USDA Natural Resources
Conservation Service

Ecological site AX001X01X402
Mesic Udic Moist Forest

Last updated: 5/15/2025
Accessed: 04/07/2026

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

Mesic Udic Moist Forest sites occur on stable landscape positions on glacial valley walls,

colluvial aprons, and moraines in the mesic temperature zone. These sites are located on both the windward and leeward sides of the Olympic mountains. Runoff generated from less stable Mesic Udic Forest and Mesic Udic Dry Forest sites accumulates on Mesic Udic Moist Forest sites, resulting in increased available water. As a result, Mesic Udic Moist Forest sites characteristically favor the growth and production of moist mesophytic understory species, such as salmonberry (Rubus spectabilis) and threeleaf foamflower (Tiarella trifoliata).

Mesic Udic Moist Forest sites are characterized by a dense overstory of western hemlock (Tsuga heterophylla) and Douglas-fir (Pseudotsuga menziesii), accompanied by an understory shrub community of salmonberry (Rubus spectabilis) and oval-leaf blueberry (Vaccinium ovalifolium), locally known as oval-leaf huckleberry. The herbaceous layer is dominated by western swordfern (Polystichum munitum) and threeleaf foamflower. Deer fern (Blechnum spicant) and lady fern (Athyrium filix-femina) are also frequently found growing on this site. Western redcedar (Thuja plicata) is commonly present in the overstory.

Associated sites

AX001X01X200	**Temperate Wet Meadow** Temperate Wet Meadow sites may be found adjacent to or surrounded by Mesic Udic Moist Forest sites. Temperate Wet Meadows occur on depressions and seeps. Temperate Wet Meadow sites lack tree cover.
AX001X01X004	**Mesic Aquic Forest** Mesic Aquic Forest sites may occur downslope or in mosaic with Mesic Udic Moist Forest sites. Mesic Aquic Forest sites occur on depressions and seeps and are subject to ponding.
AX001X01X401	**Mesic Udic Forest** Mesic Udic Forest sites may be found upslope of Mesic Udic Moist Forest sites and frequently generate run-off moisture that is captured by Mesic Udic Moist Forest sites.
AX001X01X403	**Mesic Udic Dry Forest** Mesic Udic Dry Forest sites may be found upslope of Mesic Udic Moist Forest sites and frequently generate run-off moisture that is captured by Mesic Udic Moist Forest sites.

Similar sites

AX001X01X406	**Frigid Udic Forest** Frigid Udic Moist Forest sites occur at higher elevations and support Pacific Silver-fir (Abies amabilis).
AX004A01X403	**Udic Moist Forest** Isomesic Udic Moist Forest sites occur at lower elevations in the Sitka Spruce Belt and are indicated by the presence of Sitka spruce (Picea sitchensis).

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Pseudotsuga menziesii*
Shrub	(1) *Gaultheria shallon* (2) *Vaccinium parvifolium*
Herbaceous	(1) *Polystichum munitum* (2) *Linnaea borealis*

Legacy ID

F001XA402WA

Physiographic features

This site primarily occurs on glacial valley walls and colluvial aprons on mountains. These upland forest sites are strongly influenced by slope gradient. Mesic Udic Moist Forest sites are typically found on intermediate slopes between steeper Mesic Udic Forest or Mesic Udic Dry Forest sites and the more stable Temperate Wet Meadow or Mesic Aquic Forest sites. Mesic Udic Moist Forest sites receive a moderate amount of additional moisture due to their run-on slope position.

Table 2. Representative physiographic features

Landforms	(1) Mountains (2) Glacial-valley wall (3) Colluvial apron (4) Moraine
Flooding frequency	None
Ponding frequency	None
Elevation	300–800 m
Slope	15–80%
Water table depth	150 cm
Aspect	Aspect is not a significant factor

Climatic features

This site occurs in a mesic 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)	180-240 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,753-2,743 mm

Influencing water features

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

Soil features

The soils that support this ecological site occur in the mesic soil temperature regime and the udic soil moisture regime. Irely soils are very deep, well drained, formed from colluvium from metasedimentary rock, and occur on very stable glacial valley walls and colluvial aprons. They are subject to intense weathering and strongly developed. Saturated hydraulic conductivity is high or very high throughout, and rock fragment content is greater than 35 percent in the control section. Most soils contain a thin organic layer that protects the soil from wind and water erosion. These soils have no major limiting factors to plant growth. 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
Surface texture	(1) Gravelly loam (2) Gravelly silt loam (3) Gravelly sandy loam
Drainage class	Well drained
Soil depth	150 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	8.89–13.72 cm
Soil reaction (1:1 water) (0-25.4cm)	3.5–5.5
Subsurface fragment volume <=3" (0-50.8cm)	15–50%

Subsurface fragment volume >3" (0-50.8cm)	0–30%

Ecological dynamics

Frequent, small-scale disturbance from windthrow events create a mosaic fabric of early-seral patches within late-seral communities. Canopy gaps created by windthrow favor growth of deciduous tree species such as red alder (*Alnus rubra*) and vine maple (*Acer circinatum*). As conifers succeed, deciduous trees fail to regenerate in the absence of adequate sunlight. 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 the Olympic peninsula is characterized by high-intensity, stand replacing fires with a long return interval – 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 regenerates successfully and gradually succeeds 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).

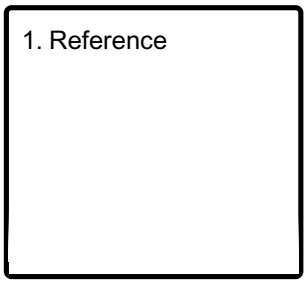
Red alder and Douglas-fir recruits regenerate in the aftermath of stand-replacing disturbance, accompanied by California blackberry (*Rubus ursinus*) and fireweed (*Chamerion angustifolium*). As Douglas-fir and red alder grow and form a discrete canopy, the understory community diversifies. Shrub and forb layers develop, dominated by red huckleberry and vine maple (*Acer circinatum*), and western swordfern and sweet after death (*Achlys triphylla*), locally known as deerfoot vanilla leaf, respectively. As the canopy begins to mature, salal establishes in the shrub layer. 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-

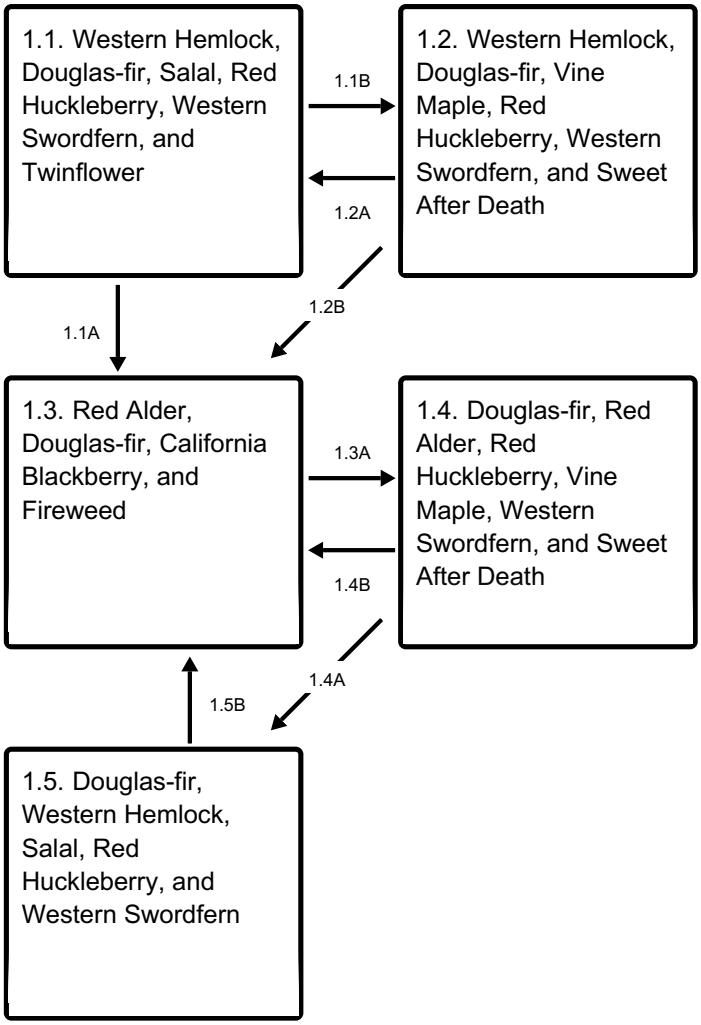
tolerant western hemlock dominated seral stage. (Reed, 2010) Alternatively, increased fire frequency in some areas due to human activity will encourage Douglas-fir recruitment and establishment. (Gavin, 2015)

State and transition model

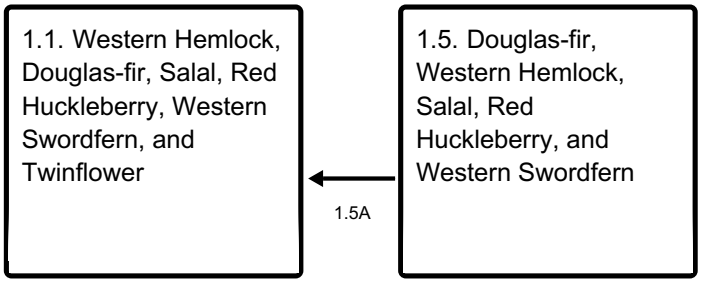
Ecosystem states



State 1 submodel, plant communities



Communities 1 and 5 (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

1.5A - Time without disturbance

1.5B - High-intensity disturbance

State 1
Reference

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

Community 1.1
Western Hemlock, Douglas-fir, Salal, Red Huckleberry, Western Swordfern, and Twinflower

Structure: Multistory with small gap dynamics Western hemlock and Douglas-fir are the dominant overstory species in the reference community. The dense canopy precludes Douglas-fir regeneration except for limited recruitment in small gaps. Shade-tolerate western hemlock will continue to successfully regenerate in this community. Common understory species include salal, red huckleberry, western swordfern, and twinflower. Cascade barberry is frequently present in this community in low abundance. Vine maple 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
Western Hemlock, Douglas-fir, Vine Maple, Red Huckleberry, Western Swordfern, 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. Western hemlock recruits

will eventually establish in the canopy openings and regenerate the canopy. Douglas-fir often does not successfully regenerate in these small gaps as sunlight does is not sufficiently abundant for its seedlings. Twinflower is diminished in these less-shaded gaps. Sweet after death frequently establishes in small canopy gaps.

Community 1.3
Red Alder, Douglas-fir, California Blackberry, and Fireweed

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. Douglas-fir has thick, corky bark and mature individuals may be able to survive some fire events. Red alder establishes quickly in recently opened areas. Big leaf maple may also establish post-disturbance. Shrubs and forbs are often able to outcompete tree saplings for several years post-disturbance. California blackberry, locally known as trailing blackberry, and fireweed are frequently the first to establish in early seral communities.

Community 1.4
Douglas-fir, Red Alder, Red Huckleberry, Vine Maple, Western Swordfern, and Sweet After Death

Structure: Dense single-story Douglas-fir can regenerate successfully in the years following a stand-replacing disturbance. As time progresses, understory species regenerate and diversify. Vine maple, red huckleberry, salal, and cascade barberry often establish on this site, accompanied by western swordfern and sweet after death. Western hemlock is slower to establish post-disturbance and may not begin successful regeneration until a canopy has been established.

Community 1.5
Douglas-fir, Western Hemlock, Salal, Red Huckleberry, and Western Swordfern

Structure: Dense single stratum canopy with diminished understory Continued Douglas-fir growth forms a dense canopy. Western hemlock gradually regenerates under the canopy. The understory continues to develop. Salal and red huckleberry dominate the shrub layer, while western swordfern is common in the herbaceous layer. While the species composition of the understory begins to resemble the reference community, understory productivity is diminished due to low canopy stratification and dense tree growth, limiting 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 western hemlock will gradually begin replacing Douglas-fir.

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 1.5A

Community 1.5 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 1.5B
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.

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	04/07/2026
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:

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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:**
