

Ecological site F003XN946WA

Southern Washington Cascades Moist Low Cryic Coniferous Forest

Last updated: 1/30/2025
Accessed: 10/04/2026

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): 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 at middle to high elevations (1,800 to 5,700 feet) in Mount Rainier National Park. Climate is key in the succession of the forest dynamics. The cold, wet winters and dry, cool summers impact the species composition and site productivity. This ecological site is in swales and on terraces and debris aprons of glacial-valley walls. The soils that support this site are in the cryic soil temperature regime and the aquic soil moisture regime. They are somewhat poorly drained and very deep. They have a seasonal high water table in March through June. The most common natural disturbance is windthrow due to the seasonal high water table. Soil moisture is not a limiting factor for forest growth 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 soil from wind and water erosion. Pacific silver fir (*Abies amabilis*) and western redcedar (*Thuja plicata*) are the most common overstory species. Bigleaf maple (*Acer macrophyllum*), western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and red alder (*Alnus rubra*) may be codominant. Devilsclub (*Oplopanax horridus*), vine maple (*Acer circinatum*), salmonberry (*Rubus spectabilis*), and thimbleberry (*Rubus parviflorus*) make up the dense subcanopy.

Associated sites

F003XN942WA	Southern Washington Cascades Moist Frigid Coniferous Forest Ecological site F003XN946WA is located at higher elevations compared to F003XN942WA. The presence of Pacific silver fir is a good indicator for F003XN946WA.
F003XN950WA	Southern Washington Cascades Moist High Cryic Coniferous Forest Ecological site F003XN950WA is located at higher elevations compared to F003XN946WA. The presence of mountain hemlock, Alaska cedar, and Cascade azalea are good indicators for F003XN950WA.

Similar sites

F003XN947WA	Southern Washington Cascades Low Cryic Coniferous Forest Ecological F003XN946WA, Southern Washington Cascades Moist Low Cryic Coniferous Forest, has features similar to those of site F003XN947WA, Washington Cascades Low Cryic Coniferous Forest. The soils of site F003XN947WA are well drained. Species adapted to the drier conditions, such as Pacific silver fir, western hemlock, and black mountain huckleberry, are common.
F003XN945WA	Southern Washington Cascades Wet Low Cryic Coniferous Forest Ecological F003XN945WA, Southern Washington Cascades Wet Low Cryic Coniferous Forest, has features similar to those of site F003XN946WA, Washington Cascades Moist Low Cryic Coniferous Forest. Ecological site F003XN945WA is wetter than site F003XN946WA. It is prone to frequent periods of ponding and it has a higher seasonal water table. As a result, site F003XN945WA supports species adapted to wetness, such as western redcedar, red alder, and American skunkcabbage. Ecological F003XN946WA is drier, and it supports species such as Pacific silver fir, western redcedar, and devilsclub.

Table 1. Dominant plant species

Tree	(1) <i>Abies amabilis</i> (2) <i>Thuja plicata</i>
Shrub	(1) <i>Oplopanax horridus</i>
Herbaceous	(1) <i>Polystichum munitum</i>

Physiographic features

This ecological site is in swales and on terraces and debris aprons of glacial-valley walls at middle to high elevations (1,800 to 5,700 feet) in Mount Rainier National Park. Slope commonly is 0 to 35 percent.

Table 2. Representative physiographic features

Landforms	(1) Swale (2) Terrace (3) Glacial-valley wall
Flooding frequency	None
Ponding frequency	None
Elevation	550 – 1,740 m
Slope	0 – 40 %
Water table depth	0 – 150 cm

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 63 to 106 inches, and the mean annual air temperature is 37 to 44 degrees F. Generally, the summers are cool and dry and the winters are cold and wet.

Table 3 Representative climatic features

Frost-free period (characteristic range)	60-90 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,600-2,690 mm

Influencing water features

In general, this ecological site is not influenced by wetland or riparian water features. The soils have a seasonal high water table at a depth of 10 to 20 inches at some time during the growing season. The water table typically rises in spring and recedes in fall.

Soil features

Applicable soils: Vantrump

Applicable soil map units: 8110, 8120, 8125, 8130, 8150, 9100, 9110, 9120, 9125

The Vantrump soils formed in volcanic ash over andesite colluvium. They have a seasonal high water table at a depth of 10 to 20 inches at some time during the growing season. They are not subject to flooding or ponding. The particle-size control section is less than 35 percent rock fragments. The soils are coarse textured and are primarily ashy sandy loam or ashy loamy sand. Pumice paragravel is in some pedons. The soils have an ochric epipedon, redoximorphic features, and andic properties. Podsolization is not evident in the profile.

Table 4. Representative soil features

Parent material	(1) Volcanic ash – andesite
Surface texture	(1) Ashy sandy loam (2) Paragravelly, ashy sandy loam (3) Ashy loamy sand
Drainage class	Somewhat poorly drained
Soil depth	150 cm
Surface fragment cover <=3"	0 – 30 %
Surface fragment cover >3"	0 – 10 %

Available water capacity (Depth not specified)	10.41 – 25.91 cm
Soil reaction (1:1 water) (Depth not specified)	3.5 – 5.5
Subsurface fragment volume <=3" (Depth not specified)	0 – 40 %
Subsurface fragment volume >3" (Depth not specified)	0 – 10 %

Ecological dynamics

This ecological site is on the cool, moist slopes of Mount Rainier at elevations of 1,800 to 5,700 feet, depending on aspect. A seasonal high water table is at a depth of 10 to 20 inches from the soil surface. Pacific silver fir (*Abies amabilis*) and western redcedar (*Thuja plicata*) are the most common overstory species. Bigleaf maple (*Acer macrophyllum*), western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and red alder (*Alnus rubra*) may be minor components of the overstory.

The most common natural disturbance is windthrow due to the seasonal high water table. The shallow rooting zone in the saturated areas causes roots to grow laterally, resulting in frequent tip-ups. This results in openings in the canopy that allow more sunlight to reach the forest floor, leading to a shrubby understory. Because of the frequent tip-ups, this site has a hummocky surface with an abundance of downed woody debris. Western redcedar regenerates successfully in the disturbed areas and reproduces on fallen branches and trees (Minore, 1990).

Devilsclub (*Oplopanax horridus*), vine maple (*Acer circinatum*), salmonberry (*Rubus spectabilis*), and thimbleberry (*Rubus parviflorus*) make up the dense subcanopy. This site has an herb layer that consists of common western swordfern (*Polystichum munitum*), deer fern (*Blechnum spicant*), western oakfern (*Gymnocarpium dryopteris*), and twinflower (*Linnaea borealis*) in scattered areas.

Pacific silver fir, western hemlock, and Douglas-fir on this site are highly susceptible to forest pathogens, particularly annosus (*Heterobasidion annosum*). Disturbance by fire is infrequent because of the high humidity and precipitation. The frequency of high-intensity, stand-replacing wildfires is approximately 500 years or more (Tesky, 1992).

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
-------	-------------	--------	-----------------	----------------------	------------------

Table 6. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height M	Canopy Cover (%)	Diameter Cm	Basal Area (square M/hectare)
Tree							
western redcedar	THPL	<i>Thuja plicata</i>	Native	–	–	–	–
Pacific silver fir	ABAM	<i>Abies amabilis</i>	Native	–	–	–	–
western hemlock	TSHE	<i>Tsuga heterophylla</i>	Native	–	–	–	–
Douglas-fir	PSME	<i>Pseudotsuga menziesii</i>	Native	–	–	–	–
red alder	ALRU2	<i>Alnus rubra</i>	Native	–	–	–	–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Forb/Herb					
sweet after death	ACTR	<i>Achlys triphylla</i>	Native	0.3-7.3	0-35
twinflower	LIBO3	<i>Linnaea borealis</i>	Native	0.3-0.9	0-10
Fern/fern ally					
western swordfern	POMU	<i>Polystichum munitum</i>	Native	1.8-7.3	0-20
common ladyfern	ATFI	<i>Athyrium filix-femina</i>	Native	1.2-7.3	0-15
western oakfern	GYDR	<i>Gymnocarpium dryopteris</i>	Native	0.3-7.3	0-10
Shrub/Subshrub					
vine maple	ACCI	<i>Acer circinatum</i>	Native	3.7-54.9	0-60
devilsclub	OPHO	<i>Oplopanax horridus</i>	Native	3.7-21.9	0-25
salmonberry	RUSP	<i>Rubus spectabilis</i>	Native	3.7-14.6	0-15
thinleaf huckleberry	VAME	<i>Vaccinium membranaceum</i>	Native	1.8-11	0-15

