Ecological site F006XY710OR
Mesic Xeric Foothills 14-20 PZ

Last updated: 9/11/2023
Accessed: 10/12/2024

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 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)
CPS211 – Ponderosa Pine/Bitterbrush/Fescue

Plant Associations of the Commercial Forest of the Warm Springs Indian Reservation (Marsh 1987)
PIPO/PUTR - Ponderosa Pine/Bitterbrush

PIPO/GETR-WYAM – Ponderosa pine/Praire smoke avens – Mule's ears

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 composed of ponderosa pine (Pinus ponderosa) with occasional incense cedar (Calocedrus decurrens), Douglas-fir (Pseudotsuga menziesii) and western juniper (Juniperus occidentalis) and a shrub understory of bitterbrush (Purshia tridentata) largely characterize the visual aspect of the historical reference plant community. Occupying a dry, warm ponderosa pine elevation band, this site transitions into western juniper woodland, sagebrush steppe, and Oregon white oak (Quercus garryana) communities at its lower elevations and ponderosa-manzanita and Douglas-fir communities at its upper elevations. Abiotically, this site is distinguished from other forest sites by a warmer and drier climate which limits available growing season moisture. In comparison to adjacent warm, moist ponderosa forest types with a greenleaf manzanita (Arctostaphylos patula) dominated understory, this site receives less precipitation (15 to 20 in). In comparison to other sites with ponderosa overstories and bitterbrush dominated shrub layers, this site is warmer with a mesic, rather than frigid or cryic, soil temperature regime. This site will only host scattered Douglas-fir and incense cedar, unlike other sites where they will become more dominant, due to the lower available precipitation for these less drought-adapted tree species. At its lower elevations, this site borders shrublands, juniper woodlands and ponderosa pine - oak woodlands. 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 stands 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

R006XB208OR	**Shallow Slopes 14-20 PZ** Adjacent south aspects with shallow soils, non-forested plant community
F006XB802OR	**Mesic Xeric North Slopes 15-25 PZ** Occupying north aspects and cooler slope positions where the sites co-occur, QUGA absent
F006XY709OR	**Mesic Xeric Foothills 20-25 PZ** Adjacent upslope positions, ARPA more common

Similar sites

F006XB800OR	**Frigid Xeric Foothills 20-30 PZ** Higher precipitation, Frigid soil temperature regime
F006XY709OR	**Mesic Xeric Foothills 20-25 PZ** Higher precipitation, higher elevations
F006XB802OR	**Mesic Xeric North Slopes 15-25 PZ** Steeper slopes, occupying north aspects, cooler landscape positions and somewhat lower elevations

Table 1. Dominant plant species

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

Physiographic features

This site is largely found occupying benches and side slopes of the foothills and canyons 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 are commonly 2,200 to 3,300 feet (675 to 1,000 m) but can range from 1,800 to 3,500 feet (550 to 1050 m). Slopes are most often nearly level to 12 percent but can be as steep as 65 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	2,200–3,300 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	1,800–3,400 ft
Slope	0–65%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The average annual precipitation ranges from 15 to 20 inches (375 to 500 mm) which occurs mainly between the months of November and June, mostly in the form of rain and snow. The average annual air temperature is 45 to 48 degrees Fahrenheit (7 to 9 °C) and the frost-free period ranges from 90 to120 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)	90-120 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	15-20 in
Frost-free period (average)	105 days
Freeze-free period (average)	
Precipitation total (average)	17 in

