

Ecological site R003XN540WA

Southern Washington Cascades Wet Subalpine Parkland

Last updated: 1/29/2025
Accessed: 09/24/2026

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 region. 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 Cascades. Movement between these plates has resulted in major earthquakes in this area in the past and the formation of large stratovolcanoes. The Cascade Mountains consist primarily of volcanic crystalline rocks with some associated metasedimentary rocks. The average annual precipitation ranges from 60 to 100 inches in much of the region and 30 to 60 inches on the east side of the Cascade Mountains. The dominant soil orders in this MLRA are Andisols, Spodosols, and Inceptisols, with minor amounts of Entisols, and Histosols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an udic soil moisture regime. They generally are shallow to very deep, well drained, ashy to medial, and loamy or sandy and occur on mountain slopes and ridges.

Ecological site concept

This ecological site occurs in small depressions on cirque floors, debris aprons, swales on glacial valley walls, or cold air drainages in subalpine parkland environments. The most common natural disturbance is heavy snowpack, with the volume and longevity of the snowpack defining the effect on the dynamics of the ecosystem. These sites generally retain snow cover later into the summer than sites on south and west slopes and start growth more slowly due to the cooling effects of the high water table at the beginning of the growing season. Soils that support this ecological site occur in the cryic soil temperature regime and the aquic soil moisture regime. These sites are typically wet with poorly drained soils. They have a very short growing season as a result of cool temperatures and the total heat load during the summer. Ponding on the soil surface is frequent and often persists for long periods of time. Black sedge (*Carex nigricans*) is the most common species on this site, and it is often a homogenous ecosystem. In areas with snow recession earlier in the growing season, the site may have greater vegetative diversity including lady fern (*Athyrium filix-femina*), black sedge (*Carex nigricans*), bluejoint reedgrass (*Calamagrostis canadensis*), marsh marigold (*Caltha leptosepala*), and water parsley (*Oenanthe sarmentosa*). As a result of the short growing season, flowering will typically occur later in the season and vegetation growth is limited. Alternatively, some growing seasons may be affected by continuous snowpack and vegetation is therefore absent.

Associated sites

R003XN544WA	Southern Washington Cascades Wet Alpine Tundra Ecological sites R003XN544WA, Southern Washington Cascades Wet Alpine Tundra, and R003XN540WA, Southern Washington Cascades Wet Subalpine Parkland are both heavily influenced by the amount and duration of annual snowpack. The main abiotic factor affecting plant growth in ecological site R003XN544WA is the proximity to water and melting snow. Common plants include Tiling's monkeyflower , arctic lupine, partridgefoot, and black alpine sedge. Site R003XN544WA supports a wider variety of vegetation species that have higher production as compared to site R003XN540WA.
-------------	--

Similar sites

R003XN541WA	Southern Washington Cascades Moist Subalpine Parkland Ecological Site 540, Southern Washington Cascades Wet Subalpine Parkland, has similar features to Ecological Site 541, Southern Washington Cascades Moist Subalpine Parkland. Both ecological sites are found in parklands within the same elevation range, however the position on the landscape affects the persistence of snow cover which create a distinct influence on both sites. Ecological Site 540 is more commonly found in depressions and swales which captures and stores snow for longer periods of the growing season. Wet adapted plants such as black sedge are commonly homogeneous in these growing environments. Ecological Site 541 has a greater level of plant diversity and production as a result of earlier seasonal snow melt which extends the growing season.
--------------------	--

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Carex nigricans</i>

Physiographic features

This ecological site occurs across many landscape positions in depressions on cirque floors, debris aprons, and swales on glacial valley walls of Cascade Mountains (3,300-7,000 ft) in Mt. Rainier National Park. The site is most commonly found between 0 to 15 percent slopes.

Table 2. Representative physiographic features

Landforms	(1) Swale (2) Cirque floor > Closed depression
Flooding frequency	None
Ponding duration	Long (7 to 30 days)
Ponding frequency	None to frequent
Elevation	1,010 – 2,130 m
Slope	0 – 20 %
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This ecological site receives most of its annual precipitation from October to March. The mean annual precipitation ranges from 53 to 125 inches and the annual air temperature ranges from 33 to 45 degrees Fahrenheit. Microclimate may vary depending on soil temperature and site specific features. Generally, this site occupies areas cool, dry summers and cold, wet winters.

Table 3 Representative climatic features

Frost-free period (characteristic range)	30-90 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,350-3,180 mm

Influencing water features

This site is located in middle to high elevations on depressions on cirque floors, debris aprons, and swales in Mount Rainier National Park. This site does not experience flooding, however ponding occurrences are frequent and may persist for long durations. The Williwakas Series soils are poorly drained and the water table will typically rise during the spring months and recede in the fall.

Soil features

Applicable Soils: Williwakas

Applicable Soil Map Units within Mt. Rainier National Park: 8201, 8211, 8220, 8225, 8250, 8251, 8256, 8257, 9210, 9220, 9225, 9253, 9254, 9258, 9259

The soil that support this ecological site occur in the cryic soil temperature regime and the aquic soil moisture regime. Williwakas soil is poorly drained, very deep, formed from volcanic ash, and is found on depressions on cirque floors, debris aprons, and swales on glacial valley walls. Williwakas soil has a seasonally high water table at the surface at some point during the growing season. Williwakas soil has frequent ponding potential in April, May, June. Williwakas soil has less than 35 percent rock fragments in the control section. Soil textures are coarse, primarily medial sandy loams and medial loamy sands. This soil exhibits andic soil properties in all mineral horizons. Melanization is the dominant pedogenic process and podsolization is not evident in these profiles given the lack of coniferous forest cover. An umbric epipedon and cambic horizons are present.

