USDA Natural Resources
Conservation Service

# Ecological site AX001X01X408
# Frigid Udic Dry Forest

Last updated: 5/15/2025
Accessed: 04/11/2026

## 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 area consists of a long and narrow range of mountains with associated foothills and valleys that parallels the Pacific Ocean. This area is entirely within the Pacific Border Province of the Pacific Mountain System in Oregon and Washington. MLRA 1 is bounded on the north by the highest elevations of the Olympic Mountains and the strait of Juan de Fuca, and by the Klamath Mountains on the south. The Washington portion of this MLRA is primarily composed of young Tertiary sedimentary rocks (siltstone and sandstone) mixed with some volcanic rocks of the same age. Glacial till and outwash deposits are also found in the northern half of this area in Washington. Much of this area is accreted terrane formed by tectonic processes. The average annual precipitation ranges from 60 to 200 inches (1,525 to 5,580 millimeters), increasing with elevation. Most of the precipitation in this area occurs during low-intensity, Pacific frontal storms and is evenly distributed throughout fall, winter, and spring.

The dominant soil orders in this MLRA are Andisols, Inceptisols, and Ultisols. Soil depths broadly range from shallow to very deep. Soils are primarily well drained, however poorly drained soils may be found in depressional areas and on alluvial floodplains. Surface textures are typically medial and loamy or clayey. Soils in this area dominantly have a mesic or frigid temperature regime and a udic moisture regime. Soils with aquic moisture regimes and cryic temperature regimes also occur.

## Ecological site concept

Frigid Udic Dry Forest sites occur on less stable landscape positions on glacial valley

walls, ridges, and colluvial aprons in the frigid temperature zone. These sites are located on the leeward side of the Olympic Mountains where precipitation is lower. Relatively high slope gradients limit water infiltration on these sites, generating runoff to more stable Frigid Udic Moist Forests, Frigid Aquic Forests, and Temperate Wet Meadows. As a result, Frigid Udic Dry Forest sites are indicated by the presence of dry mesophytic understory species, such as cascade barberry (*Mahonia nervosa*) and common beargrass (*Xerophyllum tenax*).

Frigid Udic Dry Forest sites are characterized by an overstory canopy of Pacific silver fir (Abies amabilis) and Western hemlock (Tsuga heterophylla), accompanied by an understory shrub community dominated by salal (Gaultheria shallon) and cascade barberry. Red huckleberry (Vaccinium parvifolium) and thinleaf huckleberry (*Vaccinium membranaceum*), locally known as black huckleberry, are also likely to be present in the shrub layer. Western redcedar (Thuja plicata) may be present as a minor overstory component. The herbaceous layer is dominated by beargrass, kinnikinnick (Arctostaphylos uva-ursi), strawberryleaf raspberry (*Rubus pedatus*), twinflower (*Linnaea borealis*), and pipissewa (*Chimaphila umbellata*).

## Associated sites

| | |
|---|---|
| AX001X01X200 | **Temperate Wet Meadow**<br>Temperate Wet Meadow sites may be found adjacent to or surrounded by Frigid Udic Dry Forest sites. Temperate Wet Meadows occur on depressions and seeps. Temperate Wet Meadow sites lack tree cover. |
| AX001X01X407 | **Frigid Udic Moist Forest**<br>Frigid Udic Moist Forest sites may occur downslope of Frigid Udic Dry Forest sites and generally have more stable slope gradients. Frigid Udic Moist Forest sites have higher productivity. Frigid Udic Moist Forest sites typically support salmonberry (Rubus spectabilis). |
| AX001X01X108 | **Frigid Aquic Forest**<br>Frigid Aquic Forest sites may occur downslope or in mosaic with Frigid Udic Dry Forest sites. Frigid Aquic Forest sites occur on depressions and seeps and are subject to ponding. |