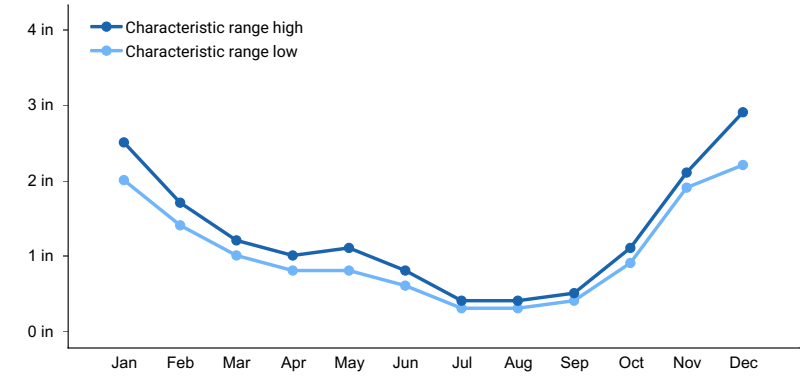


Figure 1. Monthly precipitation range

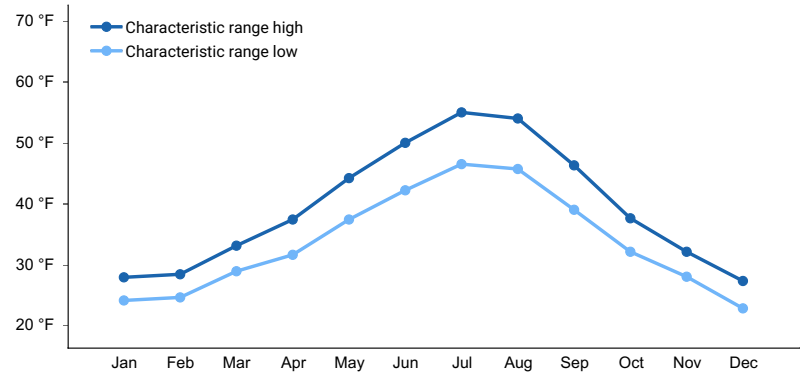


Figure 2. Monthly minimum temperature range

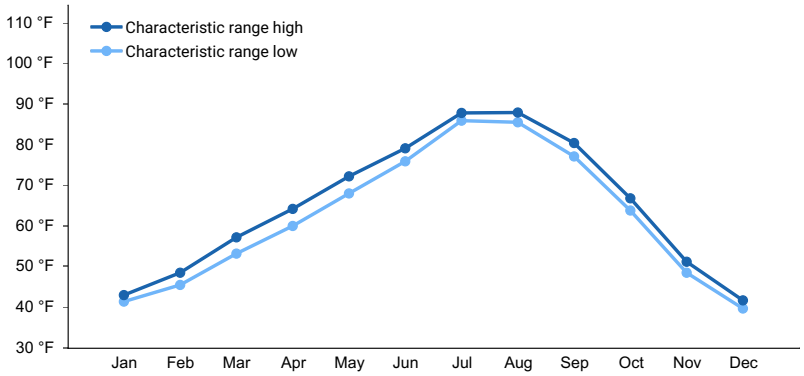


Figure 3. Monthly maximum temperature range

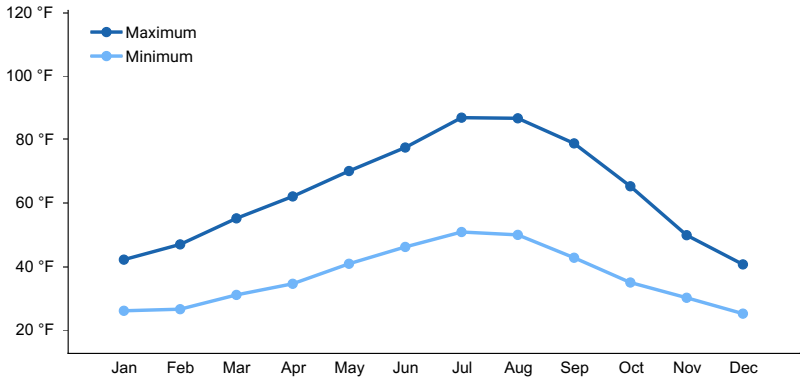


Figure 4. Monthly average minimum and maximum temperature

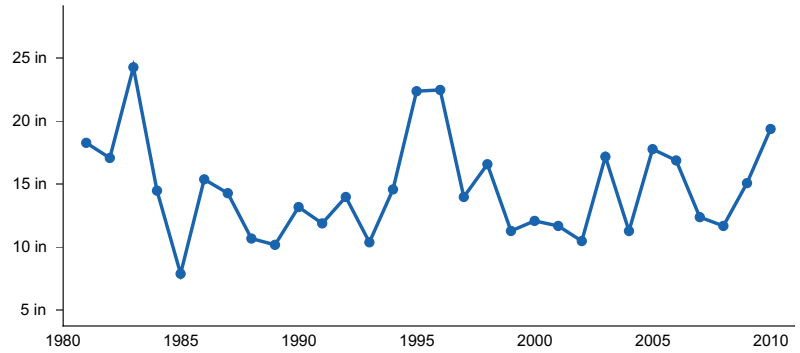


Figure 5. Annual precipitation pattern

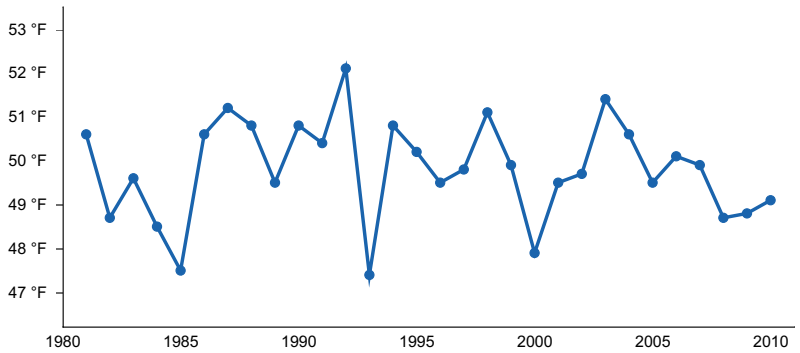


Figure 6. Annual average temperature pattern

Climate stations used

- (1) SISTERS [USC00357857], Sisters, OR
- (2) THE DALLES [USC00358407], The Dalles, 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. They are primarily well drained, volcanic soils with surface layers influenced by volcanic ash over colluvium and residuum derived from basalt, andesite and sedimentary rock. This site may also occur on soils derived from glacial outwash and pumice residuum. Surface soil textures are commonly loams. These soils often contain substantial gravels, cobbles and stones in the upper surface horizon. Volcanic ash will increase water holding capacity and productivity of these soils while rock fragments will decrease water holding capacity. Some soils are moderately well drained rather than well drained. Taxonomic classification of these soils is predominately Vitrandic Argixerolls (Grassland soils with influences of volcanic materials). See Booten for a representative soil 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) Gravelly loam (3) Cobbly loam (4) Stony loam
