Ecological site F003XN942WA
Southern Washington Cascades Moist Frigid Coniferous Forest

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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

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 Mount Rainier National Park at low to middle elevations (1,600 to 3,600 feet). Climate is a key component in the succession of the forest dynamics. This site is in depressions and stream channels of terraces, debris aprons, and valley walls. The soils that support this ecological site are in the frigid soil temperature regime and the aquic soil moisture regime. They are somewhat poorly drained and very deep. They have a seasonal high water table at a depth of 10 to 20 inches at some time during the growing season. Soil moisture is not a limiting factor to 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. Western hemlock (Tsuga heterophylla) and western redcedar (Thuja plicata) are the most common overstory species. Douglas-fir (Pseudotsuga menziesii) and Sitka spruce (Picea sitchensis) are codominant tree species. In the absence of a major disturbance, the heavy shade provided by a hemlock and redcedar forest favors the gradual replacement of Douglas-fir with more shade-tolerant trees. Red alder (Alnus rubra) may be a minor component of the overstory in recently disturbed areas and forest openings.

Associated sites

F003XN946WA	**Southern Washington Cascades Moist Low Cryic Coniferous Forest** Ecological site F003NX946WA is located at higher elevations compared to F003XN942WA. The presence of Pacific silver fir is a good indicator for F003XN946WA.

Similar sites

F003XN943WA	**Southern Washington Cascades Frigid Coniferous Forest** Site F003XN943WA has well drained soils and includes drier adapted species such as western hemlock and Cascade Oregon grape.

F003XN941WA	**Southern Washington Cascades Wet Frigid Coniferous Forest** Site F003XN941WA is in areas that have a higher water table and higher susceptibility to ponding. The vegetation in F003XN941WA includes more wet-adapted species such as western redcedar and American skunkcabbage.

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Thuja plicata*
Shrub	(1) *Oplopanax horridus* (2) *Rubus spectabilis*
Herbaceous	Not specified

Physiographic features

This ecological site is in depressions and stream channels of terraces, debris aprons, and valley walls at low to middle elevations (1,600 to 3,600 feet) in Mount Rainier National Park. Slope is dominantly 0 to 35 percent.

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Depression (3)
Flooding frequency	None
Ponding frequency	None
Elevation	490 – 1,100 m
Slope	0 – 40 %
Water table depth	30 – 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 60 to 80 inches, and the mean annual air temperature is 23 to 45 degrees F. Generally, the summers are warm 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)	1,520-2,030 mm

Influencing water features

This ecological site is in depressions and stream channels of terraces, debris aprons, and valley walls at low to middle elevations in Mount Rainier National Park. The soils have a high water table in March through June.

Soil features

Applicable soils: Tokaloo

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

The Tokaloo soils are in stream channels of terraces, on debris aprons of mountain slopes, and in swales of glacial-valley walls. The 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. The soils are not subject to flooding or ponding. They have less than 35 percent rock fragments in the control section. The soils are coarse textured and are primarily ashy sandy loam and ashy loamy sand. Pumice paragravel is in some areas. The Tokaloo soils have an ochric epipedon and andic properties. Podsolization is not evident.
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 soil from wind and water erosion.

Table 4. Representative soil features

Parent material	(1) Volcanic ash – andesite (2) Colluvium
Surface texture	(1) Paragravelly, ashy sandy loam (2) 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)	9.91 – 25.91 cm
Soil reaction (1:1 water) (Depth not specified)	3.5 – 10
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 warm, moist, lower slopes of Mount Rainier at an elevation of as much as about 3,600 feet, depending on aspect. This site is in areas that have a seasonal high water table at a depth of 10 to 20 inches from the soil surface. Western hemlock (Tsuga heterophylla) and western redcedar (Thuja plicata) are the most common overstory species. Some Douglas-fir (Pseudotsuga menziesii) and Sitka spruce (Picea sitchensis) are present.

In the absence of a major disturbance, the shade provided by the hemlock and western redcedar forest favors the gradual replacement of Douglas-fir with more shade-tolerant trees. Red alder (Alnus rubra) may be a minor component in the overstory. Cascade Oregon grape (Mahonia nervosa), vine maple (Acer circinatum), salmonberry (Rubus spectabilis), devilsclub (Oplopanax horridus), and thimbleberry (Rubus parviflorus) make up the dense subcanopy. The understory consists of western rattlesnake plantain (Goodyera oblongifolia), western swordfern (Polystichum munitum), deer fern (Blechnum spicant), western oakfern (Gymnocarpium dryopteris), Oregon oxalis (Oxalis oregana), twinflower (Linnaea borealis), and American skunkcabbage (Lysichiton americanus) in scattered areas.

The most common natural disturbance is windthrow, which commonly is a result of the seasonal high water table. The shallow rooting zone in saturated areas causes roots to grow laterally, resulting in frequent tip-ups. This creates openings in the canopy and allows more sunlight to reach the forest floor, leading to a shrubby understory. Because of the frequent tip-ups, the site has a hummocky surface with an abundance of downed woody debris.

