Ecological site F006XB004WA
Mesic Xeric Foothills and Mountain Slopes (Ponderosa Pine Hot Dry Shrub Grass)

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

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Stretching from northern Washington to southern Oregon, MLRA 6 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

Common Resource Area (CRA) 6.5 - Chiwaukum Hills and Lowlands

This LRU occurs predominantly on slopes of hills and mountains. The soils are dominantly in the Mollisols taxonomic order with less extensive areas of Andisols, Alfisols and Inceptisols . Soil parent materials are dominantly colluvium and residuum from igneous, sedimentary, and metamorphic rock, glacial outwash, and glacial till, with a mantle or mixture of volcanic ash and loess in the upper part. Taxonomic soil climate is primarily a mesic temperature regime and xeric moisture regime with average annual precipitation of about 19 inches.

Other LRU'S where the site occurs:
CRA 6.3 - Okanogan Pine / Fir Hills
CRA 6.4 - Chelan Tephra Hills
CRA 6.6 - Yakima Plateau and Slopes
CRA 6.8 - Oak-Conifer Eastern Cascades - Columbia Foothills

Classification relationships

CPS241 - ponderosa pine/bitterbrush/ bluebunch wheatgrass (PIPO/PUTR/PSSP) (WEN)

Ecological site concept

This ecological site can be highly variable depending on fire occurrence and severity, and seed source of shrubs and pine. It includes two plant associations: Ponderosa pine/bitterbrush/bluebunch wheatgrass and Ponderosa pine/bitterbrush. Pine savannahs are the transition from forest to range and are considered part of the range ecological site. For this ecological site Ponderosa pine and bitterbrush are the main cover species with Idaho fescue and bluebunch wheatgrass inversely proportionate to bitterbrush depending on fire disturbance. Soils will vary from sandy to loamy.

Associated sites

F006XA007WA	**Warm Frigid Xeric Mountain Slopes (Douglas-fir Warm Dry Shrub/Herb)** On northerly aspects.
F006XB001WA	**Frigid Xeric Mountain Slopes (Douglas-fir Moderately Dry Shrub/Herb)** Little moister.

Similar sites

F006XA002WA	**Mesic Xeric Hill Slopes and Terraces (Ponderosa Pine Hot Dry Grass)** This site lacks bitterbrush in the understory.

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa*
Shrub	(1) *Purshia tridentata*
Herbaceous	(1) *Pseudoroegneria spicata*

Physiographic features

This ecological site occurs mainly on plateaus, and back slopes, shoulders and foot slopes of hills and mountains, glacial outwash terraces, and alluvial fans. It is found between 900 feet and 3800 feet in elevation on all aspects. Slope gradients generally range from 8 to 45 percent but can be found on slopes up to 90 percent.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Hillslope (2) Mountains > Mountain slope (3) Foothills > Structural bench (4) Alluvial fan (5) Outwash terrace
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to occasional
Ponding frequency	None
Elevation	1,200–3,200 ft
Slope	8–45%
Water table depth	80 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to occasional

Ponding frequency	None
Elevation	900–3,800 ft
Slope	0–90%
Water table depth	35–80 in

Climatic features

Mean Annual precipitation
Total Range: 12 - 35 inches
Central tendency: 16 - 23 inches

Mean Annual Air Temperature
Total Range: 6 - 11 C (43 - 52 F)
Central tendency: 7 - 10 C (45 -50 F)

Frost-free period (days)
Total range: 90 - 170
Central tendency: 110 - 160

Table 4. Representative climatic features

Frost-free period (characteristic range)	110-160 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	16-23 in
Frost-free period (actual range)	90-170 days
Freeze-free period (actual range)	
Precipitation total (actual range)	12-35 in

