

# Ecological site AX001X03X402

## Frigid Udic Forest

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### 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): 001X–Northern Pacific Coast Range, Foothills, and Valleys

This long and narrow resource area stretches along the Pacific Border Province of the Pacific Mountain System in Oregon and Washington. The area is bounded by the Olympic Mountains on the north and the Klamath Mountains on the south. Most of the area consists of hills and low mountains with gentle to steep slopes. The parent materials are composed primarily of young Tertiary sedimentary rocks with some minor volcanic rocks. Glacial till and outwash deposits are found in the northern half of the area within Washington. In the far southern portion of the area, near the Klamath Mountains, the sedimentary rocks are older and some have been metamorphosed. The average annual precipitation ranges from 60 to 200 inches, increasing with elevation.

The dominant soil orders in this MLRA are Andisols, Inceptisols, and Ultisols. Soil depth ranges from shallow to very deep. While most soils in the area are well drained and occur on foothills, mountain slopes and ridges, floodplain and depressional soils can range from well drained to very poorly drained. Soil textures are typically medial, loamy, or clayey. The dominant soils in the area have a mesic or frigid soil temperature regime and a udic soil moisture regime; however, soils with an aquic soil moisture regime or cryic soil temperature regime do occur.

### LRU notes

The Central Pacific Coast Range land resource unit (LRU 3) of MLRA 1 ranges from the Olympic Peninsula south into northern Oregon. LRU 3 is located south of the Olympic National Forest and extends to the Siletz River in Oregon. LRU 3 is bounded on the west by MLRA 4a Sitka Spruce Belt and MLRA 2 Willamette and Puget Sound Valleys to the east. Several major rivers have headwaters in this LRU or carved valleys through the landscape depositing more recent alluvium. These include the Chehalis, Columbia, Grays, Humptulips, Klaskanine, Nehalem, Satsop, Siletz, Willapa, Wilson, Wynoochee, and Yamhill Rivers.

### Ecological site concept

This ecological site is found on the western Coast Range in the Pacific Northwest southern Washington to northern Oregon. It is located on mountain slopes. Elevations are typically between 1,500 and 3,000 feet with slopes ranging from 3 to 90 percent.

The most common overstory species are western hemlock (*Tsuga heterophylla*) and Douglas-fir (*Pseudotsuga menziesii*). Western redcedar (*Thuja plicata*), bigleaf maple (*Acer macrophyllum*), and grand fir (*Abies grandis*) may be present in minor components of the overstory. Areas in the higher elevations and colder microsites may have a component of Pacific silver fir (*Abies amabilis*). Red alder (*Alnus rubra*) may be common where there are forest openings. Regeneration of red alder is limited by canopy cover and is often limited to gaps where sunlight is most available. Common understory species include salal (*Gaultheria shallon*), Pacific rhododendron (*Rhododendron macrophyllum*), evergreen huckleberry (*Vaccinium ovatum*), Cascade oregongrape (*Mahonia nervosa*), western swordfern (*Polystichum munitum*), deerfoot vanillaleaf (*Achlys triphylla*), and twinflower (*Linnaea borealis*).

The most common natural disturbance on this ecological site is from windthrow of overstory trees, which results in pockets of open areas. These areas commonly occur in conjunction with either root-, butt- or stem rot. Western hemlock is highly susceptible to rot diseases from fungi such as; *Armillaria ostoyae*, *Heterobasidion annosum*,

Phellinus weirii, and Echinodontium tinctorium which may exacerbate the extent and area of disturbance. The resulting openings in the canopy allow sunlight to reach the forest floor, benefiting the understory. Disturbance by fire is infrequent as a result of the high humidity and precipitation within the western hemlock zone; however, the site has a fire regime between 150-400 years and may experience stand replacing catastrophic wildfires (US Department of Agriculture, 2012).

## Associated sites

AX001X03X401	<p><b>Cryic Udic Forest</b> Cryic Udic Forest is located at higher elevations from Frigid Udic Forest. The prominence of Pacific silver fir (<i>Abies amabilis</i>) can be used as a good indicator for Cryic Udic Forest.</p>
AX001X03X410	<p><b>Mesic Udic Forest</b> Mesic Udic Forest is located a lower elevations from Frigid Udic Forest. Species are similar in both ecological sites but Frigid Udic Forest will have a shorter growing season. The presence of deerfoot vanillaleaf (<i>Achlys triphylla</i>) is a good indicator for Frigid Udic Forest.</p>

**Table 1. Dominant plant species**

Tree	(1) <i>Tsuga heterophylla</i> (2) <i>Pseudotsuga menziesii</i>
Shrub	(1) <i>Gaultheria shallon</i> (2) <i>Mahonia nervosa</i>
Herbaceous	(1) <i>Polystichum munitum</i> (2) <i>Achlys triphylla</i>

## Legacy ID

F001XC402OR

## Physiographic features

This ecological site is located on mountain slopes. Elevations are typically between 1,500 and 3,000 feet with slopes ranging from 3 to 90 percent.