Western hemlock is highly susceptible to rot diseases such as armillaria (Armillaria ostoyae), annosus (Heterobasidion annosum), laminated root rot (Phellinus weirii), and Indian paint fungus (Echinodontium tinctorium). The resulting openings in the canopy allow sunlight to reach the forest floor, benefiting the understory. Disturbance by fire is infrequent because of the high humidity and precipitation. Fires occur every 200 to 400 years, and they may be stand-replacing (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 hemlock	TSHE	*Tsuga heterophylla*	Native	–	–	–	–
western redcedar	THPL	*Thuja plicata*	Native	–	–	–	–
Douglas-fir	PSME	*Pseudotsuga menziesii*	Native	–	–	–	–
Sitka spruce	PISI	*Picea sitchensis*	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	*Achlys triphylla*	Native	1.8-5.5	0-65
twinflower	LIBO3	*Linnaea borealis*	Native	0.3-0.9	0-5
western rattlesnake plantain	GOOB2	*Goodyera oblongifolia*	Native	0.3-0.6	0-1
Fern/fern ally					
western swordfern	POMU	*Polystichum munitum*	Native	3.7-11	0-15
common ladyfern	ATFI	*Athyrium filix-femina*	Native	2.4-5.5	0-1
western oakfern	GYDR	*Gymnocarpium dryopteris*	Native	1.2-2.4	0-1
Shrub/Subshrub					
salmonberry	RUSP	*Rubus spectabilis*	Native	7.3-29.3	0-15
red huckleberry	VAPA	*Vaccinium parvifolium*	Native	3.7-11	0-10
devilsclub	OPHO	*Oplopanax horridus*	Native	11-29.3	0-10
vine maple	ACCI	*Acer circinatum*	Native	1.8-73.2	0-5
Cascade barberry	MANE2	*Mahonia nervosa*	Native	1.8-3.7	0-1

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 This ecological site is prone to rotting diseases. Annosus, armillaria, and laminated root rot can infest western hemlock and Douglas-fir forests. Indian paint fungus (Echinodontium tinctorium) can cause heart rot in true firs and hemlocks. Root and heart rot can cause mortality of individual trees to several acres of trees and result in widespread windthrow. Annosus root disease (Heterobasidion annosum) affects nearly all conifer species in the Pacific Northwest. It is a slow-growing pathogen, but it can cause severe root and butt decay in affected stands. It commonly occurs in conjunction with armillaria and laminated root rot and precedes infestations of bark beetle. Annosus commonly is challenging to differentiate from armillaria. Obvious signs include circular pockets of windthrown trees and dieback of the canopy. Annosus results in growth of a distinctive fruiting body, called a conk, in hollow stumps. Other identifying features include a reddish stain, decay, and “spongy” texture of 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 of annosus in managed stands. Armillaria root disease (Armillaria ostoyae) affects all conifer species and shrubs in the Pacific Northwest. It can affect several acres and cause widespread tree mortality. Western hemlock and western redcedar are susceptible to armillaria, but they commonly are more tolerant of the disease in mixed conifer stands. Young regenerating stands (less than 30 years) are most susceptible; therefore, maturation and succession of the forest may be delayed. Identification of armillaria is similar to that of other root diseases; however, armillaria produces a distinct white mycelial fan between the wood and bark. Rhizomorphs (brown shoestrings of fungal mycelia) are common under the bark and roots of trees (Goheen, 2006). High resin flow and excessive sapping is also common. Management commonly is limited to use of less susceptible species in plantings. Hemlock and Douglas-fir forests of the Washington and Oregon Cascades are highly susceptible to laminated root rot (Phellinus weirii), which causes moderate disturbances that result in openings in the forest. The fungus can cause severe root rot and butt decay, leading to stunted growth and mortality. Laminated root rot may affect western hemlock, but it rarely causes mortality of the species. Laminated root results in pockets of dead and fallen trees, which are broken at or near ground level. Decay is identified by a brown to reddish brown speckled staining in

the sapwood and wood that separates along the growth rings. Regeneration of highly susceptible species in areas affected by the fungus typically is unsuccessful (Goheen, 2006).

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
Sitka spruce	*PISI*	–	106	–	230	90	–	–	

Inventory data references

Other Established Classifications National vegetation classification: Vancouverian Lowland and Montane Rainforest-North Pacific Maritime Douglas-fir-Western Hemlock Forest group U.S. Department of Agriculture, Forest Service, plant association: TSHE/POMU-TITR U.S. Department of the Interior, National Park Service, plant association: TSUHET-PSEMEN-(PHUPLI)/OPLHOR/POLMUN

Type locality

Location 1: Pierce County, WA	
Township/Range/Section	T18N R07E S34
Latitude	46° 59′49″
Longitude	121° 53′24″

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Approval

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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	05/10/2024
Approved by	
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:**