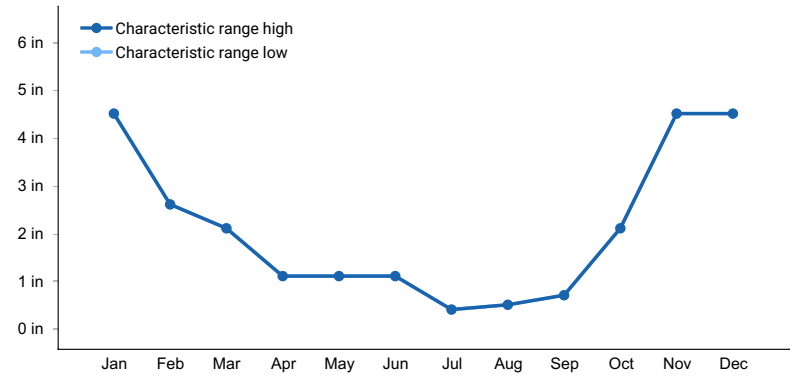


Figure 1. Monthly precipitation range

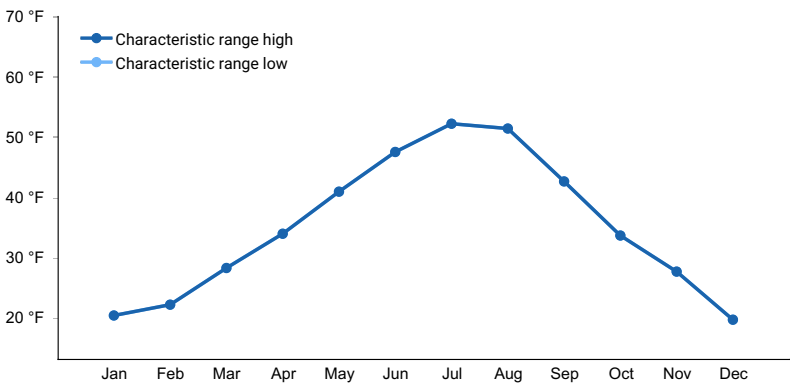


Figure 2. Monthly minimum temperature range

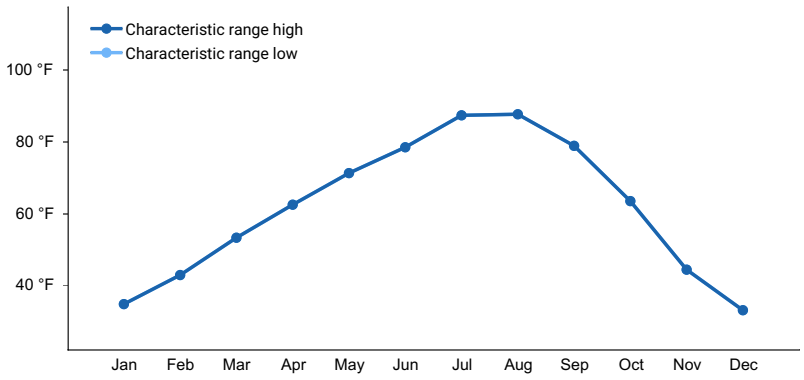


Figure 3. Monthly maximum temperature range

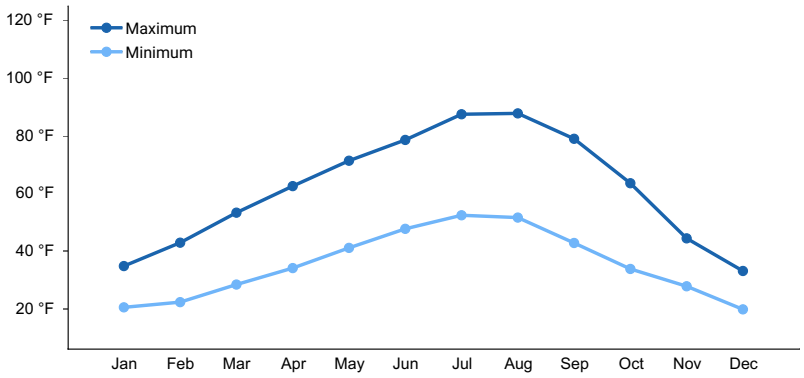


Figure 4. Monthly average minimum and maximum temperature

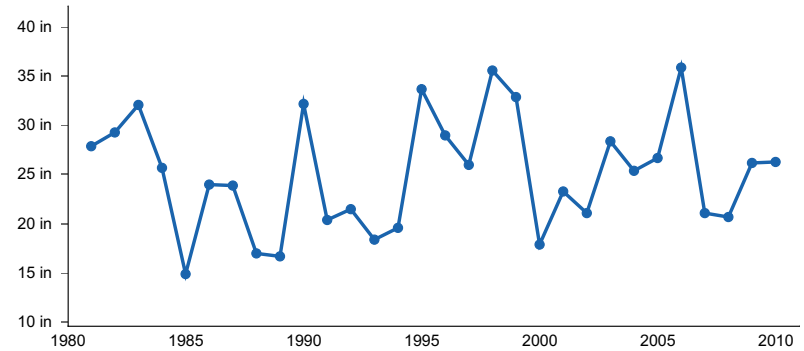


Figure 5. Annual precipitation pattern

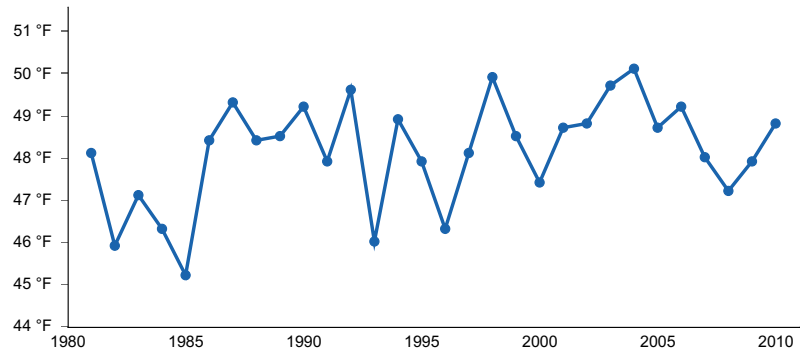


Figure 6. Annual average temperature pattern

Climate stations used

- (1) LEAVENWORTH 3 S [USC00454572], Leavenworth, WA

Influencing water features

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

Wetland description

N/A

Soil features

This ecological site is associated with several soil map unit components. The components are dominantly Haploxerolls in the Mollisols taxonomic order, with less extensive areas of Haploxeralfs in the Alfisols order and Vitrixerands in the Andisols order. Soils range from shallow to very deep and have average available water capacity of about 4.4 inches (11.2 cm) in