## Similar sites

| | |
|---|---|
| AX001X01X406 | **Frigid Udic Forest**<br>Frigid Udic Forest sites are located on the windward side of the Olympic mountains and receive higher precipitation. Production on Frigid Udic Forest sites is significantly higher. |
| AX001X01X403 | **Mesic Udic Dry Forest**<br>Mesic Udic Dry Forest sites are located at lower elevations and lack Pacific silver-fir (Abies amabilis). |

| | |
|---|---|
| AX001X01X412 | **Low Cryic Udic Dry Forest**<br>Low Cryic Udic Dry Forest sites occur at higher elevations and are indicated by the presence of mountain hemlock (Tsuga mertensiana). |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Abies amabilis*<br>(2) *Tsuga heterophylla* |
| Shrub | (1) *Gaultheria shallon*<br>(2) *Mahonia nervosa* |
| Herbaceous | (1) *Xerophyllum tenax*<br>(2) *Arctostaphylos uva-ursi* |

## Legacy ID

F001XA408WA

## Physiographic features

This site primarily occurs on glacial valley walls, ridges, and colluvial aprons on mountains. These upland forest sites are strongly influenced by slope gradient. Frigid Udic Dry Forests are typically found on less stable slopes and generate run-off that is collected by more stable Frigid Udic Moist Forest, Frigid Aquic Forest, or Temperate Wet Meadow sites. Frigid Udic Dry Forests lose a significant amount of moisture via run-off.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Mountains<br>(2) Glacial-valley wall<br>(3) Colluvial apron<br>(4) Ridge |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 700–1,250 m |
| Slope | 0–100% |
| Water table depth | 150 cm |
| Aspect | W, NW, N, NE, E, SE, S, SW |

## Climatic features

This site occurs in a frigid temperature and udic moisture regime. Precipitation arrives mostly via low-intensity, Pacific frontal storms. Precipitation is unevenly distributed, with the lowest amounts on the leeward side of the Coast Range mountains. Precipitation falls

largely as snow in higher elevations. Precipitation is evenly distributed throughout the fall, winter, and spring, while summers are dry. Air temperatures vary significantly along the elevation gradient.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 90-150 days |
| Freeze-free period (characteristic range) | |
| Precipitation total (characteristic range) | 1,245-1,753 mm |

## Influencing water features

There are no dominant water features influencing plant community dynamics on site.

## Soil features

The soils are shallow to very deep, have very high or high Ksat throughout, and are well drained. The soils are formed from colluvium or residuum derived from metasedimentary rock. Soil surface texture is gravelly loam. Clay content is 8 to 17 percent throughout. The soil series for this ecological site are Beecreek and Sunnybrook. Although representative of this site, these soils may exist across multiple ecological sites because of naturally variable slope, texture, rock fragments, and pH. An on-site soil pit and the most current ecological site key are necessary to classify a site.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Colluvium–metasedimentary rock<br>(2) Residuum–metasedimentary rock |
| Surface texture | (1) Gravelly loam |
| Drainage class | Well drained |
| Soil depth | 150 cm |
| Surface fragment cover <=3" | 0–5% |
| Surface fragment cover >3" | 0–5% |
| Available water capacity (0-101.6cm) | 3.81–15.24 cm |
| Soil reaction (1:1 water) (0-25.4cm) | 4.5–5.5 |
| Subsurface fragment volume <=3" (0-50.8cm) | 15–40% |

| | |
|---|---|
| Subsurface fragment volume >3" (0-50.8cm) | 0–20% |

## Ecological dynamics

Frequent, small-scale disturbances from windthrow events create a mosaic fabric of early-seral patches within late-seral communities. Windthrow events create canopy gaps that favor establishment of deciduous tree species such as vine maple (*Acer circinatum*). As conifers succeed and close the canopy gap, vine maple fails to regenerate. Dominant conifers on this site are susceptible to a variety of root and butt rot fungi. Wood decay fungi exacerbate mature trees' vulnerability to windthrow events.

