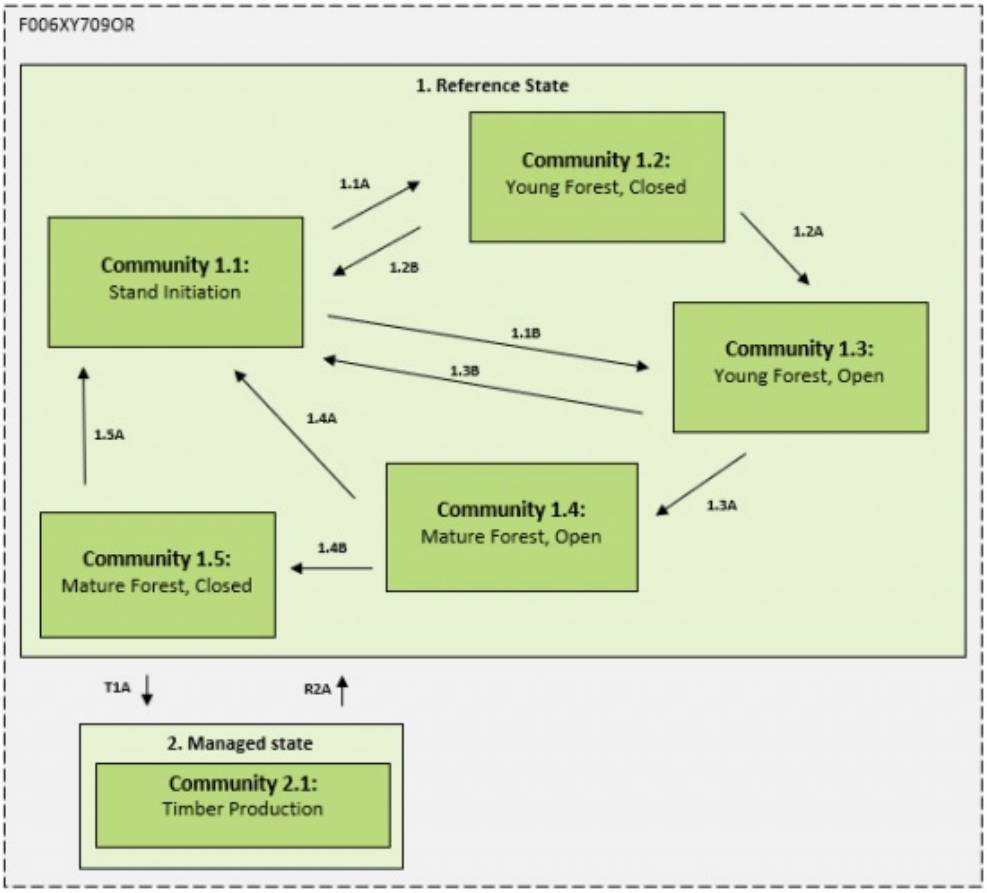
Disturbance:

A lack of specific fire rotation information is available for this forest type, yet warm ponderosa pine forests were historically subject to frequent surface fires primarily ignited by lightning strikes. Little evidence exists for local Native American cultural burning in this dry forest type, a practice more commonly used in wetter mixed conifer forests of the area (Steen-Adams et al. 2019). These low intensity fires would have decreased the density of young regenerating understory trees, which may otherwise act as ladder fuels to ignite crown fires and lead to stand replacing events. Overtime, frequent low intensity fires, as well as occasional mixed severity fires, would have favored the development of mature, even-aged ponderosa pine stands with open canopies (Landfire 2007). Fire resistant ponderosa is well adapted to these conditions, developing increasing fire resistance with age by growing thick bark and self-thinning lower limbs (Fryer 2008). Incense cedar is much less fire tolerant than ponderosa, yet more shade tolerant. Given long periods without fire, it may become more prominent in the overstory (Tollefson 2008). Douglas-fir is moisture limited on this site and therefore often occupies northern aspects and declines without overstory ponderosa (Marsh et al. 1987). Manzanita and snowbrush will increase following fire and may form shrub fields on sites with higher moisture following stand replacing fires. With longer time between fire, increased development of understory fuels, especially shade tolerant trees such as incense cedar and Douglas-fir, along with the development of a closed canopy, can promote an increased frequency of stand replacing fires and insect outbreaks. This condition characterizes much of the historically open canopy, dry ponderosa forests due to a history of selective logging and fire suppression (Ritchie et al 2005). Prolonged anthropogenic fire suppression may lead to cycles of overstocking and high severity fires, yet evidence is insufficient for the characterization of this pattern as an alternative state.

