USDA Natural Resources Conservation Service

Ecological site R006XA304OR
Loamy 20-40 PZ

Last updated: 9/11/2023
Accessed: 05/19/2024

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

Located at the eastern edge of the Columbia river gorge, this unit is restricted to areas influenced by the modified maritime climate of this unique passageway through the Cascades. This setting allows for the persistence of Oregon White Oak woodlands east of the Cascade crest. These woodlands often include ponderosa pine, and on sites with greater soil moisture, Douglas-fir. Botanical diversity is high, with a mixture of West Cascade and East Cascade plant species commonly co-occurring. Physiographically, this unit is characterized by dissected foothills, valleys and ridges draining Mount Hood in Oregon and Mount Adams in Washington. Geologically, the unit is characterized by late tertiary pyroclastic and volcanoclastic deposits and basalt flows. The climate of this unit is generally warm and dry with a predominately xeric soil moisture regime and mesic soil temperature regime. Historically, the drier extent of these forests have been influenced by a fire regime whereby frequent low and mixed severity fires would have favored the development of open canopied forests. Higher elevations and more westerly locations receiving more moisture within this unit would have been influenced by moderately frequent, low and mixed severity fires favoring a mosaic of forest stages with closed canopy conditions common.

Ecological site concept

This site represents a forest community at the transition zone between the eastside foothills of the Oregon Cascades and the Columbia plateau. The Historical Reference Plant Community is that of a ponderosa pine (Pinus ponderosa) - Douglas-fir (Pseudotsuga menziesii) forest with an herbaceous understory dominated by elk sedge (Carex geyeri) and a shrub layer including antelope bitterbrush (*Purshia tridentata*) and redstem ceanothus

(Ceanothus sanguineus). In comparison to adjacent East Cascade foothill plant communities which are highly influenced by aspect, this site has deep, loamy soils and low slope angles which buffer the site from strong aspect influences. This site occurs within the higher end of the precipitation range (20 to 40 in) for Oregon white oak (Quercus garryana) on the east slope of the Oregon cascades, and some white oak is often present within the stands. Compared to sites with deep soils on adjacent south slopes where Oregon white oak is often a dominant component of overstory composition, greater effective soil moisture allows Douglas-fir and ponderosa pine to outcompete oak over time. South aspect sites with shallower soils are dominated by perennial grasses with only occasional incidences of white oak or conifers.

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

F006XA804OR	**Mesic Xeric Maritime Foothills 30-50 PZ** Heavily forested components within shared map units, greater than 15% forest cover

Similar sites

R006XA302OR	**Steep South Slopes 20-40 PZ** South aspected site, ponderosa pine and douglas-fir uncommon
R006XA204OR	**South Slopes 20-40 PZ** South aspected site, shallower soils

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa* (2) *Pseudotsuga menziesii*
Shrub	Not specified
Herbaceous	(1) *Carex geyeri*

Physiographic features

This site occurs on ridgetops and shoulders in mountainous areas. Slopes range from 5 to 70 percent. Elevation ranges from 1,200 to 3,000 feet (350 to 900 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

Hillslope profile	(1) Summit (2) Shoulder
Landforms	(1) Mountains > Ridge
Flooding frequency	None
Ponding frequency	None
Elevation	366–914 m
Slope	5–70%
Ponding depth	0 cm
Water table depth	254 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site has a xeric soil moisture regime with mean annual precipitation ranging from 20 to 40 inches (500 to 1000 mm), most of which occurs during the months of October through May. Most of the precipitation occurs in the form

of rain and snow. This climate is modified by the influence of the Columbia River Gorge which acts as a conduit for maritime air masses to move past the Cascade mountains. The soil temperature regime is mesic with a mean annual air temperature of about 50 degrees Fahrenheit (10 degrees C). Historical temperature extremes range from 100 to -20 degrees F (38 to -29 degrees C). The frost-free period ranges from about 120 to 160 days. The optimum period for plant growth is from mid-March through the first of August. 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)	120-160 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	508-1,016 mm
Frost-free period (average)	140 days
Freeze-free period (average)	
Precipitation total (average)	762 mm

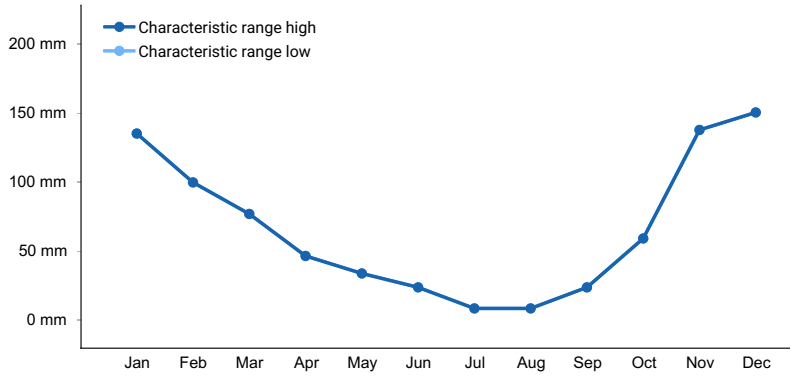


Figure 1. Monthly precipitation range

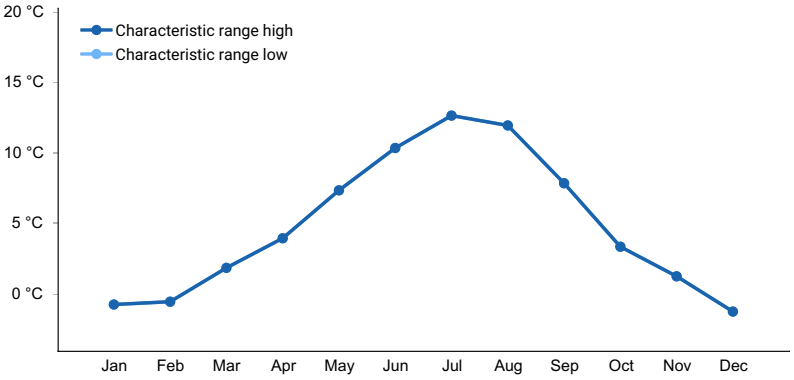


Figure 2. Monthly minimum temperature range

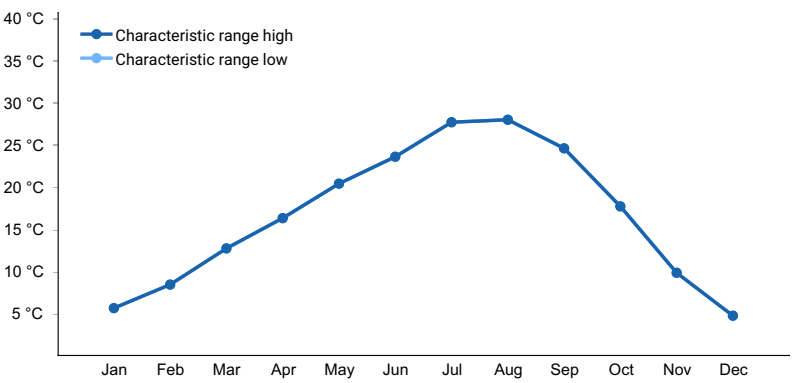


Figure 3. Monthly maximum temperature range

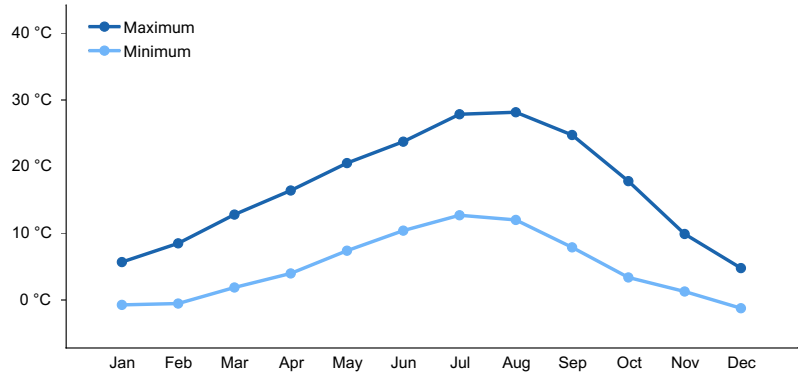


Figure 4. Monthly average minimum and maximum temperature

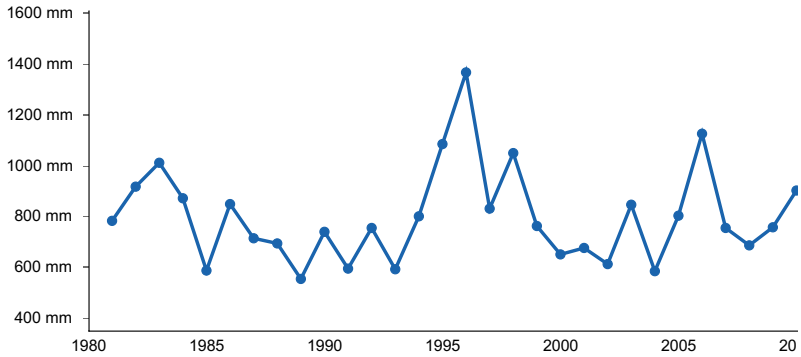


Figure 5. Annual precipitation pattern

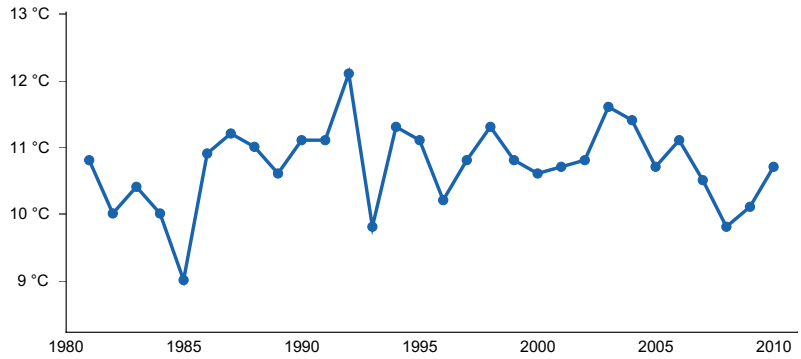


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HOOD RIVER EXP STN [USC00354003], Hood River, 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 typically moderately deep to very deep and well drained. Typically the surface layer is a loam, silt loam, or cobbly loam about 6 to 17 inches thick. Subsoil textures often range from loam, sandy clay loam, or extremely cobbly loam about 21 to 30 inches thick. Depth to fractured basalt bedrock ranges from 36 to greater than 60 inches. Permeability is moderate to moderately slow. The available water holding capacity is 6.5 to 11 inches, but may be less than 5 inches on some soils. The potential for erosion is severe.

Table 4. Representative soil features

Parent material	(1) Loess (2) Volcanic ash (3) Colluvium–volcanic rock (4) Alluvium–volcanic rock
Surface texture	(1) Loam (2) Silt loam (3) Cobbly loam
Family particle size	(1) Loamy-skeletal (2) Coarse-loamy (3) Fine-loamy
Drainage class	Well drained
Permeability class	Moderate to moderately slow
Depth to restrictive layer	91–203 cm
Soil depth	91–203 cm
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-152.4cm)	16.51–27.94 cm
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.3
Subsurface fragment volume <=3" (10.2-152.4cm)	5–30%
Subsurface fragment volume >3" (10.2-152.4cm)	0–35%

Table 5. 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 (0-152.4cm)	12.7–27.94 cm
Soil reaction (1:1 water) (0-101.6cm)	Not specified
Subsurface fragment volume <=3" (10.2-152.4cm)	Not specified
Subsurface fragment volume >3" (10.2-152.4cm)	Not specified

Ecological dynamics

Reference Plant community:

The Reference Plant Community of this site is characterized by an open forest of ponderosa pine and Douglas-fir maintained by relatively frequent, low-intensity fires. The herbaceous understory is primarily characterized by elk sedge, but Idaho fescue (*Festuca idahoensis*), blue wildrye (*Elymus glaucus*), western fescue (*Festuca*

occidentalis), and pinegrass (*Calamagrostis rubescens*) are also common. Shrubs such as bitterbrush (*Purshia tridentata*), and greenleaf manzanita (*Arctostaphylos patula*) are often present in the stand. Vegetative composition of the community is approximately 60 percent grasses, 10 percent forbs and 30 percent trees and shrubs. Variability in density and composition is dependent on aspect and ranges in precipitation that occur within the site, including microclimatic conditions. composition of this site may range from an open stand of ponderosa pine and Douglas-fir with sedges and grasses, to a more dense stand of pine and fir with very little grass or forb component in the understory.

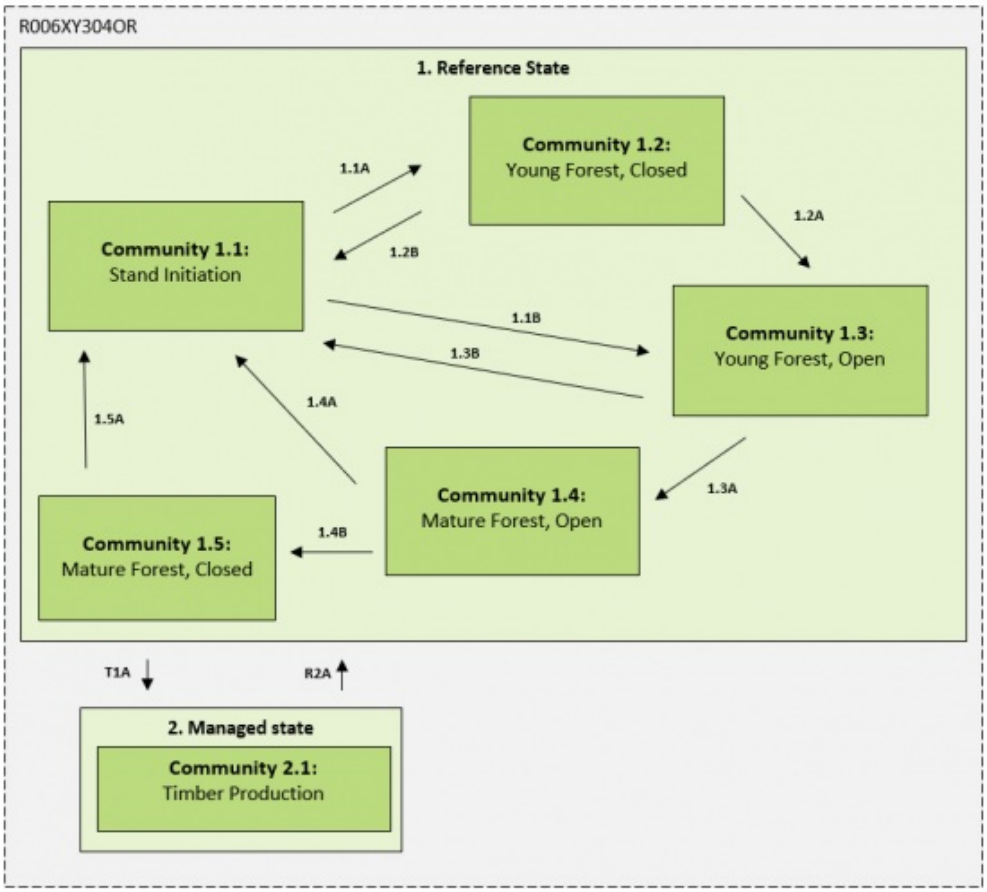
Disturbance:

Mixed ponderosa pine and Douglas-fir forests were historically subject to frequent surface fires and occasional mixed and high severity fires (Landfire 2007). 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 this fire regime would have favored the development of mature, even-aged ponderosa pine and Douglas-fir 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 pine 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). Oregon white oak can be a pioneer species on this site following fire due to its shade tolerance when young and its ability to re-sprout from bases. However, with age, white oak loses much of its shade tolerance and will often be outcompeted by conifers, especially if fire is suppressed (Gucker 2007). While bitterbrush may re-sprout following fire, repeated fire may reduce its cover over time (Busse and Riegel 2009). Ceanothus will often increase following fire. With longer time between fire, increased development of understory fuels, especially shade tolerant trees such as Douglas-fir and shrubs such as bitterbrush, along with the development of a closed canopy, can promote an increased frequency of stand replacing fires and insect outbreaks. As the understory changes as a result of increased shading, elk sedge and other forage bunchgrasses lose vigor and decrease in the stand. The more densely shaded areas will have a sparse ground cover of grasses, forbs and shrubs. 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 pine forests were harvested extensively for timber products (Ritchie et al. 2005). Commercial timber harvesting will have varying effects on stand structure and composition depending on harvest practices. Selective logging of large shade tolerant ponderosa pine may favor the development of stands dominated by more shade tolerant Douglas-fir overtime (Hessberg et al. 2005).

The state and transition model below represents a generalized and simplified version of plant community change in response to major disturbance types in this ecological site. It does not attempt to model all of the complex interacting effects of grazing, fire and invasive species on ecosystem change and the potential restoration pathways emerging from these dynamics. 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 reference state is largely based on Landfire biophysical settings model 0710600: East Cascades Oak-Ponderosa Pine Forest and Woodland and 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 fire regime sustained for 50+ years
1.2A	Mixed severity fire occurs
1.2B	High severity, stand replacing fire occurs
1.3A	Historical fire regime sustained
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

The Reference Plant Community of this site is that of an open, mature, ponderosa pine - Douglas-fir stand represented by Community Phase 1.4. This is the most advanced community within the historical disturbance regime for this site, yet occurs across the landscape as a mosaic of plant community phases characterized by variation in community structural stage (tree age, density and cover) and species composition. Historically, Oregon white oak - ponderosa woodlands would have cycled from a shrub bunchgrass young tree stand initiation phase (1.1) to a young woodland phase (1.2) to a mature woodland phase (1.3) with a disturbance regime characterized by frequent, low intensity surface fires with occasional mixed or replacement severity fires (Landfire fire regime group 1). 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 (Devine et al. 2013). 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

- Douglas-fir (*Pseudotsuga menziesii*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- Geyer's sedge (*Carex geyeri*), grass

Community 1.1
Stand Initiation

Plant community dominated by ceanothus, bitterbrush, and Oregon white oak sprouting from bases. Ponderosa pine and Douglas-fir initiating. Frequent, severe fire will maintain this community. All other communities may transition to this phase after stand replacing fires.

Community 1.2
Young Forest, Closed

Closed canopy, densely stocked with young to intermediate aged ponderosa pine, Douglas-fir, and Oregon white oak. Herbaceous species such as elk sedge decline with shading.

Community 1.3
Young Forest, Open

Open overstory of uneven aged ponderosa pine, Douglas-fir and Oregon white oak with understory regeneration. Herbaceous species such as elk sedge increase with greater light availability.

Community 1.4
Reference community: Mature Forest, Open

This is the Reference Community. Mature, open canopy of ponderosa pine and Douglas-fir with some Oregon white oak in the sub-canopy of openings. Frequent, low severity fires maintain this community, lack of fire will increase understory infill and vulnerability to severe fire. Herbaceous species such as elk sedge increase with greater light availability.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	381	409	443
Shrub/Vine	123	135	146
Tree	118	129	135
Forb	50	56	62
Total	**672**	**729**	**786**

Community 1.5
Mature Forest, Closed

Mature closed canopy of ponderosa pine and Douglas-fir in the overstory with Oregon white oak declining in the sub-canopy due to shading. Herbaceous species such as elk sedge decline with shading.

Pathway 1.1A
Community 1.1 to 1.2

Fire cycle(s) missed

Pathway 1.1B
Community 1.1 to 1.3

Historical fire regime sustained for over 50 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 1.4A
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

Alterations of forest tree species composition, as well as soil compaction and surface disturbances due to large machine usage may hinder passive forest reestablishment. 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. Selective removal of large ponderosa pine may advance succession and favor maturation of more shade tolerant trees such as Douglas-fir.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), 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, and soil compaction and surface disturbances due to large machine usage may hinder passive forest reestablishment.

Additional community tables

Table 7. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass and grasslike plants**			314–437	
	Geyer's sedge	CAGE2	Carex geyeri	258–291	

	Geyer's sedge	CAGE2	*Carex geyeri*	258–291	–
	Idaho fescue	FEID	*Festuca idahoensis*	17–39	–
	western fescue	FEOC	*Festuca occidentalis*	17–39	–
	blue wildrye	ELGL	*Elymus glaucus*	17–39	–
	pinegrass	CARU	*Calamagrostis rubescens*	17–39	–
2	**Big Bluegrass**			–	
3	**Pine Bluegrass**			–	
4	**Other perennial grasses**			6–73	
	timothy	PHPR3	*Phleum pratense*	–	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	–	–
	mountain brome	BRMA4	*Bromus marginatus*	–	–
	spike trisetum	TRSP2	*Trisetum spicatum*	–	–
	Sandberg bluegrass	POSE	*Poa secunda*	–	–
Forb					
5	**Other perennial forbs**			39–73	
	lupine	LUPIN	*Lupinus*	–	–
	Scouler's woollyweed	HISC2	*Hieracium scouleri*	–	–
	strawberry	FRAGA	*Fragaria*	–	–
	beardtongue	PENST	*Penstemon*	–	–
	pea	LATHY	*Lathyrus*	–	–
	arrowleaf balsamroot	BASA3	*Balsamorhiza sagittata*	–	–
	white hawkweed	HIAL2	*Hieracium albiflorum*	–	–
	yarrow	ACHIL	*Achillea*	–	–
	dogbane	APOCY	*Apocynum*	–	–
	sweetroot	OSMOR	*Osmorhiza*	–	–
	cinquefoil	POTEN	*Potentilla*	–	–
	big deervetch	LOCR	*Lotus crassifolius*	–	–
	licorice	GLYCY	*Glycyrrhiza*	–	–
	geranium	GERAN	*Geranium*	–	–
Shrub/Vine					
6	**Shrubs**			45–191	
	antelope bitterbrush	PUTR2	*Purshia tridentata*	17–56	–
	redstem ceanothus	CESA	*Ceanothus sanguineus*	17–56	–
	hollyleaved barberry	MAAQ2	*Mahonia aquifolium*	6–39	–
	common snowberry	SYAL	*Symphoricarpos albus*	6–39	–
7	**Other shrubs**			6–34	
	deerbrush	CEIN3	*Ceanothus integerrimus*	–	–
	greenleaf manzanita	ARPA6	*Arctostaphylos patula*	–	–
	rose	ROSA5	*Rosa*	–	–
	serviceberry	AMELA	*Amelanchier*	–	–
	oceanspray	HOLOD	*Holodiscus*	–	–
	pipsissewa	CHUM	*Chimaphila umbellata*	–	–
	prostrate ceanothus	CEPR	*Ceanothus prostratus*	–	–
	willow	SALIX	*Salix*	–	–

	mallow ninebark	PHMA5	*Physocarpus malvaceus*	–	–
	white spirea	SPBE2	*Spiraea betulifolia*	–	–
Tree					
8	**Trees**			90–168	
	Douglas-fir	PSME	*Pseudotsuga menziesii*	39–73	–
	ponderosa pine	PIPO	*Pinus ponderosa*	39–73	–
	Oregon white oak	QUGA4	*Quercus garryana*	17–22	–

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 - 2020/2021 update of original draft concept

Approval

Kirt Walstad, 9/11/2023

Acknowledgments

Development of this site as a range site was based on field data collection completed in 1989. 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	05/19/2024
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:**

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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:**