the 0 to 40-inches (0 to 100 cm) depth range. Soil parent material is dominantly colluvium and residuum from granitic, volcanic, metamorphic, and sedimentary rock , glacial outwash, and glacial till, with minor amounts of volcanic ash and loess.

Dominant Soil Series: Blag, Brisky, Cle Elum, Leiko Lyville, Tekison, Thowson

Parent Materials:
Kind – colluvium, residuum, glacial outwash, glacial till, minor amounts of volcanic ash and loess
Origin – granitic, volcanic, metamorphic, and sedimentary rock

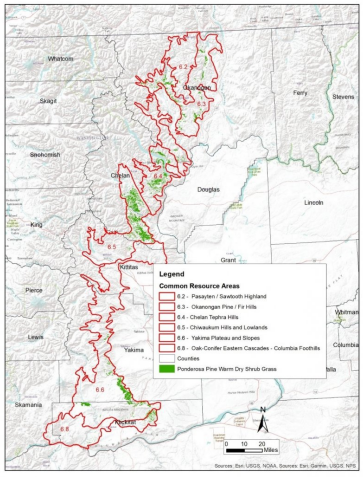


Figure 7. Map of soil mapunits with a major component linked to the Ponderosa Pine Warm Dry Shrub Grass Ecological Site

Table 5. Representative soil features

Surface texture	(1) Ashy loam (2) Ashy sandy loam (3) Ashy fine sandy loam
Family particle size	(1) Loamy-skeletal (2) Sandy-skeletal (3) Fine-loamy
Drainage class	Well drained
Depth to restrictive layer	10–60 in
Surface fragment cover <=3"	0–30%
Surface fragment cover >3"	0–25%
Available water capacity (Depth not specified)	0.6–9.8 in
Calcium carbonate equivalent (Depth not specified)	0–5%