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
-------	-------------	--------	-----------------	----------------------	------------------

Table 9. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
-------	-------------	--------	-----------------	----------------------	------------------

Table 10. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
-------	-------------	--------	-----------------	----------------------	------------------

Table 11. Community 1.5 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
-------	-------------	--------	-----------------	----------------------	------------------

Table 12. Community 1.6 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
-------	-------------	--------	-----------------	----------------------	------------------

Other information

Pathogens Annosus root disease (*Heterobasidion annosum*) can affect nearly all conifer species in the Pacific Northwest. This disease is slow growing, but it can cause severe root and butt decay in affected stands. It commonly affects stands in conjunction with armillaria and laminated root rots and precedes bark beetle infestations. Signs and symptoms of annosus commonly are difficult to differentiate from those of armillaria. Obvious signs include circular pockets of windthrown trees and canopy dieback. A distinctive fruiting body, called a conk, is in hollow stumps of forests affected by annosus. Other identifying features include a reddish stain, decay, and a spongy texture in the heartwood and roots (Goheen, 2006). Regeneration of conifers may be unsuccessful for several decades, until the soil is void of fungal inoculum. Application of borax on freshly cut tree stumps (within 24 hours) may reduce the spread in managed stands.

Table 13. 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	<i>TSHE</i>	–	123	–	227	90	–	–	
Pacific silver fir	<i>ABAM</i>	96	151	104	192	90	–	–	

Inventory data references

Other Established Classifications National vegetation classification: Vancouverian Flooded and Swamp Forest Macrogroup-North Pacific Montane Riparian Woodland U.S. Department of Agriculture, Forest Service, plant association: ABAM/OPHO U.S. Department of the Interior, National Park Service, plant association: ABIAMA-TSUHET/OPLHOR

Type locality

Location 1: Pierce County, WA	
Township/Range/Section	T17N R10E S33
Latitude	46° 54'39"
Longitude	121° 32'44"