**Table 2. Representative physiographic features**

Landforms	(1) Mountains > Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	457–914 m
Slope	3–90%
Aspect	W, NW, N, NE, E, SE, S, SW

## Climatic features

The climate has warm, moist summers and cool, wet winters. Mean annual precipitation ranges from 70 to 150 inches. Average annual temperatures range from 41 to 46 degrees F. The mild temperatures, abundant precipitation, and a long growing season result in highly productive forestlands.

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	60-150 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,778-3,810 mm

## Influencing water features

In general, this ecological site is not influenced by wetland or riparian water features but may be found on stream terraces or adjacent to wetland and riparian areas. This site does not experience flooding or ponding.

## Soil features

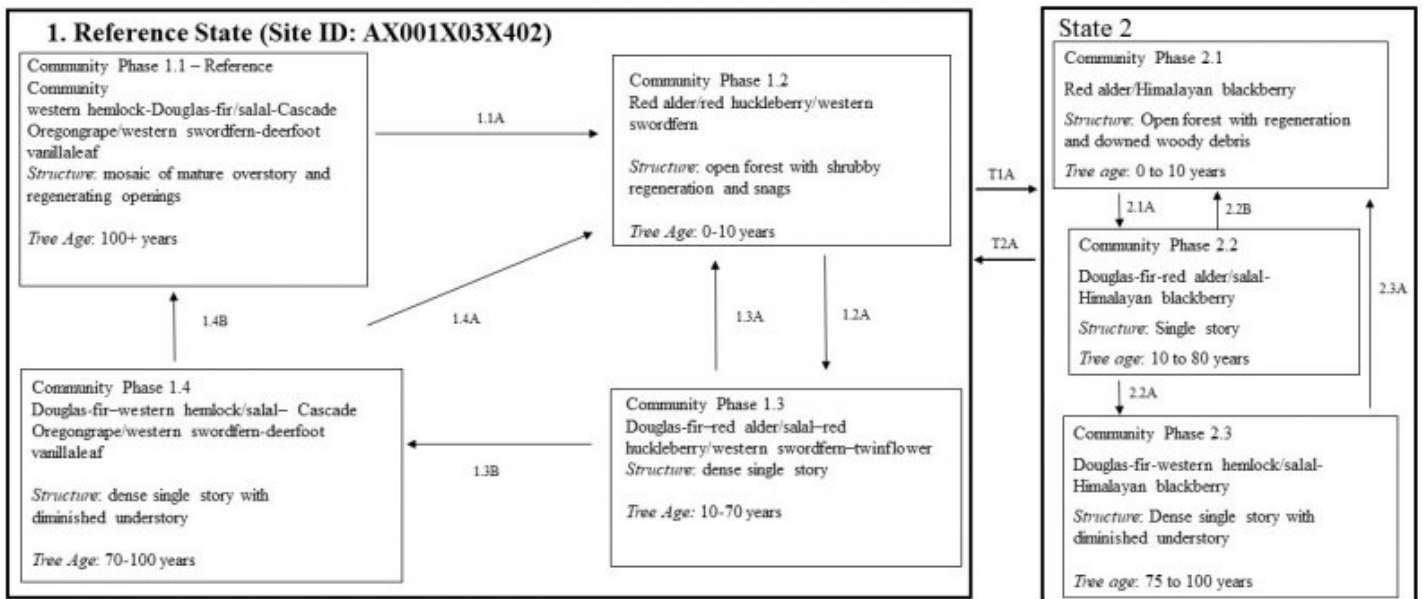
Soils that support this ecological site occur in the frigid soil temperature regime and the udic soil moisture regime. Excess moisture can be limited to some species, however, and soils with a seasonally high water table in the upper part of the profile may not be included in this concept.

**Table 4. Representative soil features**

Parent material	(1) Colluvium–igneous rock (2) Residuum–igneous rock
Surface texture	(1) Loam (2) Silt loam (3) Silty clay loam (4) Extremely gravelly sandy loam (5) Gravelly loam (6) Medial loam (7) Gravelly silt loam (8) Medial silt loam
Drainage class	Well drained
Depth to restrictive layer	51–152 cm
Soil depth	51–152 cm
Surface fragment cover <=3"	0–37%
Surface fragment cover >3"	0–30%
Clay content (2.5-20.3cm)	3–28%
Subsurface fragment volume <=3" (2.5-152.4cm)	5–42%
Subsurface fragment volume >3" (2.5-152.4cm)	0–27%

## Ecological dynamics

### State and transition model



*Tsuga heterophylla*-*Pseudotsuga menziesii*/*Gaultheria shallon*-*Mahonia nervosa*/*Polystichum munitum*-*Achlys triphylla*  
Western hemlock-Douglas-fir/salal-Cascade Oregongrape/western swordfern-deerfoot vanillaleaf

Community Phase Pathway 1.X = Community Phase X#Y = Transition Pathway  
1.XY = Pathway (ecological response to natural processes)  
T.XY = Pathway (ecological response to forest management influenced by invasive species)

## State 1

### Community 1.1

Western hemlock – Douglas-fir / salal – Cascade Oregongrape / western swordfern – deerfoot vanillaleaf Structure: mosaic of mature overstory and regenerating openings Western hemlock is the most common overstory species in this community. It is highly shade tolerant and has the ability to release quickly following extended periods of suppression (Packee, 1990). Douglas-fir will be present, but there will be minimal Douglas-fir regeneration with the absence of canopy openings. Western redcedar, grand fir, and bigleaf maple may also be present in smaller components of the overstory. Gaps in the mid-canopy and overstory allow sunlight to reach the ground and are where the majority of the understory plants establish. In addition, these gaps provide opportunities for deciduous tree species such as red alder and bigleaf maple to regenerate throughout this reference community. Common understory species include salal, red huckleberry (*Vaccinium parvifolium*), evergreen huckleberry, vine maple (*Acer circinatum*), Pacific rhododendron, Cascade oregongrape, western swordfern, deerfoot vanillaleaf, and twinflower.

### Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western redcedar (*Thuja plicata*), tree
- bigleaf maple (*Acer macrophyllum*), tree
- grand fir (*Abies grandis*), tree
- Pacific silver fir (*Abies amabilis*), tree
- red alder (*Alnus rubra*), tree
- salal (*Gaultheria shallon*), shrub
- Cascade barberry (*Mahonia nervosa*), shrub
- Pacific rhododendron (*Rhododendron macrophyllum*), shrub
- California huckleberry (*Vaccinium ovatum*), shrub
- vine maple (*Acer circinatum*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- sweet after death (*Achlys triphylla*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous

## Community 1.2

Red alder / red huckleberry / western swordfern Structure: open forest with shrubby regeneration and snags  
Community phase 1.2 is an early seral plant community that has been impacted by a stand-replacing disturbance such as a wildfire, large scale wind event, mass movement, or major insect pest or disease. Nearly all trees are absent, but some fire-resistant trees may survive in the overstory. Douglas-fir is relatively fire tolerant, and large overstory trees may be present. Snags are prevalent and remain standing and decaying. Large woody debris may be present on the surface and serve as nurse sites. The understory is predominately early seral tree, shrub, and forb species such as red alder, red huckleberry, and western swordfern. Red alder has several competitive advantages and can establish quickly, relative to conifers. Red alder can sprout and establish in full sunlight and fixes nitrogen providing an early competitive advantage (Villarin, 2009). In addition, the seeds of deciduous species are light and can be transported long distances by wind and water, allowing for rapid recolonization. Red alder seedlings and saplings will typically establish 3 to 10 years following disturbance, depending on severity. Some grasses will establish but will be replaced with shrubs overtime. When resulting from a moderate to severe disturbance event, there is a good probability for shrubs to out-compete tree seedlings. Vine maple, red huckleberry, salal, Pacific rhododendron, and Cascade Oregongrape (which may have been only moderately abundant previously) all have the capacity to rapidly recover and spread when top-killed, slowing successful overstory regeneration.

### Dominant plant species

- red alder (*Alnus rubra*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- red huckleberry (*Vaccinium parvifolium*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

## Community 1.3

Douglas-fir – red alder / salal - red huckleberry / western swordfern – twinflower Structure: dense single story  
Community phase 1.3 is an early seral forest in regeneration, possibly with scattered remnant mature trees. Species composition depends on the natural seed sources present and the intensity of disturbance. When resulting from a moderate to severe fire event, it is probable that shrubs will out-compete tree seedlings. Red alder, red huckleberry, evergreen huckleberry, western swordfern, deerfoot vanillaleaf, and Pacific trillium (*Trillium ovatum*) may be abundant in the understory depending on sunlight availability (Bailey, 1968). Red alder will begin to die between 40 to 70 years following disturbance and allow more light to penetrate the newly nitrogen rich soil (Naiman, 2009). As a result, conifer regeneration becomes more prevalent in this community phase. Seed sources for tree species would be from the surrounding, undisturbed forest. The combination of new seedling growth and the survivors of the previous disturbance would result in a mixed stand which could include Douglas-fir and western hemlock.

### Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- red alder (*Alnus rubra*), tree
- salal (*Gaultheria shallon*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- California huckleberry (*Vaccinium ovatum*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous
- Pacific trillium (*Trillium ovatum*), other herbaceous
- sweet after death (*Achlys triphylla*), other herbaceous

## Community 1.4

Douglas-fir - western hemlock / salal – Cascade Oregongrape / western swordfern – deerfoot vanillaleaf Structure: dense single story with diminished understory  
Community phase 1.4 is a forest in the competitive exclusion stage, possibly with scattered remnant mature trees. There is increasing competition among individual trees for available water and nutrients. Douglas-fir and western hemlock will dominate the overstory canopy, however red alder may be present in pockets of canopy openings. Canopy closure is almost 100 percent leading to diminished shrub and forb layers. Some understory species better adapted to at least partial shade will begin to increase. Over time, the forest

will begin to self-thin due to the elevated competition. Species composition depends on the original seed source(s) available. The forest could be single or mixed-species including Douglas-fir, western hemlock, red alder, western red cedar, bigleaf maple, and grand fir.

### **Dominant plant species**

- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- red alder (*Alnus rubra*), tree
- bigleaf maple (*Acer macrophyllum*), tree
- grand fir (*Abies grandis*), tree
- salal (*Gaultheria shallon*), shrub
- Cascade barberry (*Mahonia nervosa*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- California huckleberry (*Vaccinium ovatum*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- sweet after death (*Achlys triphylla*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous

### **Pathway 1.1A**

#### **Community 1.1 to 1.2**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, large scale wind event, major insect pest infestation, timber management, or large mass movement event leading to the stand initiation phase of forest development.

### **Pathway 1.2A**

#### **Community 1.2 to 1.3**

This pathway represents growth over time with no further significant disturbance.

### **Pathway 1.3A**

#### **Community 1.3 to 1.2**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, large scale wind event, major insect pest or disease infestation, timber management, or large mass movement leading to the stand initiation phase of forest development.

### **Pathway 1.3B**

#### **Community 1.3 to 1.4**

This pathway represents growth over time with no further significant disturbance.

### **Pathway 1.4B**

#### **Community 1.4 to 1.1**

This pathway represents growth over time with no further major disturbance.

### **Pathway 1.4A**

#### **Community 1.4 to 1.2**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, large scale wind event, major insect pest or disease infestation, timber management, or large mass movement leading to the stand initiation phase of forest development.

## **State 2**

## Community 2.1

Red alder/Himalayan blackberry Structure: Open forest with regeneration and downed woody debris Community Phase 2.1 represents a recently disturbed forest that is naturally regenerating. Logging slash and large woody debris are often prolific following large-scale disturbances which inhibits vegetation to establish under natural conditions. Areas that are not replanted immediately (1 to 3 years) following a timber harvest or large-scale disturbance may become vulnerable to invasive species infestation. Typically, commercially managed forests will be replanted following disturbance and species preference depends on site conditions and long-term economic market decisions. Overall, species biodiversity in forests managed for short rotation timber is diminished. Natural reforestation depends on available seed sources following disturbance. Early seral species such as red alder tend to regenerate quickly with abundant sunlight. Plant community composition is typically homogenous and even-aged. Following disturbance, these sites are often dominated by Himalayan blackberry (*Rubus armeniacus*) and Scotch broom (*Cytisus scoparius*) which tend to outcompete native species establishment. Invasive species management is most critical during this phase.