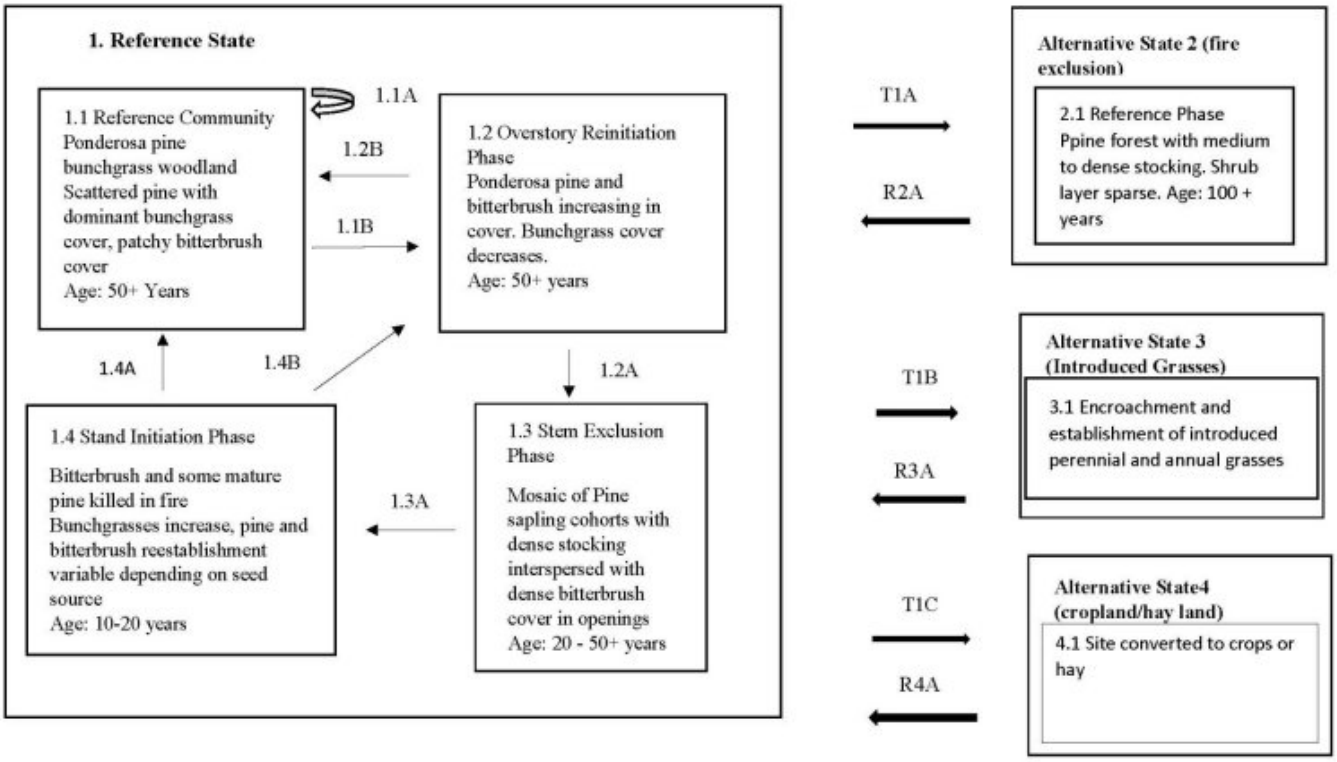
Soil reaction (1:1 water) (0-10in)	5.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–40%
Subsurface fragment volume >3" (Depth not specified)	0–40%

Ecological dynamics

This ecological site can be highly variable depending on fire occurrence and severity, and seed source of shrubs and pine. It includes two plant associations: Ponderosa pine/bitterbrush/bluebunch wheatgrass and Ponderosa pine/bitterbrush. It is found scattered throughout CRA 6.3, on foothills and side slopes of Lake Chelan in CRA 6.4, large acreages in the north half of CRA 6.5 and on the eastern edge of CRA 9a. It is very similar to the ecological site Ponderosa Pine Warm Dry Shrub Grass in MLRA 430 along the Columbia and Spokane Rivers. Through the ages it has had much human disturbance from Native Americans and from European settlement. Sites can be described as open pine/woodland with the overstory pine cover less than 40 percent. As the landscape becomes hotter and drier the overstory pine stocking drops below 10 percent, due to site conditions, this is considered a pine savanna. Pine savannahs are the transition from forest to range and are considered part of the range ecological site. For this ecological site Ponderosa pine and bitterbrush are the main cover species with Idaho fescue and bluebunch wheatgrass inversely proportionate to bitterbrush depending on fire disturbance. Soils will vary from sandy to loamy.

