USDA Natural Resources
Conservation Service

Ecological site R006XA217OR
Very Shallow Pumice Terrace 8-11 PZ

Last updated: 3/31/2025
Accessed: 04/23/2025

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 a landscape of basalt terraces, abandoned lakebeds and dunes where exceedingly dry ponderosa pine – western juniper forests occur. These forests are largely geographically confined to the Lost Forest Research Natural Area, and despite receiving less than 11 inches of annual precipitation, persist among a desert shrubland due to unique soil characteristics. Here, deep eolian deposits of ash and pumice increase water holding capacity relative to nearby soils. Geologically, these deposits are underlain by Pliocene basalt from the High Cascades volcanic province. Botanically, these forests share characteristics with other dry pine forests as well as the nearby shrub steppe. Common members include, antelope bitterbrush, big sagebrush, needle and thread, Indian ricegrass, creeping wildrye and granite prickly gilia. The climate of this unit is cool and very dry with a soil climate defined by a frigid temperature regime and an aridic moisture regime. The historical fire regime of this site is likely similar to other very dry ponderosa pine communities, with moderately frequent, low severity fire common.

Ecological site concept

This site represents a western juniper (Juniperus occidentalis) – low sagebrush (Artemesia arbuscula) woodland occurring upon shallow terraces and lake beds within the Lost Forest Research Natural Area at the northwestern edge of the Great Basin. Ponderosa pine (Pinus ponderosa) may be found scattered throughout this site. Dislocated from other dry western juniper and ponderosa pine sites at the Eastern foothills of the Cascades, the Lost Forest stands is in stark contrast to the surrounding sagebrush steppe landscape. Here deep eolian deposits of volcanic ash and pumice have created the conditions for ponderosa pine persistence despite receiving

precipitation generally lower than is required for the species (Moir and Franklin 1974). The influence of ash in these soils increases water holding capacity and bolsters site resilience during drought, facilitating the survival of ponderosa pine. In contrast to other sites occupying terrace landforms on the Lost Forest, this site has shallower soils which favor western juniper and low sagebrush and support very little ponderosa pine.

This is a provisional ecological site and is subject to extensive review and revision before final approval. All data herein should be considered provisional and contingent upon field validation prior to use in conservation planning.

Associated sites

R006XA212OR	**Forested Sandy Loam 8-11 PZ** Adjacent forested areas not on dune landforms
R006XA213OR	**Pumice Terrace 8-10 PZ** adjacent forested terraces with deeper soils
R006XA214OR	**Forested Pumice Dunes 8-11 PZ** forested dune landforms
R006XA216OR	**Forested Shrubby Dunes 8-11 PZ** higher elevation dunes with greater bitterbrush cover

Similar sites

R006XA213OR	**Pumice Terrace 8-10 PZ** Deeper soils, greater cover of ponderosa pine
R006XA212OR	**Forested Sandy Loam 8-11 PZ** Deeper soils (deep and very deep vs shallow and very shallow)

Table 1. Dominant plant species

Tree	(1) *Juniperus occidentalis*
Shrub	(1) *Artemisia arbuscula*
Herbaceous	(1) *Achnatherum thurberianum* (2) *Pseudoroegneria spicata*

Physiographic features

These sites are on old lake terraces in Pleistocene lacustrine basins. Slopes are commonly 2 to 5 percent and elevations range from 4,400 to 4,600 feet (1,350 to 1,400 meters). This site occurs on all aspects. This site is not subject to ponding or flooding and no water table is present within the upper 100 inches of soil.

Table 2. Representative physiographic features

Landforms	(1) Basin > Lake terrace
Flooding frequency	None
Ponding frequency	None
Elevation	1,341–1,402 m
Slope	2–5%
Ponding depth	0 cm
Water table depth	254 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site is characterized by hot dry summers and cold wet winters. Precipitation, largely in the form of rain and

snow, ranges from 8 to 11 inches, averaging 10 inches annually. Frost-free days range from 85 to 95 and the freeze-free period ranges from 120 to 135 days. The soil temperature regime is frigid and the soil moisture regime is aridic. The graphs below are populated from the closest available weather station to representative site locations and are provided to indicate general climate patterns.

Table 3. Representative climatic features

Frost-free period (characteristic range)	85-95 days
Freeze-free period (characteristic range)	120-135 days
Precipitation total (characteristic range)	203-279 mm
Frost-free period (average)	90 days
Freeze-free period (average)	125 days
Precipitation total (average)	254 mm

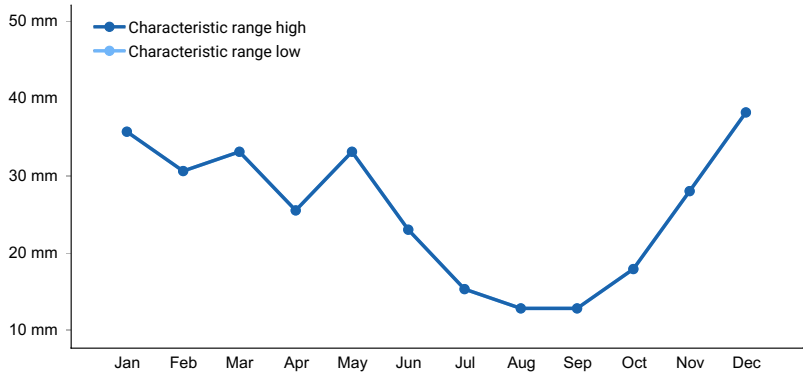


Figure 1. Monthly precipitation range

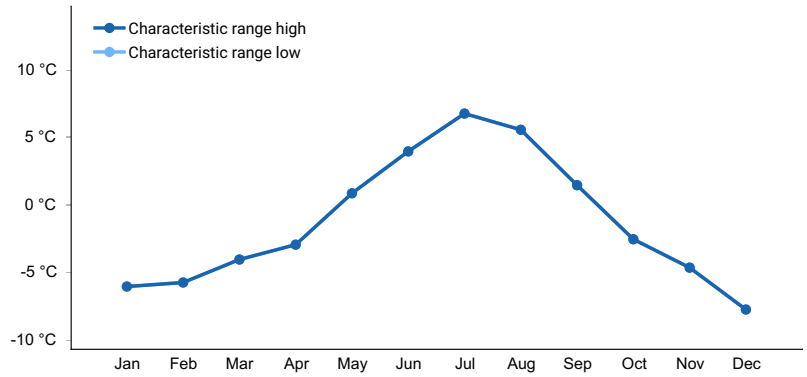


Figure 2. Monthly minimum temperature range

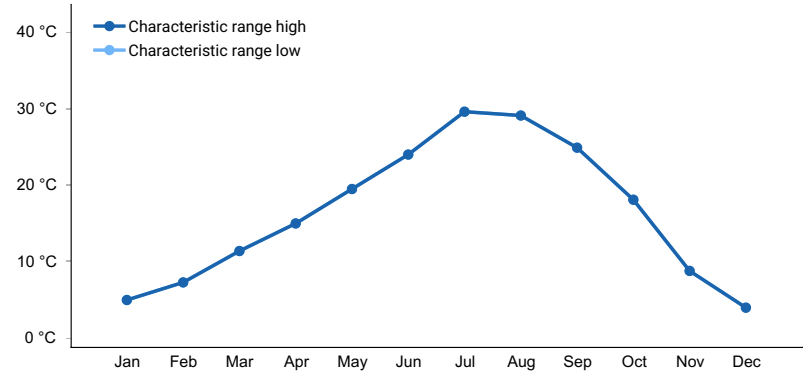


Figure 3. Monthly maximum temperature range

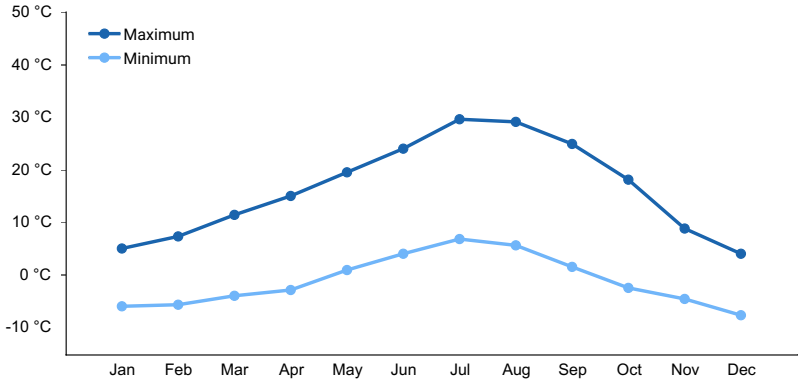


Figure 4. Monthly average minimum and maximum temperature

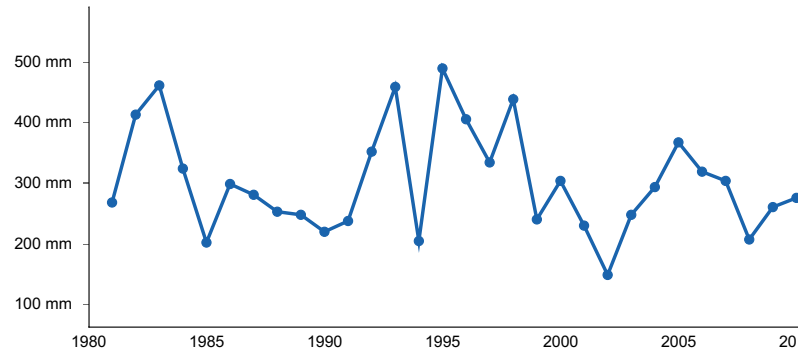


Figure 5. Annual precipitation pattern

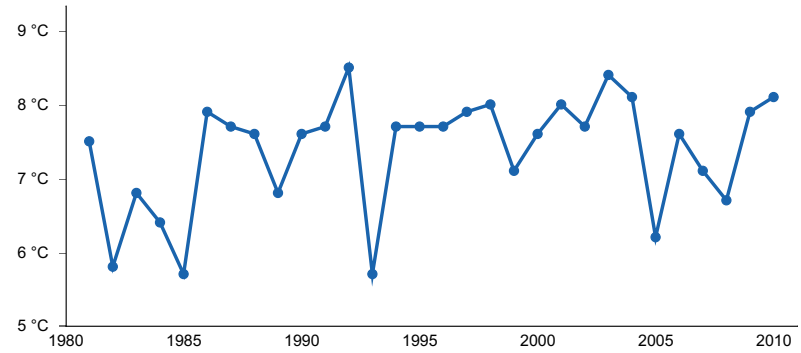


Figure 6. Annual average temperature pattern

Climate stations used

- (1) THE POPLARS [USC00358420], Silver Lake, OR

Influencing water features

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

Wetland description

N/A

Soil features

Soils that typify this site concept are shallow and very shallow ashy loamy sands and ashy loamy fine sands over ashy loamy sands and ashy sandy clay loams. These soils were formed in eolian deposits of pumice and volcanic ash and slope alluvium from volcanic rock. Soils typically have a weakly developed argillic horizon. These soils are moderately well-drained and have moderately rapid over moderately slow permeability.

A representative soil component associated with this site:

Sandrock Ashy, frigid Lithic Xeric Haplargid, 0 – 5% slopes

Table 4. Representative soil features

Parent material	(1) Eolian deposits–pumice (2) Volcanic ash (3) Slope alluvium–volcanic rock
Surface texture	(1) Ashy loamy sand (2) Ashy loamy fine sand
Family particle size	(1) Ashy
Drainage class	Moderately well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	23–25 cm
Soil depth	23–25 cm
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-25.4cm)	4.32–6.1 cm
Soil reaction (1:1 water) (0-25.4cm)	6.6–7.8
Subsurface fragment volume <=3" (10.2-25.4cm)	10–20%
Subsurface fragment volume >3" (10.2-25.4cm)	5–25%

Table 5. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	23–51 cm
Soil depth	23–51 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-25.4cm)	Not specified
Soil reaction (1:1 water) (0-25.4cm)	Not specified
Subsurface fragment volume <=3" (10.2-25.4cm)	Not specified
Subsurface fragment volume >3" (10.2-25.4cm)	Not specified

Ecological dynamics

Reference Plant community:

The Reference Plant Community of this site is dominated by low sagebrush, western juniper, Thurber's needlegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (Pseudoregenaria spicata) and Sandberg bluegrass (*Poa secunda*). The occasional ponderosa pine may be present. Shallow soils limit production compared to similar sites.

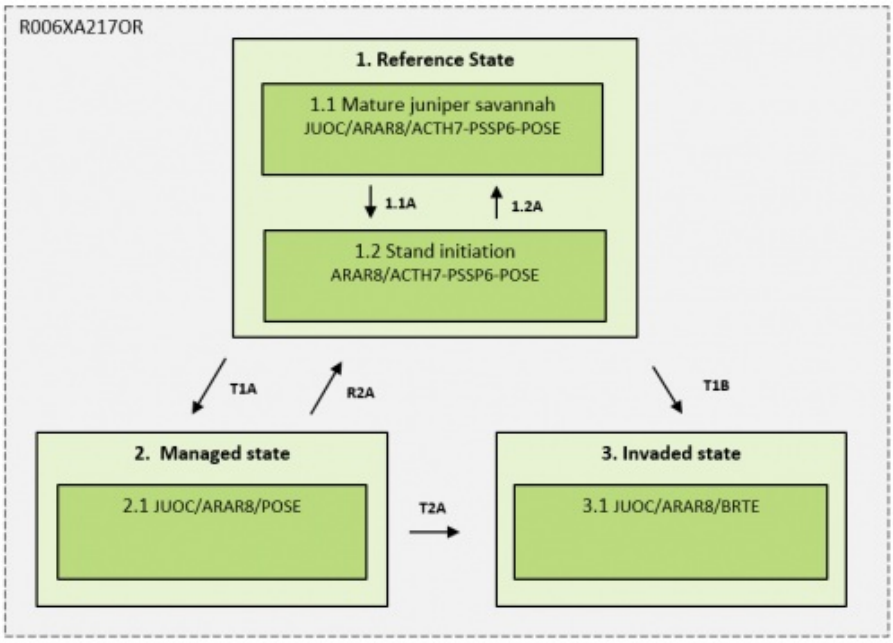
A comprehensive forest health study of the Lost Forest was undertaken by the USFS in 2007. Researchers recorded an abundance of western juniper greater than 150 years old, with considerable numbers of younger trees that were less than 150 years old (40 and 60 percent of all trees recorded, respectively) (Chadwick and Eglitis 2007). This suggests that this is a persistent juniper site, yet infill of younger trees may be greater than it was historically, possibly due to grazing practices and harvest of mature pine.

Disturbance:

A complex host of mortality agents and disturbance factors have been recorded for sites in the Lost Forest. Factors that have contributed to the mortality of juniper and pine in the past include the drought of the 1920s and 1930s, movement of dune landforms into forest stands, annosus root disease and windthrow (Chadwick and Eglitis 2007). Other disturbances include livestock grazing which may have produced vegetation changes prior to its exclusion in 1968 and ongoing off road recreational activity (Moir et al. 1973). Grazing disturbance may alter the composition of the herbaceous layer and favor an increase in Sandberg bluegrass at the expense of bluebunch wheatgrass and Thurber's needlegrass. Despite a high frequency of lightning strikes, research suggests that fire was likely not a common disturbance agent in this forest due to low fuel loads and continuity (Chadwick and Eglitis 2007). According to the best available knowledge of similar systems, the fire regime is likely comparable to other very dry ponderosa pine sites and influenced by the surrounding Wyoming big sage (Artemesia tridentata ssp. wyomingensis) plant communities (Landfire fire regime group 3: 35 to 100 plus year frequency, mixed severity) (Landfire 2007). This fire regime of this site is approximated by the landfire biophysical setting model 0710532 - Northern Rocky Mountain Ponderosa Pine Woodland and Savanna – Xeric. The resilience and resistance of this site to widespread invasions of exotic annual grasses is not known, however plant data collected to describe the reference state indicates a minimal cover of weed species present, indicating that this site may have the potential for widespread weed infestation.

Given that this site occupies a limited geographic area, little is known about the plant community dynamics over time, therefore the model below represents a generalized and simplified understanding of community response to disturbance. 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, these impacts may include the possibility of regeneration failure following wildfire disturbance (Halofsky et al. 2020). As our understanding of these systems evolves and this site is updated in future iterations, descriptions will include more thorough treatments of disturbance and ecological change.