Excessive soil moisture is a limiting factor to plant growth on this soil owing to the frequently shallow depths to saturated soil horizons and the abundance of precipitation and snow melt. Thin organic horizons consisting of decomposing litter are present on the soil surface, serving to protect the soil from wind and water erosion.

Subsurface Texture Group: medial sandy loam, medial loamy sand, paragravelly medial sandy loam

Table 4. Representative soil features

Parent material	(1) Volcanic ash
Surface texture	(1) Sandy loam (2) Loamy sand
Drainage class	Poorly drained
Soil depth	150 cm
Surface fragment cover <=3"	0 – 20 %
Surface fragment cover >3"	Not specified

Available water capacity (10.2-30.5cm)	Not specified
Soil reaction (1:1 water) (11.4-14cm)	Not specified
Subsurface fragment volume <=3" (0-88.9cm)	Not specified
Subsurface fragment volume >3" (0cm)	Not specified

Ecological dynamics

This driving abiotic factors for this ecological site are landscape position, landform, and the heavy snow pack that occurs at the higher elevations of Mt. Rainier National Park. The volume and longevity of the snowpack is the primary defining factor that impacts the dynamics of this ecosystem. These sites generally retain snow cover later into the summer than sites on south and west slopes and start growth more slowly due to the cooling effects of the high water table at the beginning of the growing season. Soils that support this ecological site occur in the cryic soil temperature regime and the aquic soil moisture regime and are typically wet and poorly drained. They have a very short growing season as a result of cool temperatures and the total heat load during the summer. Ponding on the soil surface is frequent and often persists for long periods of time.

Black sedge (*Carex nigricans*) is the most common species on this site, and is often a homogenous ecosystem. Black sedge is adapted to a short growing season (45-60 days) and is suited to survive within snowfields. It also has a unique adaptability to flower within seven days of snow release (Canaday, 1974). In years of continuous snowpack vegetation is virtually absent on this ecological site, however in light snow pack years or in areas with snow recession earlier in the growing season, the site may have greater vegetative diversity including lady fern (*Athyrium filix-femina*), black sedge (*Carex nigricans*), bluejoint reedgrass (*Calamagrostis canadensis*), marsh marigold (*Caltha leptosepala*), and water parsley (*Oenanthe sarmentosa*). The short growing season typically results in flowering later in the season and results in limited vegetation growth.

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 1.2 plant community composition

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

Inventory data references

Relationship to Other Established Classifications This ecological site falls within the National Vegetation Classification Group-Vancouverian & Rocky Mountain Subalpine Snowbed, Wet Meadow & Dwarf-Shrubland Group This ecological site includes the following USDI National Park Service Associations Groups: CARNIG

Type locality

Location 1: Pierce County, WA

Township/Range/Section	T16N R07E S14
Latitude	46° 52'17"
Longitude	121° 53'27"

Other references

Canaday, B.B., Fonda, R.W. 1974. The Influence of Subalpine Snowbanks on Vegetation Pattern, Production, and Phenology. Bulletin for Torrey Botanic Club, Vol 101 pp 340-350.

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.

Dwire, K. and Kauffman, J. 2003. Fire and Riparian Ecosystems in Landscapes in the Western United States. Forest Ecology and Management, Vol. 178 pp 61-74.

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. USDA Forest Service Pacific Northwest Research Station, Research Note PNW-RN-533.

Hemstrom, M., Franklin, J. 1982. Fire and Other Disturbances of the Forests in Mount Rainier National Park. Quaternary Research, Vol 18 pp 32-61.

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. USDA Forest Service Pacific Northwest Region Technical Paper R6-ECOL-TP-028-91.

Pojar J., and MacKinnon. 1994. Plants of the Pacific Northwest Coast. Lone Pine, Vancouver, British Columbia. 528 pages.

PRISM Climate Group, Oregon State University, <http://prism.oregonstate.edu>, visited February, 2015.

Rochefort, R.M. and Peterson, D.L. 1996. Temporal and Spatial Distribution of Trees in Subalpine Meadows of Mount Rainier National Park. Arctic and Alpine Research, Vol. 28, No. 1 pp 52-59.

Seastedt, T.R., Adams, G.A. 2001. Effects of Mobile Tree Islands on Alpine Tundra Soils. Ecology, Vol 82 pp 8-17.

United States Department of Agriculture, Forest Service, 2015. Silvics Manual Vol 1. http://na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/vol1_Table_of_contents.htm, visited December 2015.

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.

United States National Vegetation Classification. 2016. United States National Vegetation Classification Database, V2.0. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. (accessed 28, November, 2016).

Washington Department of Natural Resources, Natural Heritage Program. 2015. Ecological Systems of Washington State. A Guide to Identification.

Contributors

Erin Kreutz
 Erik Dahlke
 Philip Roberts
 Marty Chaney

Approval

Kirt Walstad, 1/29/2025

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:
