USDA Natural Resources Conservation Service

Ecological site F003XN941WA
Southern Washington Cascades Wet Frigid Coniferous Forest

Last updated: 1/30/2025
Accessed: 05/10/2025

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

Steep mountains and narrow to broad, gently sloping valleys characterize this MLRA. A triple junction of two oceanic plates and one continental plate is directly offshore from Puget Sound. Subduction of the oceanic plates under the westerly and northwesterly moving continental plate contributes to volcanic activity in the Cascade Mountains. Movement among these plates has resulted in major earthquakes and the formation of large stratovolcanoes. The Cascade Mountains consist primarily of volcanic crystalline rock and some associated metasedimentary rock. The mean annual precipitation is dominantly 60 to 100 inches, but it is 30 to 60 inches on the east side of the Cascade Mountains.
The soil orders in this MLRA are dominantly Andisols, Spodosols, and Inceptisols and minor areas of Entisols and Histosols. The soils are dominantly in the frigid or cryic temperature regime and the udic moisture regime. The soils generally are shallow to very deep, well drained, ashy to medial, and loamy or sandy. They are on mountain slopes and ridges.

Ecological site concept

This ecological site is in depressions and swales and on terraces, glacial-valley walls, and debris aprons in Mount Rainier National Park. Climate is a key component in the succession of the forest dynamics. The site is in cool, wet areas at middle to high elevations (1,600 to 4,600 feet).
The soils that support this ecological site are in the frigid soil temperature regime and the aquic soil moisture regime. They are poorly drained and very deep. The soils have a seasonal high water table at the surface to a depth of 10 inches below the surface at some time during the growing season. They are subject to frequent periods of ponding in April, May, and June, which has a direct effect on the vegetative productivity of the site. A thin organic horizon consisting of decomposing twigs, needles, and litter is on the soil surface. This horizon helps to protect the soils from wind and water erosion.
Western redcedar (*Thuja plicata*) and red alder (*Alnus rubra*) are the most common overstory species, but some western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and grand fir (*Abies grandis*) are present. The root penetration of western redcedar makes it well adapted to forested swamps. American skunkcabbage (*Lysichiton americanus*), Oregon oxalis (*Oxalis oregana*), western swordfern (*Polystichum munitum*), deer fern (*Blechnum spicant*), western oakfern (*Gymnocarpium dryopteris*), and twinflower (*Linnaea borealis*) are in scattered areas.

Associated sites

F003XN945WA	**Southern Washington Cascades Wet Low Cryic Coniferous Forest** The vegetation in ecological site F003XN945WA has commonalities to that of site F003XN941WA; however, site F003XN945WA receives more precipitation and is commonly located at higher elevations.

Similar sites

F003XN943WA	**Southern Washington Cascades Frigid Coniferous Forest** Ecological site F003XN941WA, Southern Washington Cascades Wet Frigid Coniferous Forest, is similar to site F003XN943WA, Southern Washington Cascades Frigid Coniferous Forest. F003XN943WA has a lower water table and higher water-holding capacity. The vegetation ranges from the more wet-adapted species, such as western redcedar and American skunkcabbage, in site F003XN941WA to drier species, such as western hemlock and Cascade Oregon grape, in site F003XN943WA.
F003XN942WA	**Southern Washington Cascades Moist Frigid Coniferous Forest** Ecological site F003XN941WA, Southern Washington Cascades Wet Frigid Coniferous Forest, is similar to site F003XN942WA, Southern Washington Cascades Moist Frigid Coniferous Forest. Ecological site F003XN941WA is wetter and will frequently pond water on the soil surface between April and June. Site F003XN942WA has a high seasonal water table starting at a depth of 10-20 inches from the soil surface at some point during the growing season.

Table 1. Dominant plant species

Tree	(1) *Thuja plicata* (2) *Alnus rubra*
Shrub	Not specified
Herbaceous	(1) *Lysichiton americanus* (2) *Oxalis oregana*

Physiographic features

This ecological site in depressions and swales and on terraces, glacial-valley walls, and debris aprons at middle to high elevations (1,600 to 4,600 feet) in Mount Rainier National Park. Slope commonly is 0 to 10 percent.

Table 2. Representative physiographic features

Landforms	(1) Terrace > Swale (2) Depression (3) Glacial-valley wall
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	1,600–4,600 ft
Slope	0–10%
Water table depth	0–10 in
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

Most of the annual precipitation is received in October through March. The mean annual precipitation is 70 to 83 inches, and the mean annual air temperature is 41 to 45 degrees F. Generally, the summers are cool and dry and the winters are cool and wet.

Table 3. Representative climatic features

Frost-free period (characteristic range)	90-130 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	70-83 in

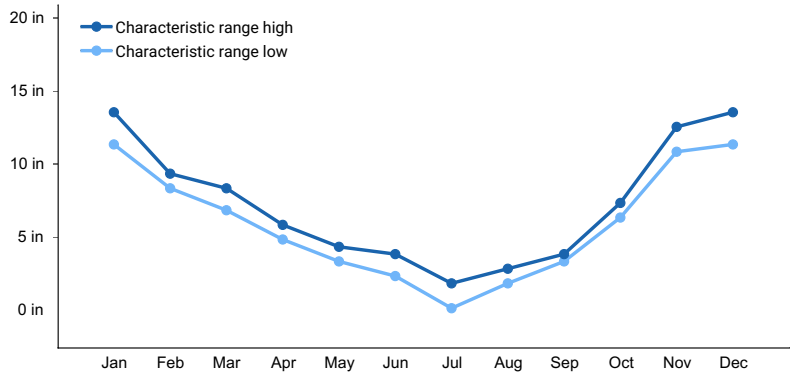


Figure 1. Monthly precipitation range

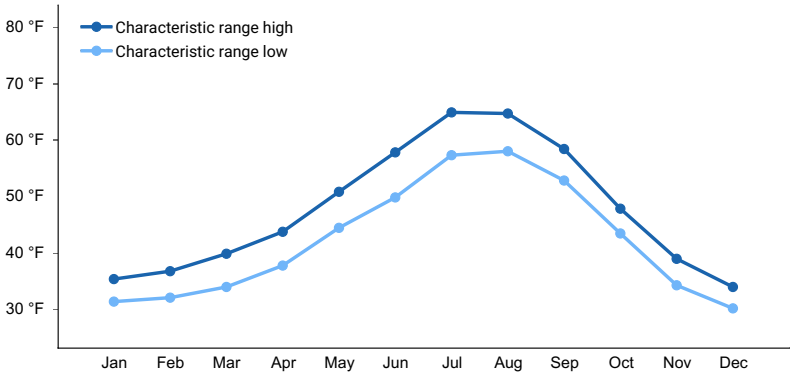


Figure 2. Monthly minimum temperature range

Influencing water features

This ecological site is at middle to high elevations of flood plains in Mount Rainier National Park. The soils associated with this site have a seasonal high water table. They are subject to frequent, long periods of ponding during the growing season.

Soil features

Applicable soils: Sunbeam

Applicable soil map units: 6101, 6110, 6120, 6125, 7110, 7120, 7125

The Sunbeam soils are in depressions and swales, on terraces of river valleys, and on debris aprons and glacial-valley walls of mountain slopes. The soils have a seasonal high water table at the surface to a depth of 10 inches below the surface some time during the growing season. They are subject to frequent periods of ponding in April, May, and June. The soils formed in volcanic ash, and they have less than 35 percent rock fragments in the particle-size control section. They are coarse textured and primarily ashy loamy sand and ashy sandy loam. The upper mineral horizon is mucky. These soils have an ochric epipedon and a cambic horizon. Podsolization is not evident in the profile.
Soil moisture is not a limiting factor to forest growth on these soils because of the abundance of precipitation and the inherent water-holding properties of soils influenced by volcanic ash. A thin organic horizon consisting of decomposing twigs, needles, and litter is on the soil surface. This horizon helps to protect the soils from wind and water erosion.

Table 4. Representative soil features

Parent material	(1) Volcanic ash
Surface texture	(1) Marly, ashy sandy loam (2) Mucky, ashy loamy sand
Drainage class	Poorly drained

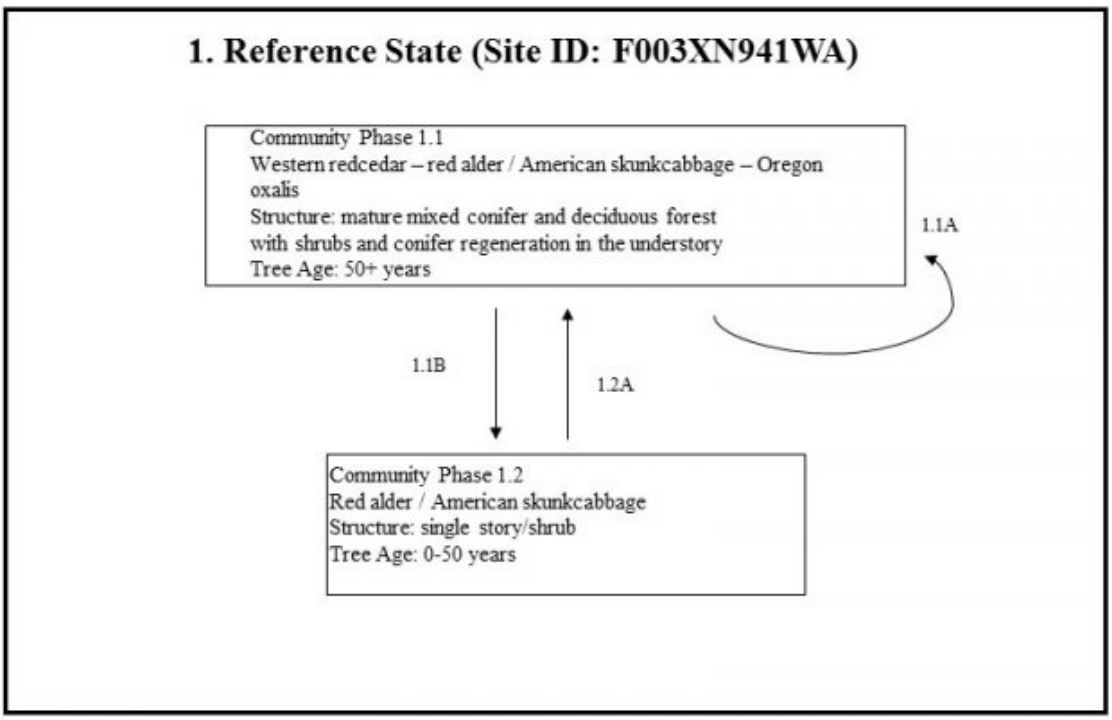
Soil depth	60 in
Surface fragment cover <=3"	0–26%
Surface fragment cover >3"	0–6%
Available water capacity (Depth not specified)	4.3–11.8 in
Soil reaction (1:1 water) (Depth not specified)	3.5–5.5
Subsurface fragment volume <=3" (Depth not specified)	0–35%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

This ecological site is in depressions and swales and on terraces, debris aprons, and glacial valley walls. The soils that support the site have a seasonal high water table. Western redcedar (*Thuja plicata*) and red alder (*Alnus rubra*) are the most common overstory species, but some western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and grand fir (*Abies grandis*) are present. Vine maple (*Acer circinatum*), salmonberry (*Rubus spectabilis*), devilsclub (*Oplopanax horridus*), and thimbleberry (*Rubus parviflorus*) make up the dense subcanopy. American skunkcabbage (*Lysichiton americanus*), Oregon oxalis (*Oxalis oregana*), western swordfern (*Polystichum munitum*), deer fern (*Blechnum spicant*), western oakfern (*Gymnocarpium dryopteris*), and twinflower (*Linnaea borealis*) are in scattered areas.

The most common natural disturbance is ponding. The volume and longevity of the ponding determine the effect on the dynamics of the forest. Windthrow occurs as a result of the seasonal high water table. In saturated areas, trees tip up because the roots grow laterally as a result of the shallow rooting depth. This creates openings in the canopy and allows more sunlight to reach the forest floor, which lead to a shrubby understory. Because of the frequent tip-ups, the site has a hummocky surface and an abundance of downed woody debris. Western redcedar regenerates in these disturbed areas and reproduces on fallen branches and trees (Minore, 1990).

State and transition model



Tjuja plicata – Alnus rubra / Lysichiton americanus – Oxalis oregana

Western redcedar – red alder / American skunkcabbage – Oregon oxalis

→ Community Phase Pathway 1.X = Community Phase X#Y = Transition Pathway
1.XY = Pathway (ecological response to natural processes)

State 1
Reference

Community 1.1
Western Redcedar, Red Alder, American Skunkcabbage, and Oregon Oxalis

Structure: Mature mixed conifer and deciduous forest with shrubs and conifer regeneration in the understory The reference community represents an absence of major disturbance for at least 50 years. Western redcedar and red alder are the dominant overstory species. Western redcedar is shade tolerant, and it can survive as long as 1,000 years (Minore, 1990). In contrast, red alder is relatively short lived. It matures at about 65 years of age and rarely survives longer than 100 years (Harrington, 1990). With the absence of disturbance and openings in the canopy,

red alder will be replaced by shade-tolerant species. Douglas-fir and western hemlock are subcomponents of the forest; however, both species are poorly suited to areas that have a water table at a depth of less than 6 inches. Both species can become established in areas that are in an ustic or xeric soil moisture regime, but they grow poorly and rarely become as prolific or dominant as does western redcedar (Packee, 1990). If the soil moisture shifts over time to more well drained conditions, western hemlock and western redcedar may become dominant. Vine maple (*Acer circinatum*), salmonberry (*Rubus spectabilis*), devilsclub (*Oplopanax horridus*), and thimbleberry (*Rubus parviflorus*) make up the dense subcanopy. Because of the frequent tip-up of trees, the site has a hummocky surface and an abundance of downed woody debris. American skunkcabbage (*Lysichiton americanus*), Oregon oxalis (*Oxalis oregana*), western swordfern (*Polystichum munitum*), deer fern (*Blechnum spicant*), western oakfern (*Gymnocarpium dryopteris*), and twinflower (*Linnaea borealis*) are in scattered areas. Common disturbances include small gap dynamics (openings of 1/2 acre or smaller) following the decline of shade-intolerant species and minor deposition of sediment, which leads to mortality of the vegetation. Community phase pathway 1.1A This pathway represents minor disturbances that maintain the overall structure of the reference community. The mortality of one or two trees creates gaps that allow sunlight to reach the forest floor, promoting the growth of forbs and shrubs and the regeneration of overstory species. Deposition of soil material as a result of ponding temporarily affects the understory community, but it does not alter the composition of the overstory.

Forest overstory. The forest canopy consists of western redcedar, western hemlock, Douglas-fir, grand fir, and red alder. The forest has multiple layers. The upper canopy ranges from 100 to 220 feet in height, and it averages 110 feet. The diameter of the trees varies depending on the species.

Forest understory. The understory varies depending on the overstory and competition for moisture and light. Overall cover of shrubs such as vine maple and devilsclub is as much as 35 percent. Shrubs are prolific in the reference community. Overall cover of forbs such as oxalis, common ladyfern, and western swordfern is as much as 30 percent.

Dominant plant species

- western redcedar (*Thuja plicata*), tree
- red alder (*Alnus rubra*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- vine maple (*Acer circinatum*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- devilsclub (*Oplopanax horridus*), shrub
- thimbleberry (*Rubus parviflorus*), shrub
- American skunkcabbage (*Lysichiton americanus*), other herbaceous
- redwood-sorrel (*Oxalis oregana*), other herbaceous
- western oakfern (*Gymnocarpium dryopteris*), other herbaceous
- western swordfern (*Polystichum munitum*), other herbaceous
- deer fern (*Blechnum spicant*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous

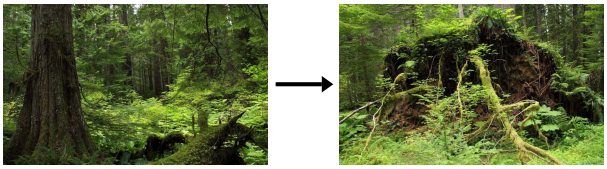
Community 1.2
Red Alder and American Skunkcabbage

Structure: Single story/shrub Community phase 1.2 represents a forest that is undergoing regeneration or stand initiation. Scattered remnant mature trees are in some areas. Red alder, salmonberry, and vine maple are the pioneering early seral species that establish first after a major disturbance. The seeds of these species are light and can be transported long distances by wind and water, allowing for rapid recolonization. Most of the common shrubs, such as vine maple, can readily regenerate by sprouting from the root crown that has been buried by sediment during periods of ponding. The shrubs compete with seedlings and saplings until the tree species overtop them. Major disturbances allow seral forb species to become established.

Dominant plant species

- red alder (*Alnus rubra*), tree
- salmonberry (*Rubus spectabilis*), shrub
- vine maple (*Acer circinatum*), shrub
- American skunkcabbage (*Lysichiton americanus*), other herbaceous

Pathway 1.1B
Community 1.1 to 1.2

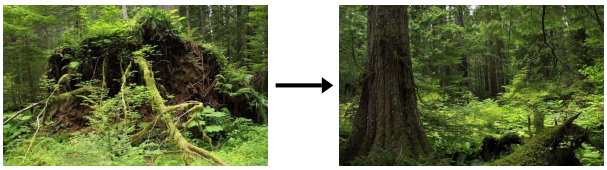


Western Redcedar, Red Alder, American Skunkcabbage, and Oregon Oxalis

Red Alder and American Skunkcabbage

This pathway represents excessive ponding, which results in a shallow rooting zone. This affects the stability of trees. Windthrow may create pockets of fallen trees in areas larger than 1 acre in size.

Pathway 1.2A
Community 1.2 to 1.1



Red Alder and American Skunkcabbage

Western Redcedar, Red Alder, American Skunkcabbage, and Oregon Oxalis

This pathway represents growth over time with no further significant disturbance. The areas of regeneration move through the typical phases of stands, including competitive exclusion, maturation, and understory reinitiation, until they resemble the old-growth structure of the reference community.

Additional community tables

Table 5. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
grand fir	ABGR	*Abies grandis*	Native	–	–	–	–
western redcedar	THPL	*Thuja plicata*	Native	–	–	–	–
red alder	ALRU2	*Alnus rubra*	Native	–	–	–	–
western hemlock	TSHE	*Tsuga heterophylla*	Native	–	–	–	–
Douglas-fir	PSME	*Pseudotsuga menziesii*	Native	–	–	–	–

Table 6. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Forb/Herb					
redwood-sorrel	OXOR	*Oxalis oregana*	Native	1–8	0–20
twinflower	LIBO3	*Linnaea borealis*	Native	1–6	0–3
Fern/fern ally					
western swordfern	POMU	*Polystichum munitum*	Native	12–48	0–30
common ladyfern	ATFI	*Athyrium filix-femina*	Native	1–36	0–20
western oakfern	GYDR	*Gymnocarpium dryopteris*	Native	3–6	0–15
Shrub/Subshrub					
vine maple	ACCI	*Acer circinatum*	Native	24–360	0–35
devilsclub	OPHO	*Oplopanax horridus*	Native	12–120	0–30
Cascade barberry	MANE2	*Mahonia nervosa*	Native	12–24	0–10
red huckleberry	VAPA	*Vaccinium parvifolium*	Native	12–36	0–5

Table 7. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
western hemlock	*TSHE*	–	67	–	175	90	–	–	

Inventory data references

Other Established Classifications

National vegetation classification: Vancouverian Flooded and Swamp Forest Macrogroup-North Pacific Hardwood-Conifer Swamp Group

U.S. Department of Agriculture, Forest Service, plant association: TSHE/LYAM, TSHE/OPHO-ATFI

U.S. Department of the Interior, National Park Service, plant association: TSUHET-(THUPLI-ALNRUB)/LYSAME-ATHFIL; TSUHET-ABIAMA/VACALA/LYSAME

Type locality

Location 1: Pierce County, WA	
Township/Range/Section	T15N R07E S34
Latitude	46° 44′ 39″

Longitude	121° 54′ 5″

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Contributors

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Approval

Kirt Walstad, 1/30/2025

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	05/10/2024
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:**

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:**

17. **Perennial plant reproductive capability:**