Ponderosa pine/shrub woodland will occur when fire intervals are 20 to 30 years allowing the bitterbrush to dominate the cover with scattered pine clusters. Frequent ground fires every 7 to 10 years will lead to a ponderosa pine/grass savanna with the bitterbrush killed by fire and bunchgrasses increasing. When fire occurrence is extended in the pine/shrub woodland pine cover increases with a mosaic of medium density pine stands with bitterbrush in the openings. Mix severity fires maintain this mosaic pine/shrub woodland and/or pine/grass woodland. In long extended fire intervals, a multi-story dense ponderosa pine forest will establish with shrubs and grass in small percentages in the understory.

State and transition model



1.1A – Frequent ground fires burn out pine and bitterbrush reproduction maintaining open pine/grass woodland.
1.1B – Fire interval extended beyond normal 7 - 10 year interval allowing bitterbrush and ponderosa pine regeneration to reestablish.
1.2A – Reestablished pine cohorts grow into dense stands shading out bitterbrush and grass.
1.2B - Ground fires reoccur prior to understory becoming ladder fuels returning site to open pine/grass woodland.
1.3A – Severe fire killing most of pine and bitterbrush. Scattered live overstory remain.
1.4A – Reoccurring ground fires every 10 years leaving scattered pine and small clumps of pine to grow and maintain open pine/grass woodland.
1.4B – Time, fire interval increased allowing pine and bitterbrush to reestablish

T1A – Fire exclusion for 50+ years allows pine to dominate area and form dense multi-aged stand
T1B – Introduced cool season grasses invading sites near homesteads, pastureland, and other converted land. This includes cheatgrass invasion of overgrazed sites
T1C – Site converted to annual cropland or pasture/hayland
R2A – Heavy overstory thinning and understory burning
R3A – Site preparation and reseeding with native vegetation followed by grazing protection.
R4A – Site preparation, tree planting and maintenance.

State 1
Reference State: Ponderosa pine open/grass woodland

Ponderosa pine is the only tree species. Antelope bitterbrush is the major shrub species with kinnikinnick, snowbrush ceanothus, spirea, snowberry, and sagebrush in minor amounts depending on location and moisture. Idaho fescue and bluebunch wheatgrass dominate the grass component with varying amount of geyer's sedge, needle and thread grass, blue wildrye, and rough fescue. Major insects that cause mortality are the western pine beetle, mountain pine beetle, and pine engraver beetle. The western and mountain pine beetles can kill mature to

old growth pine. The pine engraver beetles attack and kill young pole size stands. Drought and tree to tree competition cause stress which increases bark beetle mortality. Other insect concerns in pine include the following defoliators: Pandora moth, pine butterfly, sawflies, and needle miners. Major diseases include Annosum and Armillaria root rot, commandra rust, and elytroderma needle disease, Dwarf mistletoe is a major concern infecting over 25 percent of ponderosa pine acreage. It is more serious in the drier ponderosa pine sites. Forest productivity is measured using site index (SI) and culmination of annual increment (CMAI). Ponderosa pine is the only tree species and site indexes ranges greatly depending on local site characteristics. NRCS forest site index plots taken throughout MLRA B6 shows this variability. Site index ranges from 40 to 81 using Meyers 100 year total age table. CMAI range is 14 to 46 cubic feet/acre/year at 40 years of age in a fully stocked stand. Low CMAI values are due to low stocking (density) as compared to fully stocked stands. Most stands are less than 40 percent stocked. Forage production estimates from NRCS Range 5 Plots in Okanogan County in Ponderosa pine / antelope bitterbrush sites are as follows based on overstory tree canopy. Forage production figures are in pounds/acre for all vegetation below 4.5 feet (grass, sedges, forbs, shrubs, tree regeneration): Overstory tree canopy – Forage production 0 – 20% - 800 to 1400 lbs/ac 20 – 40% - 300 to 650 lbs/ac The bulk of the grass production is bluebunch wheatgrass and Idaho fescue. Other grass species include needle and thread grass, prairie junegrass, rough fescue, pine grass and big bluegrass. The most prominent forbs are lupine, basalmroot, pussytoes, hawkweed, and yarrow. The most prominent shrub is bitterbrush. Other shrubs include currant, snowbrush ceanothus, big sagebrush, rabbitbrush, and buckwheat. Tree regeneration included mostly ponderosa pine with an occasional Douglas-fir.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- antelope bitterbrush (*Purshia tridentata*), shrub
- currant (*Ribes*), shrub
- snowbrush ceanothus (*Ceanothus velutinus*), shrub
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- big sagebrush (*Artemisia tridentata*), shrub
- rabbitbrush (*Chrysothamnus*), shrub
- buckwheat (*Eriogonum*), shrub
- kinnikinnick (*Arctostaphylos uva-ursi*), shrub
- common snowberry (*Symphoricarpos albus*), shrub
- white spirea (*Spiraea betulifolia*), shrub
- bluebunch wheatgrass (*Pseudoroegneria spicata*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- needle and thread (*Hesperostipa comata*), grass
- pinegrass (*Calamagrostis rubescens*), grass
- Geyer's sedge (*Carex geyeri*), grass
- prairie Junegrass (*Koeleria macrantha*), grass
- bluegrass (*Poa*), grass
- lupine (*Lupinus*), other herbaceous
- arrowleaf balsamroot (*Balsamorhiza sagittata*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- white hawkweed (*Hieracium albiflorum*), other herbaceous
- pussytoes (*Antennaria*), other herbaceous

Community 1.1
Reference Community

This phase will be considered the Historical Plant Community with ground fire frequency 7 to 10 years maintaining an open pine/grass woodland with scattered pine and bitterbrush not killed in ground fire. Idaho fescue and bluebunch wheatgrass will dominate ground cover with shrubs less the 10 percent cover and pine coverage 10 to 30 percent.

Resilience management. Community Pathway 1.1A Frequent ground fires prevent pine and bitterbrush reestablishment maintaining pine/bunchgrass woodland.

Community 1.2

Re-initiation Phase

No reoccurring ground fires allow overstory of bitterbrush and ponderosa pine to reseed and establish. Ground cover of bitterbrush will exceed that of understory bunchgrass. Ponderosa pine stands form a patchy mosaic with bitterbrush. This condition can be maintained with mixed severity fires causing varying degrees of kill to shrubs and trees creating the mosaic shrub/pine clump pattern.

Community 1.3
Stem Exclusion Phase

Dense clumps of ponderosa pine shade out grass and shrubs. Bitterbrush in openings reduce bunchgrass cover.

Community 1.4
Stand Initiation Phase

Figure 8. (Fire killing bitterbrush and some mature pine. Bunchgrasses increase)

Bitterbrush is killed and some of the pole-sized pine are killed in ground fire, but scattered pole-sized pines survive and some large overstory pine survive. Bunchgrasses increase in cover.

Pathway 1.1B
Community 1.1 to 1.2

Fire interval extended 20 plus years allowing bitterbrush and ponderosa pine to reestablish.

Pathway 1.2B
Community 1.2 to 1.1

Ground fires reoccur killing shrubs and most of pine seedlings/saplings returning site to open pine/grass woodland.

Pathway 1.2A
Community 1.2 to 1.3

Reestablished pine regeneration form dense clumps in between dense bitterbrush cover in openings.

Pathway 1.3A
Community 1.3 to 1.4

Severe fire killing most of pine and bitterbrush. Variable, scattered overstory pine and maybe some pole pine stands remain.

Pathway 1.4A
Community 1.4 to 1.1

Time. Reoccurring ground fires every 7 to 10 years leaving scattered pine and small clumps of pine to grow and maintain open pine/grass woodland.

Pathway 1.4B
Community 1.4 to 1.2

Time, fire interval increased allowing pine and bitterbrush to reestablish.

State 2
Alternative State 2 – Fire Exclusion Ponderosa Pine Woodland

Fire exclusion for over 50 years allows ponderosa pine stands to dominate cover and form multi-aged medium to dense woodlands. In most cases mixed severity to stand replacing fires will not revert site back to a pine/savanna condition in State 1.

Community 2.1
Fire Exclusion Community

Medium to dense stands of ponderosa pine. Multi-aged with overstory of 100 year old pine with multi-level overstory and patches of dense seedling to pole stands. Shrub layer is sparse and bunchgrass cover is scattered.

State 3
Alternative State 3 –Introduced Grasses

The plant composition in this state is variable with cool-season introduced grasses encroaching from adjacent homesteads and pastures. One annual species of special note that can cause a drastic shift in grass species is cheatgrass (*Bromus tectorum*). It invades from overgrazed or heavily disturbed pastures and can out compete the native bunchgrasses changing to a shrub/cheatgrass site.

Community 3.1
Introduced Grass Community

Cool-season perennial grasses could include crested wheatgrass, intermediate wheatgrass, and wild rye grass. Annual cool-season grasses could include cheatgrass.

State 4
Alternative State 4 Land Conversion

This ecological site is located near human settlement, and over the ages some of it was converted to homesteads, pastures and cropland.

Community 4.1
Land Conversion Community

The plant community will be variable but reflective of the fact that this ecological site is located near human settlement, and the conversion for farm fields and pastures.

Transition T1A
State 1 to 2

Natural fire regime interval stopped through fire prevention allowing pine to dominate site overtopping bitterbrush. Site converted to multi-storied forest condition without the natural reoccurring fire regime. Stand density increased and competition mortality begins. Forest health decreased by possible bark beetle mortality and fire severity increased.

Transition T1B

State 1 to 3

Introduced non-native grasses invade site over the years of human habitation. Native grasses cannot compete with these grasses especially when heavily grazed for many years.

Transition T1C
State 1 to 4

Site converted to other land uses.

Restoration pathway R2A
State 2 to 1

Heavy overstory thinning followed by reoccurring understory prescribed burning to return to pine/grass savanna state.

Restoration pathway R3A
State 3 to 1

Site preparation followed by native plant reseeding with grazing protection.

Restoration pathway R4A
State 4 to 1

Site preparation, tree planting and maintenance.

Additional community tables

Inventory data references

Relationship to Other Established Classifications:

United States National Vegetation Classification (2008) – A3446 Ponderosa Pine / Shrub Understory Central Rocky Mt. Forest & Woodland Alliance

Washington Natural Heritage Program. Ecosystems of Washington State, A Guide to Identification, Rocchio and Crawford, 2015 – Northern Rocky Mountain Ponderosa Pine Woodland and Savanna

Description of Ecoregions of the United States, USFS PN # 1391, 1995 - M332 Middle Rocky Mountain Steppe–Coniferous Forest –Alpine Meadow Province

USDA NRCS WA Common Resource Areas. CRA 6.3 Okanogan Pine/Fir Hills. CRA 6.4 Chelan Tephra Hills, CRA 6.5 Chiwaukum Hills and Lowlands, CRA 6.6 Yakima Plateau and Slopes

Level III and IV Ecoregions of WA, US EPA, June 2010 – 77e Okanogan Pine/Fir Hills, 77f Chelan Tephra Hills, 77h Chiwaukum Hills and Lowlands, 9a Yakima Plateau and Slopes

This ecological site includes the following USDA Forest Service Plant Associations: PIPO/PUTR, PIPO/PUTR/PSSP. (Lillybridge et. al. 1995)

Wenatchee National Forest Plant Association: CPS241 - ponderosa pine/bitterbrush/ bluebunch wheatgrass (PIPO/PUTR/PSSP)

Yakama Nation Habitat Type: 35 - Pinus ponderosa /Purshia tridentata (PIPO/PUTR)

Other references

Forest Vegetation of Eastern Washington and Northern Idaho. Washington State University, College of Agriculture,

Tech. Bulletin 60, R. Daubenmire and J. Daubenmire, 1968
Fire Ecology of the Forest Habitat Types of Northern Idaho. USFS Intermountain Research Station, GT Report INT – GTR – 363,
Smith and Fischer, 1997.
Forested Plant Associations of the Okanogan National Forest, R6-Ecol-132b-1983. Williams, Lillybridge, September 1983
Forest Plant Associations of the Wenatchee National Forest, PNW-GTR-359. Lillybridge et al, October 1995
NRCS Nat. Forestry Manual, 1998
NRCS Soil and Site Index data for NE WA and N. Idaho in form of excel spreadsheets.
NRCS Range 5 Forage Production plots from Okanogan County, 1990 South Summit CRM, 1992 Chiliwist CRM

Contributors

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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:**

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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:**