USDA Natural Resources Conservation Service

Ecological site F006XB800OR
Frigid Xeric Foothills 20-30 PZ

Last updated: 9/11/2023
Accessed: 04/24/2024

General information

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

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 subdominant 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 deep pumice soils that favor lodgepole pine and discourage Douglas-fir. 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)
CPS213 – Ponderosa pine/Greenleaf Manzanita

Plant Associations of the Central Oregon Pumice Zone (Volland 1985)

CPS213 – Ponderosa pine/Bitterbrush-Manzanita/Needlegrass
CPS217 – Ponderosa pine/Bitterbrush-Manzanita/Idaho fescue

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

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

Ecological site concept

This site represents a commonly occurring moist ponderosa pine (Pinus ponderosa) site in the foothills of the Eastern Cascades of Oregon. An overstory composed of ponderosa pine and the presence of greenleaf manzanita (Arctostaphylos patula) and snowbrush (*Ceanothus velutinus*) largely characterize the visual aspect of the reference plant community.
Occupying the moist ponderosa pine elevation band, this site transitions into dry ponderosa, Douglas fir (Pseudotsuga menziesii) and Oregon white oak (Quercus garryana) communities at its lower elevations (depending on latitude) and moist Douglas fir, grand fir (Abies grandis) – white fir (Abies concolor) communities at its upper elevations and on north and east aspects where effective moisture is increased.
Bitterbrush (*Purshia tridentata*) may be a common member of the shrub community yet unlike sites where this is the dominant shrub, this site receives greater precipitation (20-30 in) which favors the competitive dominance or codominance of shrubs adapted to greater moisture.
Areas receiving higher precipitation or with soils containing a lower percentage of course fragments, Douglas fir may be common in the overstory, at times codominant with ponderosa pine. While this site may host several minor tree species in the understory such as grand fir, western larch (Larix occidentalis) and incense cedar (Calocedrus decurrens), unlike sites where these species may become dominant overtime, this site receives lower precipitation and has a more frequent fire rotation, preventing less fire resistant species from recruiting into the overstory.
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 and Douglas fir to attain an open, savanna-like appearance. Current conditions, however, have been altered by fire suppression and the site now commonly occurs with a closed canopy or dense understory infill.

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

F006XB801OR	**Frigid Xeric Foothills 30-40 PZ** Upslope, occupying higher elevations and slope positions with greater moisture
F006XY708OR	**Frigid Xeric Foothills 12-20 PZ** Downslope, occupying lower elevations with lower precipitation
F006XB802OR	**Mesic Xeric North Slopes 15-25 PZ** Occupying North slopes where precipitation zone overlaps between sites

Similar sites

F006XB801OR	**Frigid Xeric Foothills 30-40 PZ** Higher precipitation, shade tolerant conifers common in understory
F006XY708OR	**Frigid Xeric Foothills 12-20 PZ** Lower precipitation, PUTR dominant shrub
F006XY709OR	**Mesic Xeric Foothills 20-25 PZ** Lower precipitation, mesic soil temperature regime, CADE common
F006XY710OR	**Mesic Xeric Foothills 14-20 PZ** Lower precipitation, mesic soil temperature regime

F006XB802OR	**Mesic Xeric North Slopes 15-25 PZ** Occupying north slopes, PSME dominant

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa*
Shrub	(1) *Arctostaphylos patula* (2) *Ceanothus velutinus*
Herbaceous	Not specified

Physiographic features

This site is largely found occupying benches, mountain slopes and outwash plains at the foothills of the Eastern Cascades in Oregon. Elevations commonly range from 3,000 to 4,100 feet (900 to 1,250 meters) but may range from 2,500 to 4,600 feet (750 to 1,400 meters). Slopes are most often 0 to 40 percent but can be as steep as 70 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 > Mountain slope (3) Foothills > Outwash plain
Flooding frequency	None
Ponding frequency	None
Elevation	3,000–4,100 ft
Slope	0–40%
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	2,500–4,600 ft
Slope	0–70%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The average annual precipitation ranges from 20 to 30 inches (500 to 750 mm) which occurs mainly between the months of November and June, mostly in the form of snow. The average annual air temperature ranges from 40 to 46 degrees Fahrenheit (4.5 to 8 °C) and the frost-free period ranges from 50 to 100 days. The soil temperature regime is frigid, 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)	50-100 days
Freeze-free period (characteristic range)	

Precipitation total (characteristic range)	20-30 in
Frost-free period (average)	75 days
Freeze-free period (average)	
Precipitation total (average)	25 in

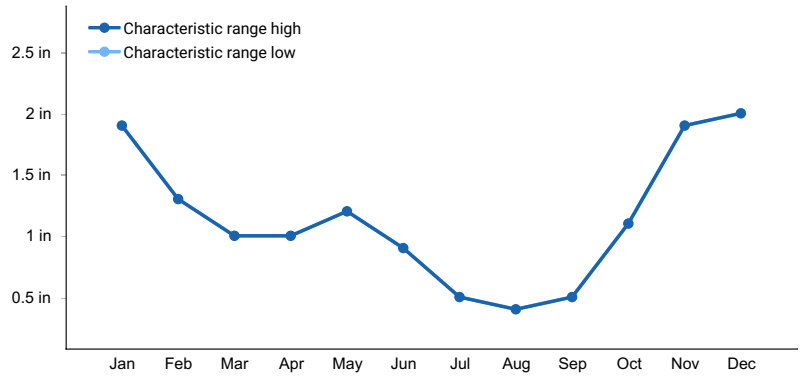


Figure 1. Monthly precipitation range

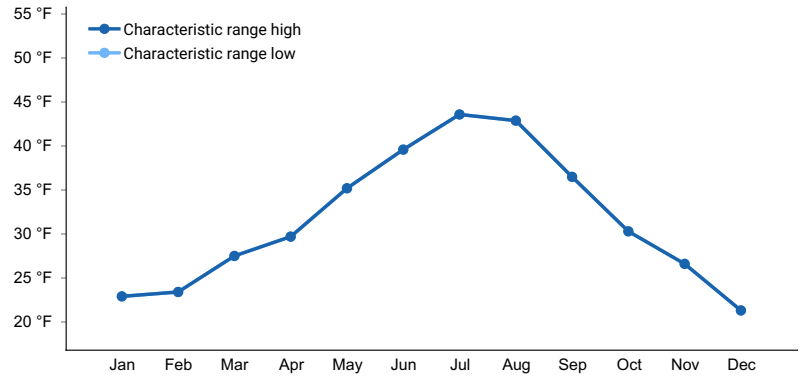


Figure 2. Monthly minimum temperature range

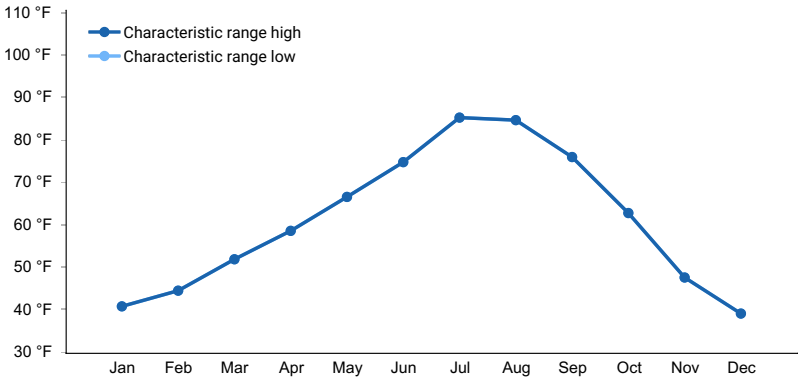


Figure 3. Monthly maximum temperature range

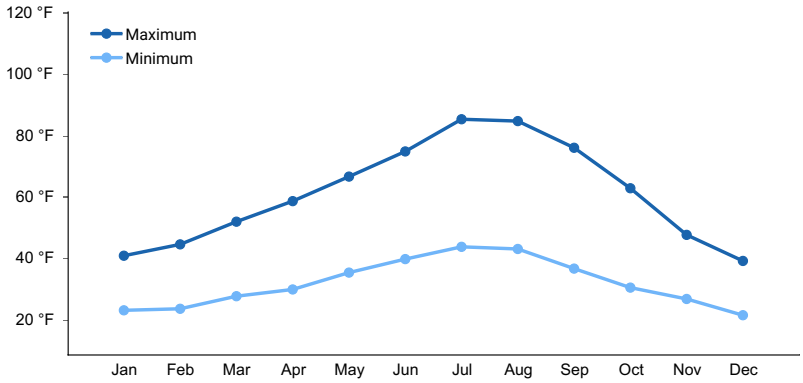


Figure 4. Monthly average minimum and maximum temperature

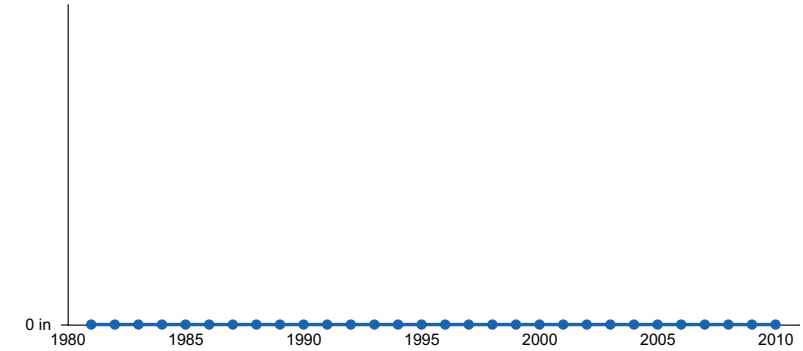


Figure 5. Annual precipitation pattern

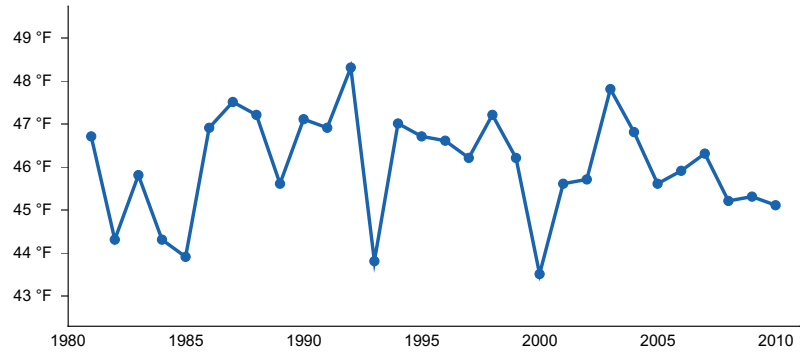


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SISTERS [USC00357857], Sisters, OR

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 lithic bedrock and glacial outwash. These are primarily well drained, volcanic soils with surface layers formed in ash over colluvium and residuum derived from basalt, andesite and tuff. Surface soil textures are commonly loamy sands and sandy loams but the site can be found on finer textured loams as well. These soils may be skeletal with substantial cobbles and stones throughout the profile.

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Colluvium–basalt (3) Colluvium–andesite (4) Colluvium–tuff (5) Residuum–volcanic rock
Surface texture	(1) Loamy sand (2) Sandy loam (3) Very cobbly loamy sand (4) Very stony sandy loam (5) Loam
Family particle size	(1) Ashy over loamy (2) Ashy-skeletal (3) Ashy over loamy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to rapid
Depth to restrictive layer	21–80 in
Soil depth	21–80 in
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-40in)	2.8–6.5 in
Soil reaction (1:1 water) (0-40in)	6.1–6.6
Subsurface fragment volume <=3" (4-60in)	5–20%
Subsurface fragment volume >3" (4-60in)	0–35%

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)	1.7–7.6 in
Soil reaction (1:1 water) (0-40in)	6.1–7.3
Subsurface fragment volume <=3" (4-60in)	0–40%
Subsurface fragment volume >3" (4-60in)	0–40%

Ecological dynamics

Reference Plant Community:

An overstory composed of ponderosa pine and the understory presence of greenleaf manzanita and snowbrush (*Ceanothus velutinus*) largely characterize the visual aspect of the Reference Plant Community. Minor tree species may include incense cedar, grand fir, and western larch, yet in most cases these do not recruit into the overstory due to frequent fire. Douglas fir become more prominent where this site is found north of Black Butte and may make up an important portion of the overstory in these forests, at times codominant with ponderosa pine. Bitterbrush (*Purshia tridentata*) is another shrub commonly found on this site. Herbaceous species usually do not make up a dominant proportion of vegetative cover, except for immediately following disturbance. Idaho fescue (*Festuca idahoensis*), Ross' sedge (*Carex rossii*), bottlebrush squirreltail (*Elymus elymoides*), western needlegrass (*Achnatherum occidentale*) and arrowleaf balsamroot (*Balsamorhiza sagittata*) are common herbaceous species.

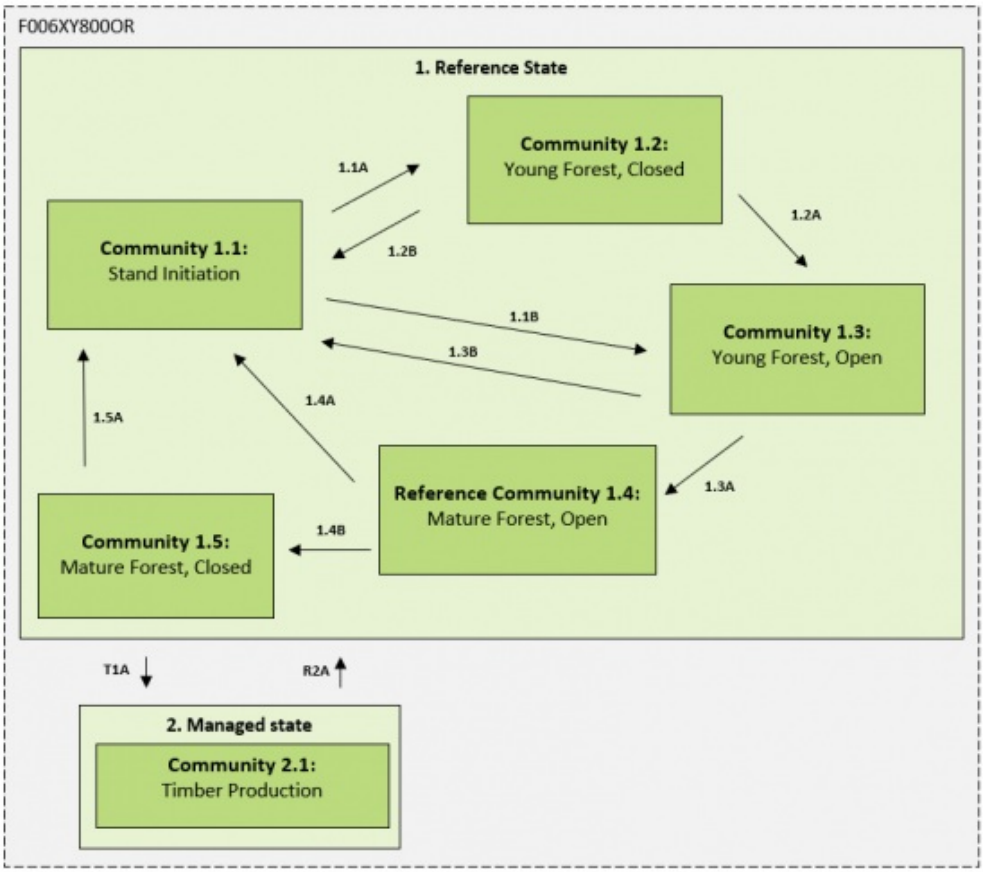
Disturbance:

Moist ponderosa pine forests were historically subject to frequent surface fires. 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). Douglas-fir is less fire resistant than ponderosa yet more shade resistant when young, but can becoming increasingly tolerant of fire with age. For this reason, as fire is suppressed, Douglas fir may become an increasingly important overstory species with time (Hessberg et al. 2005). Manzanita and snowbrush will increase following fire and often form shrub fields on favorable sites following stand replacing fires.
With longer time between fire, increased development of understory fuels, especially shade tolerant trees such as grand fir, 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 grand fir, incense cedar and Douglas fir overtime (Hessberg et al. 2005).

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. 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	Frequent, low severity fire regime sustained for extended duration
1.2A	Mixed severity fire occurs
1.2B	High severity, stand replacing fire occurs
1.3A	Frequent, low severity fire regime sustained for extended duration
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 composition. 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 community within this state is that of an open, mature, savanna like ponderosa 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.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- snowbrush ceanothus (*Ceanothus velutinus*), shrub
- greenleaf manzanita (*Arctostaphylos patula*), shrub

Community 1.1
Stand Initiation

Shrub community dominated by manzanita and snowbrush, Ponderosa pine seedlings and saplings regenerating. Frequent, severe fire that removes woody cover 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 that provide growing season moisture and may follow grass and shrub establishment.

Community 1.2
Young Forest, Closed

Closed canopy, densely stocked with young to intermediate aged ponderosa pine, grand fir, 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 Douglas fir in some areas and with understory regeneration. Shrub and bunchgrass cover increased.

Community 1.4
Reference Plant Community: Mature Forest, Open

This is the Reference Community. Mature, open canopy stand of mature ponderosa pine with Douglas fir in some areas. Shrub and bunchgrass cover is patchy in understory. Frequent, low severity fires maintain this community, lack of fire will increase understory infill and vulnerability to severe fire.

Community 1.5
Mature Forest, Closed

Mature closed canopy stand. Uneven aged stand with dense understory stocking ponderosa pine, grand fir, Douglas fir, and incense cedar. Herbaceous cover low.

Pathway 1.1A
Community 1.1 to 1.2

Fire cycle(s) missed

Pathway 1.1B
Community 1.1 to 1.3

Frequent, low and mixed severity fire regime sustained for extended duration

Pathway 1.2B
Community 1.2 to 1.1

High severity, stand replacing fire occurs

Pathway 1.2A
Community 1.2 to 1.3

Mixed severity fire occurs

Pathway 1.3B
Community 1.3 to 1.1

High severity, stand replacing fire occurs

Pathway 1.3A
Community 1.3 to 1.4

Frequent, low and mixed severity fire regime sustained for extended duration

Pathway 1.4A
Community 1.4 to 1.1

High severity, stand replacing fire occurs

Pathway 1.4B
Community 1.4 to 1.5

Fire cycle(s) missed

Pathway 1.5A
Community 1.5 to 1.1

High severity, stand replacing fire occurs

State 2
Managed State

This alternative state represents the many variations of timber harvesting that can occur in this site. This may result in a number of manipulated community types and pathways depending on strategies surrounding harvest, shrub control, weed control and replanting. Selective removal of large ponderosa pine may advance succession and favor maturation of shade tolerant trees such as grand fir, Douglas fir, and incense cedar.

Dominant plant species

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

Transition T1B
State 1 to 2

Extensive timber harvest followed by continual management for timber production that has significantly altered species compositions and resulting disturbance responses.

Restoration pathway R2A
State 2 to 1

Ecological forestry practices may promote a return to reference state. Stand replacing fire may lead to a transition to community 1.1 of the reference state if soil compaction is not severe, species composition has not been significantly altered and tree seed source is available.

Context dependence. Alterations of forest tree species composition, as well as soil compaction and surface disturbances due to large machine usage may hinder passive forest reestablishment.

Additional community tables

Inventory data references

Information presented here has been derived from NRCS data. Field observations from range trained personnel were also used. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, and USDA NRCS Soil Surveys from various counties.

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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	04/24/2024
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:

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

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

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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:**