State and transition model

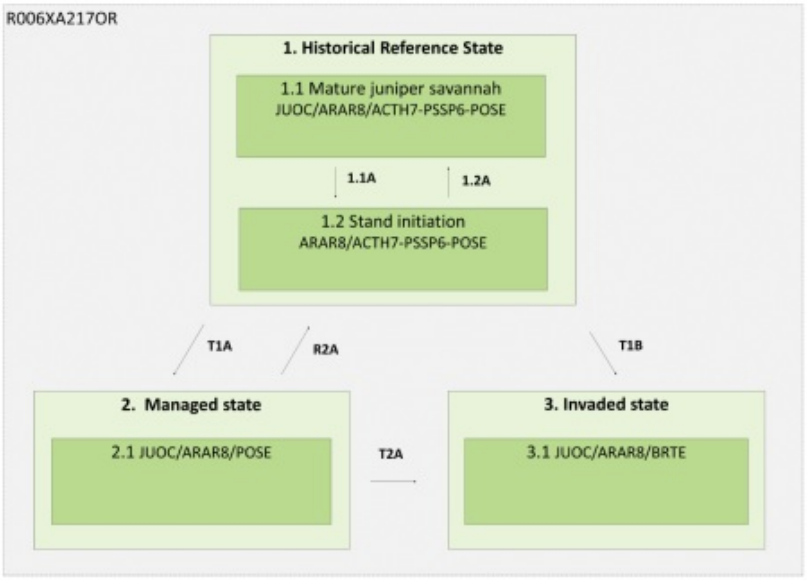


Community Pathways

1.1A	High severity fire, severe windthrow, extreme drought or disease
1.1B	Time without severe fire

Transitions / Restoration Pathways

T1A	Prolonged improper grazing management
T1B	Catastrophic fire, prolonged improper grazing management
T2A	Continued improper grazing management, catastrophic fire
R2A	Extended rest from grazing, possible reseeding of native grasses



Community Pathways

1.1A	High severity fire, severe windthrow, extreme drought or disease
1.2A	Time without severe fire

Transitions / Restoration Pathways

T1A	Prolonged improper grazing management
T1B	Catastrophic fire, prolonged improper grazing management
T2A	Continued improper grazing management, catastrophic fire
R2A	Extended rest from grazing, possible reseeding of native grasses

State 1
Historic Reference

This is the Reference Plant Community given an unaltered disturbance regime.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- little sagebrush (*Artemisia arbuscula*), shrub
- Thurber's needlegrass (*Achnatherum thurberianum*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Sandberg bluegrass (*Poa secunda*), grass

Community 1.1
Mature juniper savannah: JUOC/ARAR8/ACTH7 - PSSPS - POSE

The Reference Plant Community is dominated by low sagebrush, western juniper, Thurber’s needlegrass, bluebunch wheatgrass and Sandberg’s bluegrass. Mature juniper will characterize the overstory with younger regeneration common in the understory. Exotic annuals may be present in low numbers. Some ponderosa pine may also be present. Severe fire is relatively infrequent, in this state, and the community will be maintained by periodic mortality of young juniper caused by fire, drought, insects and disease (Chadwick and Eglitis 2007). 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.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	118	179	291
Shrub/Vine	62	95	157
Tree	22	34	67
Forb	22	28	45
Total	**224**	**336**	**560**

Community 1.2
Stand initation: ARAR8/ACTH7 - PSSPS - POSE

Following severe fire, extreme drought, widespread disease outbreak or a severe incidence of windthrow, the overstory canopy may be lost. The community will be become dominated by perennial grasses with low sagebrush returning overtime and young juniper beginning to initiate.

Pathway 1.1A
Community 1.1 to 1.2

High severity fire, severe windthrow, extreme drought or disease

Pathway 1.1B
Community 1.2 to 1.1

Time without severe fire

State 2
Grazing Managed

In this state, the site is being managed for livestock grazing. This may lead to altered plant community composition and production where plants adapted to grazing disturbance may increase while those sensitive to disturbance may decrease. Additionally, impacts to the abiotic conditions of the site may occur as soil is compacted due to hoof trampling or eroded due to an increase in bare ground.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- little sagebrush (*Artemisia arbuscula*), shrub
- Sandberg bluegrass (*Poa secunda*), grass

Community 2.1
JUOC/ARAR8/POSE

Following prolonged improper grazing, native increaser species such as Sandberg bluegrass may increase at the expense of the Reference Community dominant species, Thurber’s needlegrass and bluebunch wheatgrass. Low sage may also increase (Steinberg 2002).

State 3
Invaded

In this state much of the native herbaceous vegetation has been replaced by exotic annual grasses which at high levels may create positive feedbacks that alter fire regimes and promote prolonged invasion.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- little sagebrush (*Artemisia arbuscula*), shrub

- cheatgrass (*Bromus tectorum*), grass

Community 3.1
Invaded state: JUOC/ARAR8/BRTE

Following continued improper grazing, or catastrophic fire, where invasive annual grasses are already present on site, these grasses may increase while perennial grasses decline. Juniper and ponderosa pine will temporarily decline with catastrophic fire, yet will return over time. An abundance of annual grass will increase fine fuels and may increase fire frequency, creating a positive feedback that will encourage the maintenance of the site in this state.

Transition T1A
State 1 to 2

Prolonged improper grazing management

Transition T1B
State 1 to 3

Catastrophic fire, prolonged inappropriate grazing management

Context dependence. Invasive species must be present onsite or within a sufficiently close distance for dispersal from nearby invaded sites

Restoration pathway R2A
State 2 to 1

Extended rest from grazing, possible reseeding of native grasses

Context dependence. Excessive grazing leading to a loss of plant species diversity or reproductive output; altered abiotic conditions such as significantly compacted or eroded soil, for example, will not recover by rest alone and will require additional inputs

Transition T2A
State 2 to 3

Continued improper grazing management, catastrophic fire

Context dependence. Invasive species must be present onsite or within a sufficiently close distance for dispersal from nearby invaded sites

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass and grasslike plants**			84–207	
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	34–84	–
	bluebunch wheatgrass	PSSPS	*Pseudoroegneria spicata ssp. spicata*	17–34	–
	Sandberg bluegrass	POSE	*Poa secunda*	17–34	–
	squirreltail	elel5	*Elymus elymoides*	6–17	–
	Indian ricegrass	achy	*Achnatherum hymenoides*	6–17	–
	Idaho fescue	FEID	*Festuca idahoensis*	0–11	–
	prairie Junegrass	Koma	*Koeleria macrantha*	3–11	–
2	**Other perennial grasses**			3–17	
Forb					
3	**Forb**			11–22	
	pussytoes	anten	*Antennaria*	3–6	–
	phlox	phlox	*Phlox*	3–6	–
	fleabane	erige2	*Erigeron*	3–6	–
4	**Other perennial forbs**			3–17	
	bitter root	lere7	*Lewisia rediviva*	–	–
Shrub/Vine					
5	**Shrubs**			50–90	
	little sagebrush	arar8	*Artemisia arbuscula*	50–84	–
	mountain big sagebrush	artrv	*Artemisia tridentata ssp. vaseyana*	0–6	–
6	**Other perennial shubs**			6–17	
Tree					
7	**Trees**			17–50	
	western juniper	juoc	*Juniperus occidentalis*	17–34	–
	ponderosa pine	pipo	*Pinus ponderosa*	0–17	–

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.

References

. Fire Effects Information System. http://www.fs.fed.us/database/feis/.

. 2021 (Date accessed). USDA PLANTS Database. http://plants.usda.gov.

. 2021 (Date accessed). USNVC [United States National Vegetation Classification]. 2019. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC.. USNVC: http://usnvc.org/.

Other references

Chadwick, Kristen L. and Andris Eglitis. 2007. Health Assessment of the Lost Forest Research Natural Area, Central Oregon Service Center for Insects and Diseases, United States Forest Service, United States Department of Agriculture, Bend, Oregon.

Halofsky, J.E., Peterson, D.L. & Harvey, B.J. Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. fire ecol 16, 4 (2020). https://doi.org/10.1186/s42408-019-0062-8

LANDFIRE, 2007, Biophysical Settings Model Descriptions, LANDFIRE 1.1.0, U.S. Department of the Interior, USDA Forest service, Accessed 20 April 2020 at https://www.landfire.gov/bps-models.php

Moir, William H., Jerry F. Franklin, and Chris Maser. 1973. Lost Forest Research Natural Area, Pacific Northwest Forest and Range Experiment Station, United States Forest Service, Department of Agriculture, Portland, Oregon.

Steinberg, Peter D. 2002. Artemisia arbuscula. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.fed.us/database/feis/plants/shrub/artarb/all.html [2020, June 18].

Zouhar, Kris. 2003. Bromus tectorum. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.fed.us /database/feis/plants/graminoid/brotec/all.html [2020, June 25].

Contributors

JPR
Andrew Neary - 2020/2021 PES update of draft site

Approval

Kirt Walstad, 3/31/2025

Acknowledgments

Development of this site as a range site was based on field data collection completed in 1998 by the Burns ESI team. It was revised and updated with information regarding ecological dynamics in 2020.

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	03/31/2025
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):**

---

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

---

17. **Perennial plant reproductive capability:**