Family particle size	(1) Fine-loamy (2) Loamy-skeletal
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)	3.3–6.8 in
Soil reaction (1:1 water) (0-40in)	6.1–7.3
Subsurface fragment volume <=3" (4-60in)	5–30%
Subsurface fragment volume >3" (4-60in)	0–25%

Table 6. Representative soil features (actual values)

Drainage class	Moderately well drained to well drained
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)	1.9–7.6 in
Soil reaction (1:1 water) (0-40in)	5.6–7.3
Subsurface fragment volume <=3" (4-60in)	5–50%
Subsurface fragment volume >3" (4-60in)	0–50%

Ecological dynamics

Reference Plant community:

The reference native plant community under the natural disturbance regime, is characterized by an open stand of mature ponderosa pine with an understory cover strongly dominated by bitterbrush. Incense cedar and Douglas-fir are present on some sites but rarely codominant. Western juniper may be found on some sites, especially toward the drier margins of this site. Wax currant (*Ribes cereum*) and green rabbitbrush (*Chrysothamnus viscidiflorus*) may also be present in the shrub layer. Herbaceous species may include Idaho fescue (*Festuca idahoensis*), Ross' sedge (*Carex rossii*), squirrel tail (*Elymus elymoides*), prairie junegrass (*Koeleria macrantha*), western needlegrass (Achnatherum occidentalis), Sandberg bluegrass (*Poa secunda*), arrowleaf balsamroot (*Balsamorhiza sagittata*) and tailcup lupine (*Lupinus caudatus*). Mule-ears (*Wyethia amplexicaulis*) may be common where soils are not as well drained.

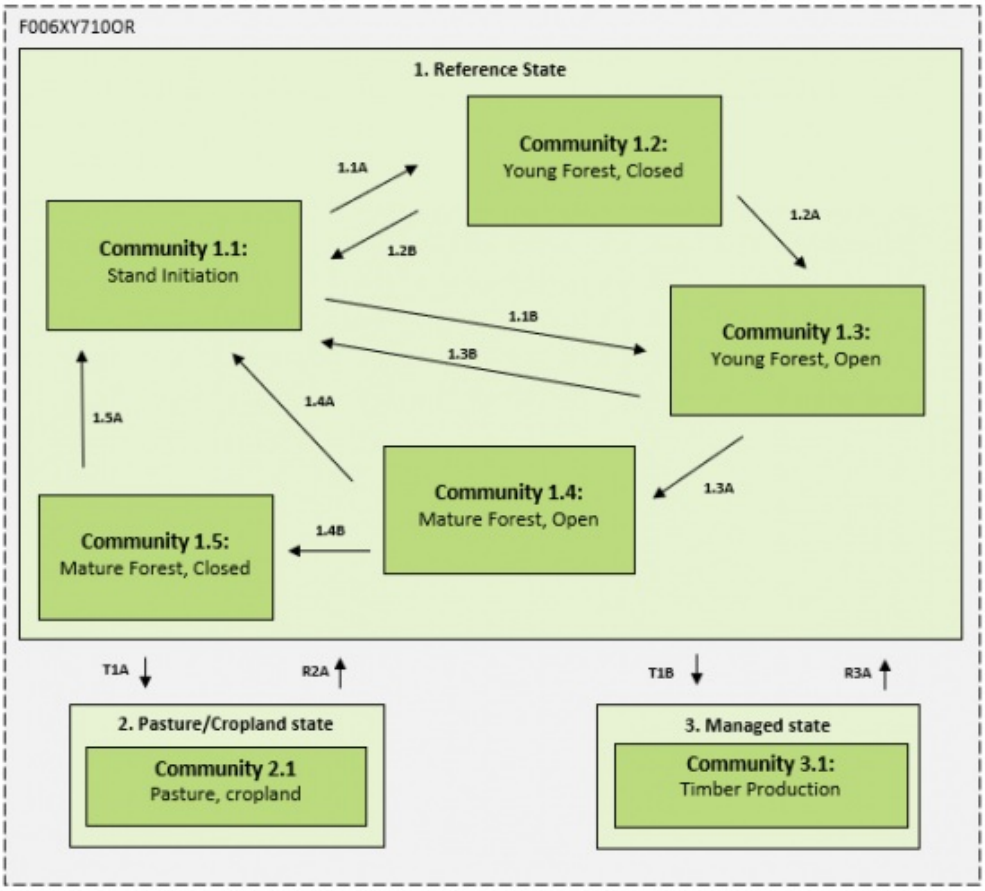
Disturbance:

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). While bitterbrush may re-sprout following fire, repeated fires may reduce its cover over time (Busse and Riegel 2009). With longer time between fire, increased development of understory fuels such as bitterbrush, incense cedar and juniper, 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 pine 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. Bark beetles are especially destructive in ponderosa forests and drought conditions may render stands more vulnerable to these outbreaks. Ponderosa pine recovery following stand replacing fire will be dependent on seed sources on site or in nearby forests as well as favorable growing season moisture and temperature conditions.

Historically, low elevation ponderosa forests were harvested extensively for timber products (Ritchie et al. 2005). Sites with higher productivity may be used for commercial timber harvesting which will have varying effects on stand structure and composition depending on harvest type. Livestock grazing is also a common land use of this site due to the favorability of open forest conditions (Marsh et al. 1987). Herbaceous composition available for grazing will be highest in open stand conditions and will decrease with prolonged fire suppression. This site is also important as elk and deer wintering range. Grazing pressure will alter herbaceous cover and composition. Idaho fescue will likely decrease while squirreltail, cheatgrass (*Bromus tectorum*), annual fescue (*Vulpia myuros*), 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 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 0710531: Rocky Mountain Ponderosa Pine Woodland and Savanna (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	Site conversion to agricultural lands
R2A	Soil preparation, extensive plantings with seedling ponderosa
T1B	Extensive timber harvest
R3A	Forest restoration, stand replacing fire

State 1
Historical Reference State

This forested 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-bunchgrass 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 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, reduce understory cover, 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
- Idaho fescue (*Festuca idahoensis*), grass

Community 1.1
Stand Initiation

Shrub and grass community dominated by bitterbrush and grasses and forbs, tree 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. This stage will include incense cedar in areas with more moisture and western juniper toward the drier margins. Shrub and bunchgrasses 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 and incense cedar. Understory regeneration occurring.

Community 1.4
Reference Community: Mature Forest, Open

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

Community 1.5
Mature Forest, Closed

Mature closed canopy stand. Uneven aged stand with dense understory stocking. 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

Historical disturbance regime maintained for 150+ years

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

Historical fire regime maintained for 100+ years

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
Agricultural state

Represents all conditions where the site may be converted for pasture or cropland purposes.

Dominant plant species

- orchardgrass (*Dactylis glomerata*), grass

State 3
Managed State

In this state the stand is used primarily for timber harvesting. This may result in a number of manipulated community types and pathways depending on strategies surrounding harvest, weed control and replanting. Shelter-wood production systems may be favored due to the detrimental effects of drought and heat on ponderosa pine regeneration. Selective harvest of ponderosa pine will favor dominance of more shade tolerant species overtime. Broadcast burning of bitterbrush may help increase ponderosa pine reestablishment. Cheatgrass and other exotic pioneer species will likely increase following timber harvest on sites where they were previously present.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree

Transition T1A
State 1 to 2

Site conversion to agricultural lands

Transition T1B
State 1 to 3

Extensive timber harvest followed by management prioritizing timber production.

Restoration pathway R2A
State 2 to 1

Intensive restoration practices involving extensive rest from pasture or cropping, soil preparation, planting, seeding and protection from drought may be required to restore forest conditions.

Restoration pathway R3A
State 3 to 1

Ecological forestry practices may promote a return to reference state. Stand replacing fire may return to community 1.1 of the 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

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	10/12/2024
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):**

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

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

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

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

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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:**