### Dominant plant species

- red alder (*Alnus rubra*), tree
- Himalayan blackberry (*Rubus armeniacus*), shrub
- Scotch broom (*Cytisus scoparius*), shrub
- fireweed (*Chamerion angustifolium*), other herbaceous

## Community 2.2

Douglas-fir-red alder/salal-Himalayan blackberry Structure: Single story Community phase 2.2 represents an even-aged, regenerating forest. Douglas-fir can regenerate quickly on nurse logs or in recently disturbed soils. Shade-intolerant red alder remains a large component in the overstory until it reaches maturity (Fonda, 1974). The vegetation in areas that have been replanted commonly is dense and even aged, and the understory species are sparse in areas that have a high percentage of canopy cover. Salal is a common understory species, but invasive species increase in prominence. Scotch broom and Himalayan blackberry can greatly impact the shrubby understory and outcompete native species. Scotch broom is shade-intolerant and will diminish as the canopy cover increases. Management techniques such as pre-commercial thinning and mitigation of invasive species will accelerate the maturation and improve the health of the forest.

### Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- red alder (*Alnus rubra*), tree
- salal (*Gaultheria shallon*), shrub
- Himalayan blackberry (*Rubus armeniacus*), shrub
- Scotch broom (*Cytisus scoparius*), shrub

## Community 2.3

Douglas-fir-western hemlock/salal-Himalayan blackberry Structure: Dense single story with diminished understory Community phase 2.3 represents a maturing forest that has increased plant diversity. Western hemlock can regenerate under dense, shrubby canopies. It will begin to establish in the overstory canopy along with Douglas-fir. Invasive species will inhibit the overall health and structure of the forest, creating an ecosystem which is susceptible to devastation from insects and disease. The dense, shrubby understory is susceptible to wildfires. Commercial logging operations commonly take place during this phase as trees reach economical maturity in size and volume. It is presumed that without timber management during this phase, an old-growth western hemlock stand will develop.

### Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- salal (*Gaultheria shallon*), shrub
- Himalayan blackberry (*Rubus armeniacus*), shrub

### **Pathway 2.1A**

#### **Community 2.1 to 2.2**

This pathway represents growth over time with no further major disturbance or active forest management.

### **Pathway 2.2B**

#### **Community 2.2 to 2.1**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, a large-scale wind event, a major insect or disease infestation, large mass movement, or timber harvest activities that lead to the stand initiation phase of forest development.

### **Pathway 2.2A**

#### **Community 2.2 to 2.3**

This pathway represents growth over time with no further major disturbance or active forest management.

### **Pathway 2.3A**

#### **Community 2.3 to 2.1**

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, a large-scale wind event, a major insect or disease infestation, large mass movement, or timber harvest activities that lead to the stand initiation phase of forest development.

### **Transition T1A**

#### **State 1 to 2**

This pathway represents an area of major disturbance that removes most of the overstory. Large-scale disturbances such as this, have the potential to increase the vulnerability of invasive species infestation when the seed source is either nearby or introduced to the site. This type of disturbance will impact the ecological site and the natural feedbacks that maintained the reference state.

### **Transition T2A**

#### **State 2 to 1**

This pathway represents intensive management to restore the historic plant community.

## **Additional community tables**

### **Inventory data references**

Other Established Classifications for Ecological Site

National Vegetation Classification Group G240 – North Pacific Maritime Douglas-fir Western Hemlock Forest and A3378 *Tsuga heterophylla* - *Pseudotsuga menziesii*/ *Cornus unalaschkensis* Mesic Forest Alliance

USDA Forest Service Plant Association and Management Guide of the Northern Oregon Coast Range: western hemlock/Oregon oxalis-vanilla leaf

Washington Department of Natural Resources Ecological Systems of Washington State- North Pacific Maritime Dry-Mesic Douglas-fir Western Hemlock Forest

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## Contributors

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## Approval

Kirt Walstad, 9/09/2023

## 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	12/16/2021
Approved by	Kirt Walstad
Approval date	

## Indicators

1. **Number and extent of rills:**  
\_\_\_\_\_
2. **Presence of water flow patterns:**  
\_\_\_\_\_
3. **Number and height of erosional pedestals or terracettes:**  
\_\_\_\_\_
4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**  
\_\_\_\_\_
5. **Number of gullies and erosion associated with gullies:**  
\_\_\_\_\_
6. **Extent of wind scoured, blowouts and/or depositional areas:**  
\_\_\_\_\_
7. **Amount of litter movement (describe size and distance expected to travel):**  
\_\_\_\_\_
8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**  
\_\_\_\_\_
9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**  
\_\_\_\_\_
10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**  
\_\_\_\_\_
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**  
\_\_\_\_\_
12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant:

Sub-dominant:

Other:

Additional:

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

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:**
-