Other references

- Barnes, George H. 1962. Yield of even-aged stands of western hemlock. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station Technical Bulletin 1273.
- Crawford, R.C., C.B. Chappell, C.C. Thompson, and F.J. Rocchio. 2009. Vegetation classification of Mount Rainier, North Cascades, and Olympic National Parks. Natural Resource Technical Report NPS/NCCN/NRTR-2009/211. National Park Service, Fort Collins, Colorado.
- Czuba, J., C. Magirl, C. Czuba, C. Curran, K. Johnson, T. Olsen, H. Kimball, and C. Gish. 2012. Geomorphic analysis of the river response to sedimentation downstream of Mount Rainier, Washington. U.S. Geological Survey Open-file Report 2012-1242. Reston, Virginia.
- Dwire, K., and J. Kauffman. 2003. Fire and riparian ecosystems in landscapes in the western United States. Forest Ecology and Management. Volume 178, pages 61-74.
- Goheen, E.M., and E.A. Willhite. 2006. Field guide to common diseases and insect pests of Oregon and Washington conifers. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region R6-NR-FID-PR-01-06.
- Hanley, D.P., and D.M. Baumgartner. 2002. Forest ecology in Washington. Washington State University Cooperative Extension Technical Report EB 1943.
- Hanson, E.J., D.L. Azuma, and B.A. Hiserote. 2002. Site index equations and mean annual increment equations for Pacific Northwest Research Station forest inventory and analysis inventories, 1985-2001. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station Research Note PNW-RN-533.
- Harrington, C. 1990. *Alnus rubra*. In *Silvics of North America: Volume 2. Hardwoods*. U.S. Department of Agriculture, Forest Service, Agriculture Handbook 654. Pages 116-123. https://www.srs.fs.usda.gov/pubs/misc/ag_654_vol2.pdf
- Henderson, J.A., R.D. Leshner, D.H. Peter, and D.C. Shaw. 1992. Field guide to the forested plant associations of the Mt. Baker-Snoqualmie National Forest. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region Technical Paper R6-ECOL-TP-028-91.
- King, James E. 1966. Site index curves for Douglas-fir in the Pacific Northwest. Weyerhaeuser Company, Forestry Research Center Forestry Paper 8.
- Kittel, G., D. Meidinger, and D. Faber-Langendoen. 2015. G240 *Pseudotsuga menziesii*-*Tsuga heterophylla*/*Gaultheria shallon* forest group. United States National Vegetation Classification. Federal Geographic Data Committee, Vegetation Subcommittee, Washington, D.C.
- Means, J.E. 1990. *Tsuga mertensiana*. In *Silvics of North America: Volume 1. Conifers*. U.S. Department of Agriculture, Forest Service, Agriculture Handbook 654. Pages 623-634. https://www.srs.fs.usda.gov/pubs/misc/ag_654_vol1.pdf
- Minore, D. 1990. *Thuja plicata*. In *Silvics of North America: Volume 1. Conifers*. U.S. Department of Agriculture, Forest Service, Agriculture Handbook 654. Pages 590-600. https://www.srs.fs.usda.gov/pubs/misc/ag_654_vol1.pdf
- Packee, E.C. 1990. *Tsuga heterophylla*. In *Silvics of North America: Volume 1. Conifers*. U.S. Department of Agriculture, Forest Service, Agriculture Handbook 654. Pages 613-622. https://www.srs.fs.usda.gov/pubs/misc/ag_654_vol1.pdf
- Pojar, J., and A. MacKinnon. 1994. Plants of the Pacific Northwest Coast. Lone Pine, Vancouver, British Columbia.
- PRISM Climate Group. Oregon State University. Accessed February 2015. <http://prism.oregonstate.edu>
- Rochefort, R.M., and D.L. Peterson. 1996. Temporal and spatial distribution of trees in subalpine meadows of Mount Rainier National Park. Arctic and Alpine Research. Volume 28, number 1, pages 52-59.
- Seastedt, T.R., and G.A. Adams. 2001. Effects of mobile tree islands on alpine tundra soils. Ecology. Volume 82, pages 8-17.
- Scientia Silvica. 1997. Regeneration patterns in the mountain hemlock zone. Extension Series, Number 6.
- Smith, K., G. Kuhn, and L. Townsend. 2008. Culmination of mean annual increment for indicator tree species in the State of Washington. U.S. Department of Agriculture, Natural Resources Conservation Service, Technical Note Forestry-9.
- Tesky, J.L. 1992. *Tsuga mertensiana*. In Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. <https://www.fs.fed.us/database/feis/plants/tree/tsumer/all.html>
- Topik, C., N.M. Halverson, and D.G. Brockway. 1986. Plant associations and management guide for the western hemlock zone, Gifford Pinchot National Forest. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region Technical Paper R6-ECOL-230A-1986.
- United States Department of Agriculture, Forest Service. 1990. Silvics of North America. Agriculture Handbook 654. <https://www.fs.usda.gov/naspf/>
- United States Department of Agriculture, Natural Resources Conservation Service, and United States Department of the Interior, National Park Service. 2014. Ecological site descriptions for North Cascades National Park Complex, Washington.

Contributors

Erik Dahlke
Erin Kreutz
Philip Roberts

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	
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:
