

## Ecological site F003XC306WA High Glacial Valley Floors Forest subalpine fir

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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): 003X—Olympic and Cascade Mountains

This area includes the west slope and parts of the east slope of the Cascades Mountains in Washington and Oregon. The Olympic Mountains in Washington State are also included. These mountains are part of a volcanic arc located at a convergent plate boundary. Volcanic rocks predominate but metamorphic and sedimentary rocks occur in the North Cascades and Olympic Mountains. Topography is generally dissected and steep, but some areas consist of constructional volcanic platforms and isolated stratovolcanoes. Elevation is usually 500 to 6000 feet but reaches to 14,410 ft at the summit of Mount Rainier. Many areas hosted alpine glaciers or ice sheets during the Pleistocene, and a few remain today.

Climate becomes cooler and moister with increasing elevation and latitude. Low elevations experience a long growing season and mild temperatures. High elevations can accumulate snowpack lasting into summer and frost may occur in any month. Average annual precipitation ranges from 60 to 180 inches in most areas. Most precipitation falls during the fall, winter, and spring during low-intensity frontal storms. Summers are relatively dry. Average annual temperature is 27 to 50 degrees F. The frost-free period is 10 to 180 days.

### LRU notes

The Glaciated Western Cascades land resource unit is located in southwestern Washington primarily along the western slope of the Cascade Range. It is bounded by the Snoqualmie Pass area to the north and the Columbia River to the south. To the west is the Puget Sound Trough (MLRA 2) and to the east is the drier eastern slope of the Cascade Range (MLRA 6).

The major rivers originating in the LRU are the Puyallup and Nisqually Rivers which drain to Puget Sound and the Cowlitz and Lewis Rivers which drain west to the Columbia.

Some of the lithology in the LRU is the result of numerous accretions from tectonic subduction of the Pacific plate along the margin of the North American plate creating combinations of metamorphized sedimentary or oceanic rock and intrusive volcanic plutons. The Cascades in this area have a long history of volcanic activity starting about 55 million years ago. Eruptions have created a complex sequence of low-silica and silica-rich depositions that have been eroded and buried repeatedly (Washington Geological Survey). Mount Rainier, Mount Adams, and Mount Saint Helens are volcanoes and the most notable peaks; Mount Saint Helens continues to vent after the 1980 eruption. Alpine glaciers still remain active at the highest elevations. The area was not influenced by continental glaciation, however Pleistocene alpine glaciation modified much of the dissected terrain and contributed glacial sediment to the complex combination of lithologies and volcanism.

Soils are mainly Spodosols and Andisols.

Vegetation is primarily dense forest with some parkland in subalpine and alpine areas. Douglas-fir (*Pseudotsuga menziesii*) and western hemlock (*Tsuga heterophylla*) are the dominant tree species found at lower elevations;

western redcedar (*Thuja plicata*) is quite common. Pacific silver fir (*Abies amabilis*) and mountain hemlock (*Tsuga mertensiana*) are the primary tree species in the higher elevations; subalpine fir (*Abies lasiocarpa*) and Alaska cedar (*Callitropsis nootkatensis*) can be widespread as well.

## Classification relationships

USFS Plant Association: ABLA/PAMY.

## Ecological site concept

This ecological site resides in mountainous areas on glacial valley floors or valley walls and mountain slopes at elevations ranging 3,000 to 5,500 feet on slopes of 5 to 30 percent. The climate is cold and relatively dry (average frost-free days range from 35 to 80, the mean annual precipitation is 55 to 100 inches and the mean annual air temperature is 38 to 42 degrees Fahrenheit. The soils are primarily Andisols. Parent material is volcanic ash over glacial till. The soils develop andic soil properties from the weathering of volcanic ash and exhibit unique water holding capacities. The soil temperature regime is cryic and the soil moisture regime is udic. The reference phase is dominated by subalpine fir and Englemann spruce (*Picea engelmannii*). Seral species include lodgepole pine (*Pinus contorta*); after 100 years, lodgepole pine begins to die. Warmer sites will have Douglas-fir, western white pine (*Pinus monticola*), and western larch (*Larix occidentalis*); higher elevations will have whitebark pine (*Pinus albicaulis*), and subalpine larch (*Larix lyallii*). The understory species include deerfoot vanilla leaf (*Achlys triphylla*), pipsissewa (*Chimaphila umbellata*), dwarf Oregon-grape (*Mahonia nervosa*), fool's huckleberry (*Menziesia ferruginea*), Oregon boxleaf (*Paxistima myrsinites*), pyrola species, Pacific yew (*Taxus brevifolia*), and various *Vaccinium* species. This site occurs in the subalpine fir zone of cold, high elevation areas with persistent slow-melting snow that causes a short growing season. Alpine areas in the Cascades can be affected by numerous lightning strikes during the growing season; fire return interval ranges 100- 300 years generally, with stand replacing events occurring 50 percent of the time; mixed severity events occur as well. Insects and disease can cause small endemic patch disturbances or larger epidemic events. Insects such as mountain pine beetles and bark beetles effect lodgepole pine seral stands, causing small or large patches of dead trees. Diseases that affect can be Armillaria and Annosum root disease, Laminated and Tomentosus root rot, Indian paint fungus (*Echinodontium tinctorium*), brown cubical rot (*Phaeolus schweinitzii*), or dwarf mistletoe (*Arceuthobium* spp.).

## Associated sites

F003XC307WA	<b>High Mountain Slopes Forest Pacific silver fir</b>
F003XC309WA	<b>Mountain Slopes Parkland and Forest whitebark pine</b>

## Similar sites

F003XA306WA	<b>East Mountain Slopes Forest subalpine fir</b>
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Table 1. Dominant plant species

Tree	(1) <i>Abies lasiocarpa</i> (2) <i>Picea engelmannii</i>
Shrub	(1) <i>Paxistima myrsinites</i> (2) <i>Mahonia nervosa</i>
Herbaceous	(1) <i>Achlys triphylla</i> (2) <i>Chimaphila umbellata</i>

## Physiographic features

This ecological site resides in mountainous areas on glacial valley floors or valley walls and mountain slopes at elevations ranging 3000 to 5500 feet on slopes of 5 to 30 percent.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Glacial-valley floor (2) Mountains > Glacial-valley wall (3) Mountains > Mountain slope
Elevation	3,000–5,500 ft
Slope	5–30%
Aspect	W, NW, S, SW

## Climatic features

The climate is cold and relatively dry. The mean annual air temperature is 38 to 42 degrees Fahrenheit.

**Table 3. Representative climatic features**

Frost-free period (characteristic range)	35-80 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	55-100 in

## Influencing water features

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

## Soil features

The soils are primarily Andisols formed from volcanic ash mixed with glacial till parent material in the cryic soil temperature and udic soil moisture regimes. Andic properties occur from 0 to 60 inches in depth in the soil pedon.

**Table 4. Representative soil features**

Parent material	(1) Volcanic ash (2) Till
Surface texture	(1) Ashy sandy loam
Family particle size	(1) Ashy-skeletal
Drainage class	Well drained
Permeability class	Rapid
Depth to restrictive layer	60 in
Soil depth	60 in
Surface fragment cover <=3"	10–30%
Surface fragment cover >3"	0–10%
Available water capacity (Depth not specified)	3–4 in
Calcium carbonate equivalent (Depth not specified)	0%
Soil reaction (1:1 water) (Depth not specified)	5.1–6.5

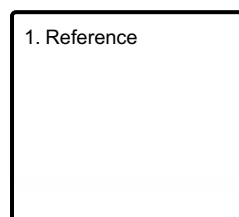
## Ecological dynamics

This site occurs in the subalpine fir zone of cold, high elevation areas with persistent slow-melting snow that causes a short growing season. There can be numerous lightning strikes in the area; and the fire return interval generally ranges 100 - 300 years, with about half of the fires occurring as stand replacing events; mixed severity fires occur as well. The USFS Fire Effects Information System classification for subalpine fir in the North Cascades states a fire

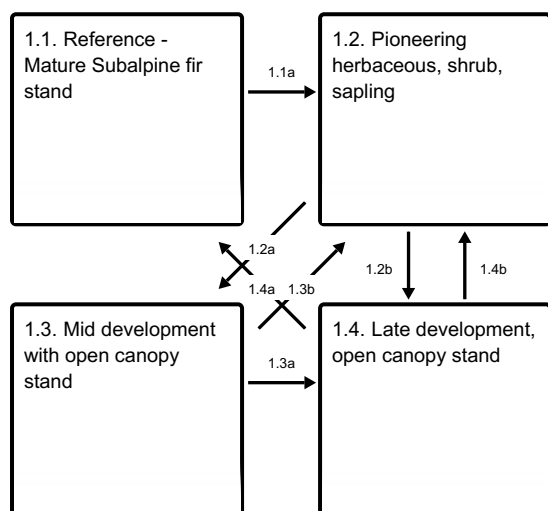
return interval of 154 years. Seral stands with lodgepole pine have a fire return interval of 109 years. In the Wenatchee National Forest., fire return intervals occur less than 300 years, as evidenced by stand ages. LANDFIRE BPS 0810550 Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland, has a fire return interval ranging from 99 to 125 years, though for subalpine mixed conifer forests as 250 years of stand replacing and mixed severity fires. Insects and disease can cause small endemic patch disturbances or larger epidemic events. Insects such as the mountain pine beetle (*Dendroctonus ponderosae*) and other bark beetles effect lodgepole pine seral stands, causing small or large patches of dead trees. Diseases the effect the site include Armillaria and Annosum root disease, Laminated and Tomentosus root rot, Indian paint fungus (*Echinodontium tinctorium*), brown cubical rot (*Phaeolus schweinitzii*), or dwarf mistletoe (*Arceuthobium* spp.).

## State and transition model

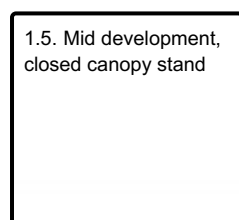
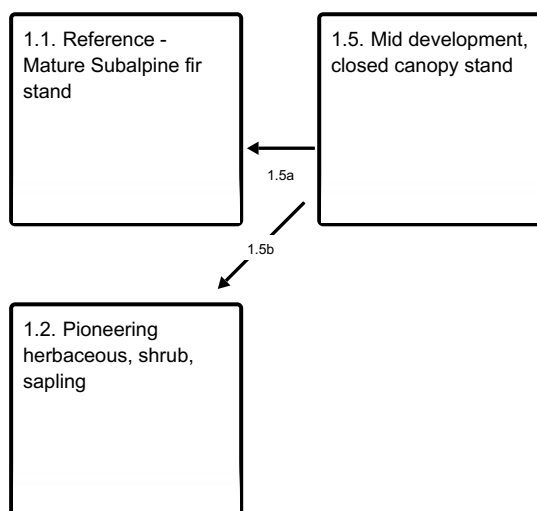
### Ecosystem states



### State 1 submodel, plant communities



### Communities 1, 5 and 2 (additional pathways)



## State 1 Reference

### Community 1.1 Reference - Mature Subalpine fir stand

The overstory and regeneration layers are dominated by subalpine fir though Englemann spruce may have high canopy cover. Trees are large (average diameter at breast height is twenty inches) and older (average age at least 150 years). At the highest elevations of the ecological site, whitebark pine and subalpine larch may be present in the canopy. At warmer site, western white pine, Douglas fir and western larch may occur in the canopy in low cover. The understory is generally dominated by shrub species, The understory species include deerfoot vanilla leaf, pipsissewa, dwarf Oregon-grape, fool's huckleberry, Oregon boxleaf , pyrola species, Pacific yew , and various *Vaccinium* species.

## **Community 1.2**

### **Pioneering herbaceous, shrub, sapling**

The post disturbance phase is initially (approximately three years) dominated by pioneering herbaceous species and resprouting shrubs and resident and windblown tree seedlings including Subalpine fir, lodgepole pine and Engelmann spruce, at warmer sites western white pine, western larch and Douglas fir and at the highest elevations subalpine larch and whitebark pine may occur. A shrub dominated phase develops until shaded by tree saplings including: pipsissewa, dwarf Oregon-grape, fool's huckleberry, Oregon boxleaf, Pacific yew, and various Vaccinium species. After twenty years, seedlings are sapling size.

## **Community 1.3**

### **Mid development with open canopy stand**

A mid development phase of pole sized seral tree species dominates in an open canopy configuration due to windthrow, disease and insect damage, particularly mountain pine beetle. Tree species can include Subalpine fir, Engelmann spruce and lodgepole pine, at warmer sites western white pine, western larch and Douglas fir and at the highest elevations subalpine larch and whitebark pine may occur, that are smaller (less than twenty inches in diameter breast height) and younger (20 to 100 years old).

## **Community 1.4**

### **Late development, open canopy stand**

An open canopy of large trees with a mix of subalpine fir and Engelmann spruce, though lodgepole pine is senescing during this phase, at warmer sites western white pine, western larch and Douglas fir and at the highest elevations subalpine larch and whitebark pine may occur, with an understory of moist adapted shrubs and herbaceous species. Trees are large (average diameter at breast height is larger than twenty inches) and mature (over 100 years old). The canopy is open due to outbreaks of mountain pine beetle primarily, but also windthrow and disease.

## **Community 1.5**

### **Mid development, closed canopy stand**

A closed canopy of mid development pole sized trees in the competitive exclusion phase results from the growth of saplings and that will eventually develop single to few tree deaths that eventually develop into the reference community. Tree species can include Subalpine fir, Engelmann spruce and lodgepole pine, at warmer sites western white pine, western larch and Douglas fir and at the highest elevations subalpine larch and whitebark pine may occur, that are smaller (less than twenty inches in diameter breast height) and younger (20 to 100 years old).

## **Pathway 1.1a**

### **Community 1.1 to 1.2**

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

## **Pathway 1.2a**

### **Community 1.2 to 1.3**

With time, the tree seedlings and small saplings go to the mid development community and due to the occurrence of mixed severity fire the canopy is in an open configuration.

## **Pathway 1.2b**

### **Community 1.2 to 1.4**

With time, the tree seedlings and small saplings go to the mid development community grow into the closed canopy configuration.

### **Pathway 1.3b**

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

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

### **Pathway 1.3a**

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

With time, the pole sized trees develop to large mature trees in the late development phase.

### **Pathway 1.4a**

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

With time, the large mature trees develop into the closed configuration of the reference phase without the occurrence of mixed severity fire.

### **Pathway 1.4b**

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

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

### **Pathway 1.5a**

#### **Community 1.5 to 1.1**

With time, the large mature trees develop into the closed configuration of the reference phase without the occurrence of mixed severity fire.

### **Pathway 1.5b**

#### **Community 1.5 to 1.2**

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

## **Additional community tables**

### **Other references**

Scientific Literature:

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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	04/28/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

## Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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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:
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17. **Perennial plant reproductive capability:**
-