Historically, low elevation ponderosa forests were harvested extensively for timber products (Ritchie et al. 2005). Sites with higher productivity are especially attractive for commercial timber harvesting which will have varying effects on stand structure and composition depending on harvest practices. Selective logging of large shade tolerant ponderosa trees may favor the development of stands dominated by more shade tolerant tree species such as incense cedar and Douglas-fir overtime (Hessberg et al. 2005). This site has been historically utilized for livestock grazing and hosts elk and deer wintering range despite low herbaceous cover (Marsh et al. 1987). Grazing pressure will alter herbaceous cover and composition. Idaho fescue will likely decrease while bottlebrush squirreltail (*Elymus elymoides*), cheatgrass (*Bromus tectorum*), Sandberg bluegrass and Ross' sedge will likely increase (Marsh et al. 1987). Advanced invasion of exotic annual grasses in dry pine sites may increase fine fuel loads and fuel continuity, thereby increasing fire rotation and altering seasonality.

The state and transition model below represents a generalized and simplified version of forest change in response to fire in this ecological site. It does not attempt to model the complex effects of forestry practices, insect outbreaks or climate change on ecosystem function or process. Emerging evidence is suggesting that climate change is leading to hotter and drier conditions in western forests that will increase fire frequency and extent and lengthen fire seasons (Halofsky et al. 2020). When combined with the interacting impacts of fire suppression, drought, and insect outbreaks, it is possible that this ecological system will experience unpredictable ecosystem shifts and additional alternative states. For warm and dry sites, this may include the possibility of regeneration failure following wildfire disturbance (Halofsky et al. 2020). The reference state of the current model is largely based on Landfire biophysical settings model Rocky Mountain Ponderosa Pine Woodland and Savanna, 0710531 (Landfire 2007).

State and transition model



Community Pathways

1.1A	Fire cycle(s) missed
1.1B	Historical disturbance regime maintained for 150+ years
1.2A	Mixed severity fire occurs
1.2B	High severity, stand replacing fire occurs
1.3A	Historical fire regime maintained for 100+ years
1.3B	High severity, stand replacing fire occurs
1.4A	High severity, stand replacing fire occurs
1.4B	Fire cycle(s) missed
1.5A	High severity, stand replacing fire occurs

Transitions / Restoration Pathways

T1A	Extensive timber harvest
R2A	Forest restoration, stand replacing fire

State 1
Historical Reference State

This site occurs across the landscape as a mosaic of plant community phases characterized by variation in forest structural stage (tree age, density and cover) and plant community. Pathways between these phases are defined by historic fire regimes. Historically, many dry pine forests would have cycled from a shrub/tree initiation phase (1.1) to a young forest stage (1.3) to a mature forest phase (1.4) with a fire regime characterized by frequent surface and mixed fires. Fire exclusion can lead to closed canopy and dense understory stocking conditions represented by Communities 1.2 and 1.5 which can be more vulnerable to stand replacing fires. The Reference Plant Community within this state is that of an open, mature, savanna like ponderosa pine stand represented by Community Phase 1.4. Historical evidence suggests that this community type was common across the landscape prior to selective logging and widespread fire suppression, which can alter fire regimes and lead to a greater frequency of high severity fire. Given the likelihood that this state, even in the best condition and highest potential, will almost always include at least some component of exotic species regardless of management inputs, this may also be referred to as the “current potential state”. In this document, the term “reference state” is used synonymously with “current potential state” for the sake of simplicity.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- antelope bitterbrush (*Purshia tridentata*), shrub
- greenleaf manzanita (*Arctostaphylos patula*), shrub
- Idaho fescue (*Festuca idahoensis*), grass

Community 1.1
Reference Plant Community: Mature Forest, Open

This is the Reference Community. Mature, open canopy. Uneven aged stand with mostly mature ponderosa and some Douglas-fir and incense cedar. Frequent, low severity fires maintain this community, lack of fire will increase understory infill and vulnerability to severe fire.

Community 1.2
Young Forest, Closed

Closed canopy, densely stocked with young to intermediate aged ponderosa pine, Douglas-fir, and incense cedar. Shrub and bunchgrass decreasing. Competition for limited soil moisture and light will result in declining tree densities overtime.

Community 1.3
Young Forest, Open

Open overstory of uneven aged ponderosa pine with some Douglas-fir and incense cedar. Understory regeneration occurring.

Community 1.4
Stand Initiation

Shrub community dominated by manzanita and snowbrush, tree seedlings and saplings regenerating. Frequent, severe fire will maintain this community. All other communities may transition to this phase after stand replacing fires. Tree regeneration will depend on local seed sources and climate cycles and may follow grass and shrub establishment.

Table 7. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	10-50%
Grass/grasslike foliar cover	5-25%
Forb foliar cover	0-3%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	5-10%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	15-20%

Table 8. Canopy structure (% cover)

Height Above Ground (Ft)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.5	–	–	–	0-2%
>0.5 <= 1	–	–	0-5%	–
>1 <= 2	–	1-5%	5-10%	–
>2 <= 4.5	–	15-40%	5-30%	–
>4.5 <= 13	–	–	–	–
>13 <= 40	0-5%	–	–	–
>40 <= 80	10-40%	–	–	–
>80 <= 120	–	–	–	–
>120	–	–	–	–

Community 1.5

Mature Forest, Closed

Mature closed canopy stand. Uneven aged stand with dense understory stocking of Douglas-fir and incense cedar. Herbaceous cover low.

Pathway 1.4A
Community 1.1 to 1.4

High severity, stand replacing fire occurs

Pathway 1.4B
Community 1.1 to 1.5

Fire cycle(s) missed

Pathway 1.2A
Community 1.2 to 1.3

Mixed severity fire occurs

Pathway 1.2B
Community 1.2 to 1.4

High severity, stand replacing fire occurs

Pathway 1.3A
Community 1.3 to 1.1

Historical fire regime maintained for 100+ years

Pathway 1.3B
Community 1.3 to 1.4

High severity, stand replacing fire occurs

Pathway 1.1A
Community 1.4 to 1.2

Fire cycle(s) missed

Pathway 1.1B
Community 1.4 to 1.3

Historical disturbance regime maintained for 150+ years

Pathway 1.5A
Community 1.5 to 1.4

High severity, stand replacing fire occurs

State 2
Managed State

In this state the stand is used for timber harvesting. This may result in a number of manipulated community types and pathways depending on strategies surrounding harvest, weed control and replanting. Selective removal of large ponderosa may advance succession and favor maturation of more shade tolerant trees such as Douglas-fir and incense cedar as well as increases in shrub understory. Brush treatment and soil scarification may enhance natural

regeneration in shelter-wood systems. Prescribed burning may help to reduce shrub understories as well. Cheatgrass will likely increase following timber harvest on sites where it was previously present.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- incense cedar (*Calocedrus decurrens*), tree

Transition T1A
State 1 to 2

Clearcut, selective thinning of large trees.

Restoration pathway R2A
State 2 to 1

Ecological forestry practices may promote a return to Reference State. Stand replacing fire may return to a Reference State if soil compaction is not severe and seed source is available.

Context dependence. Soil compaction and surface disturbances due to large machine usage may hinder passive forest reestablishment.

Additional community tables

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Contributors

Andrew Neary - Original PES site concept

Approval

Kirt Walstad, 9/11/2023

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	02/09/2025
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

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

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