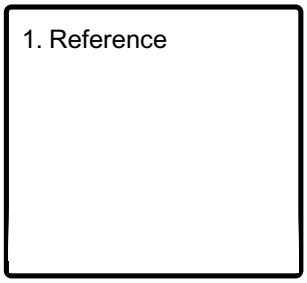
Infrequent, large-scale disturbances may occur in the form of stand-replacing wildfires, cataclysmic wind events, or large mass movement events. High-force windstorms are a major source of large-scale disturbance in these forests. These blowdown events may be stand-replacing and conditions tend to favor shade-intolerant species in their aftermath (Van Pelt, 2007). The fire regime of this portion of the Olympic Peninsula is characterized by high-intensity, stand-replacing fires with a long return interval of greater than 100 years (Agee, 1987). Though infrequent, wildfires have a profound influence on the composition of these forests. Douglas-fir is a shade-intolerant species and generally requires a stand-replacing wildfire to clear canopy for successful recruitment and regeneration. In the absence of large-scale disturbance, more shade-tolerant western hemlock and Pacific silver fir regenerate successfully and gradually succeed Douglas-fir. The longevity of Douglas-fir preserves evidence of historical high-intensity fire events. Large mass-movement events also provide conditions for the initiation of primary succession. Landslides are a significant source of disturbance, owing to the steep terrain and sedimentary geology of the park. (Gavin, 2014). As with stand-replacing wildfires, bare patches created by landslides favor establishment of non-shade tolerant Douglas-fir (Geertsema & Pojar, 2007).

Red alder and Douglas-fir recruits regenerate in the aftermath of stand-replacing disturbance, accompanied by black huckleberry (*Vaccinium membranaceum*) and common beargrass (*Xerophyllum tenax*). Western hemlock gradually establishes post-disturbance, and along with Douglas-fir, begins to form a discrete canopy. As this happens, the understory community diversifies. Shrub and forb layers develop, dominated by black huckleberry and cascade barberry (*Mahonia nervosa*), and common beargrass, twinflower (*Tiarella trifoliata*), and sweet after death (*Achlys triphylla*), locally known as deerfoot vanilla leaf, respectively. As the canopy begins to mature, western hemlock begins to replace Douglas-fir as the dominant tree species. Given enough time, extremely shade-tolerant pacific silver fir will establish on the site. At this point, the canopy is composed of a single, dense stratum. Canopy stratification will be encouraged by tree maturation, as well as by mortality induced by small-scale disturbances. Increased vertical stratification promotes diversity and abundance of shrubs and forbs, allowing a return to reference community conditions.

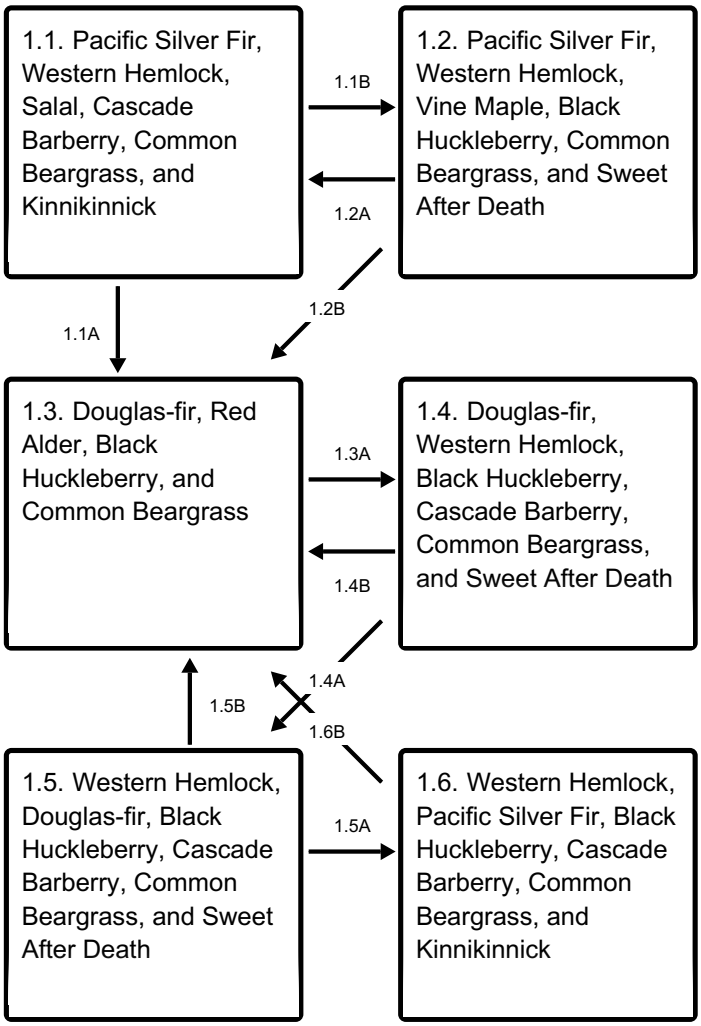
Changes in disturbance frequency or intensity through human alteration of the natural fire regime and a changing climate may promote shifts in community structure and function. For example, fire suppression efforts will likely shift communities further towards a shade-tolerant Pacific silver fir and western hemlock-dominated seral stage. (Reed, 2010) Alternatively, increased fire frequency in some areas due to human activity will encourage Douglas-fir recruitment and establishment. (Gavin, 2015)

## State and transition model

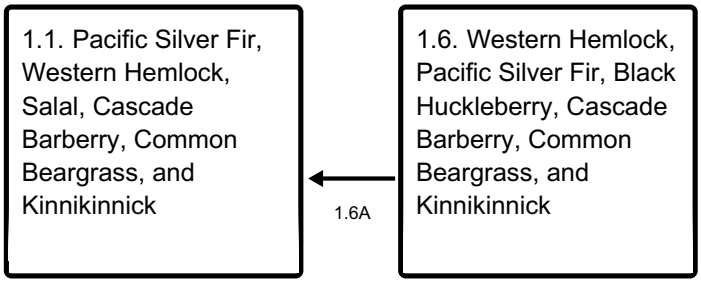
**Ecosystem states**




**State 1 submodel, plant communities**



**Communities 1 and 6 (additional pathways)**




**1.1B** - Minor disturbance

**1.1A** - High-intensity disturbance

**1.2A** - Time without disturbance

**1.2B** - High-intensity disturbance

**1.3A** - Time without disturbance

**1.4B** - High-intensity disturbance

**1.4A** - Time without disturbance

**1.5B** - High-intensity disturbance

**1.5A** - Time without disturbance

**1.6A** - Time without disturbance

**1.6B** - High-intensity disturbance

## State 1
## Reference

The reference state is comprised of six communities in varying stages of regeneration following either small-scale or large-scale disturbance.

### Dominant plant species

- Pacific silver fir (*Abies amabilis*), tree
- western hemlock (*Tsuga heterophylla*), tree
- red alder (*Alnus rubra*), tree
- salal (*Gaultheria shallon*), shrub
- Cascade barberry (*Mahonia nervosa*), shrub
- thinleaf huckleberry (*Vaccinium membranaceum*), shrub
- vine maple (*Acer circinatum*), shrub
- oval-leaf blueberry (*Vaccinium ovalifolium*), shrub
- common beargrass (*Xerophyllum tenax*), other herbaceous
- kinnikinnick (*Arctostaphylos uva-ursi*), other herbaceous
- sweet after death (*Achlys triphylla*), other herbaceous
- pipsissewa (*Chimaphila umbellata*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous
- strawberryleaf raspberry (*Rubus pedatus*), other herbaceous

## Community 1.1

### Pacific Silver Fir, Western Hemlock, Salal, Cascade Barberry, Common Beargrass, and Kinnikinnick

Structure: Multistory with small gap dynamics Pacific silver fir and western hemlock are the dominant overstory species in the reference community. The dense canopy encourages continual regeneration of the extremely shade-tolerant reference conifer species. Common understory species include salal, cascade barberry, black huckleberry, oval-leaf blueberry (*Vaccinium ovalifolium*), common beargrass, kinnikinnick, pipissewa (*Chimaphila umbellata*), strawberryleaf raspberry (*Rubus pedatus*), and twinflower (*Linnaea borealis*). Vine maple (*Acer circinatum*) may be found in small canopy gaps. High vertical stratification in the canopy and the presence of small gaps favors an abundant understory.

## Community 1.2
## Pacific Silver Fir, Western Hemlock, Vine Maple, Black Huckleberry, Common Beargrass, and Sweet After Death

Structure: Mosaic of overstory and openings in varying states of regeneration This community is initiated in the wake of small-scale disturbance which creates small canopy openings. Vine maple establishes in regenerating canopy gaps. Pacific silver fir and western hemlock recruits will eventually establish in the canopy openings and regenerate the canopy. Sweet after death frequently establishes in small canopy gaps.

## Community 1.3
## Douglas-fir, Red Alder, Black Huckleberry, and Common Beargrass

Structure: open forest with shrubby regeneration and snags This community is an early seral stage, occurring after a stand-replacing disturbance. Nearly all trees have been removed. In the case of high-intensity fire, few large fire-resistant trees may remain. Red alder establishes quickly in recently opened areas. Douglas-fir germinates and establishes in the absence of canopy cover post-disturbance. Big leaf maple may also establish. Shrubs and forbs are often able to outcompete tree saplings for several years post-disturbance. Black huckleberry and common beargrass are frequently the first to establish in early seral communities on this site.

## Community 1.4
## Douglas-fir, Western Hemlock, Black Huckleberry, Cascade Barberry, Common Beargrass, and Sweet After Death

Structure: Dense single-story As a canopy layer establishes, western hemlock seedlings begin to establish. Cascade barberry and sweet after death grow alongside the previously established black huckleberry and common beargrass.

## Community 1.5

### Western Hemlock, Douglas-fir, Black Huckleberry, Cascade Barberry, Common Beargrass, and Sweet After Death

Structure: Dense single stratum canopy with diminished understory Additional time without disturbance allows western hemlock to gradually replace Douglas-fir. The understory community composition remains similar to both the previous and subsequent community phases. Understory productivity is diminished due to the dense, single-stratum canopy.

## Community 1.6
## Western Hemlock, Pacific Silver Fir, Black Huckleberry, Cascade Barberry, Common Beargrass, and Kinnikinnick

Structure: Dense single stratum canopy with diminished understory Pacific silver fir recruits will establish in shaded conditions under the dense canopy. With continued understory diversification, the species composition begins to resemble the Reference community. Salal largely replaces black huckleberry as the dominant shrub species. In this community the understory productivity is diminished due to low canopy stratification and dense tree growth which limits available sunlight at the forest floor. Additional time will be required for the stand to develop vertical stratification. Individual tree mortality will promote age class diversity and Pacific silver fir will become either dominant or codominant with western hemlock.

## Pathway 1.1B
## Community 1.1 to 1.2

Minor disturbances, often caused by individual tree mortality, create small gaps in the forest canopy.

## Pathway 1.1A
## Community 1.1 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

## Pathway 1.2A
## Community 1.2 to 1.1

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

## Pathway 1.2B
## Community 1.2 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and

mass-movement events open the forest and lead to the stand initiation phase of development.

### Pathway 1.3A
### Community 1.3 to 1.4

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

### Pathway 1.4B
### Community 1.4 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

### Pathway 1.4A
### Community 1.4 to 1.5

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

### Pathway 1.5B
### Community 1.5 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

### Pathway 1.5A
### Community 1.5 to 1.6

Time without disturbance allows continued tree regeneration and growth.

### Pathway 1.6A
### Community 1.6 to 1.1

Time without disturbance allows regeneration, growth, and progression to the reference community. Individual tree mortality gradually leads to a varied-age stand.

### Pathway 1.6B
### Community 1.6 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and

mass-movement events open the forest and lead to the stand initiation phase of development.

## Additional community tables

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## 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 | 04/11/2026 |
| Approved by | Grant Petersen |
| 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):**

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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:

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:**