USDA Natural Resources Conservation Service

Ecological site F003XA305WA
Low Glacial Trough Valleys Moist Forest western hemlock

Last updated: 9/09/2023
Accessed: 05/09/2024

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

This area includes the west slope and parts of the east slope of the Cascades Mountains in Washington and Oregon. The Olympic Mountains in Washington State are also included. These mountains are part of a volcanic arc located at a convergent plate boundary. Volcanic rocks predominate but metamorphic and sedimentary rocks occur in the North Cascades and Olympic Mountains. Topography is generally dissected and steep, but some areas consist of constructional volcanic platforms and isolated stratovolcanoes. Elevation is usually 500 to 6000 feet but reaches to 14,410 ft at the summit of Mount Rainier. Many areas hosted alpine glaciers or ice sheets during the Pleistocene, and a few remain today.

Climate becomes cooler and moister with increasing elevation and latitude. Low elevations experience a long growing season and mild temperatures. High elevations can accumulate snowpack lasting into summer and frost may occur in any month. Average annual precipitation ranges from 60 to 180 inches in most areas. Most precipitation falls during the fall, winter, and spring during low-intensity frontal storms. Summers are relatively dry. Average annual temperature is 27 to 50 degrees F. The frost-free period is 10 to 180 days.

LRU notes

The North Cascades land resource unit is located in northwestern Washington primarily along the western slope of the Cascade Range. It bounded by the international boundary with Canada to the north and the Snoqualmie Pass area to the south. To the west is the Puget Sound Trough (MLRA 2) and to the east is the drier eastern slope of the Cascade Range (MLRA 6).

The Skagit River is the largest river to originate in the LRU and is governed by three hydroelectric dams. Other rivers that drain west include the Nooksack, Snohomish, and Skykomish. The Wenatchee River drains east toward the Columbia.

Lithology is the result of numerous accretions from tectonic subduction of the Pacific plate along the margin of the North American plate. The North Cascades are arranged in a west to east series of terranes which are combinations of metamorphized sedimentary or oceanic rock and intrusive volcanic plutons, punctuated by the minorly active Mount Baker and Glacier Peak volcanoes (Washington Geological Survey). Additionally, Pleistocene continental and alpine glaciation covered almost all of the area except the highest peaks in the range and deposited large amounts of glacial sediment. Alpine glaciers still remain active today in the highest elevations.

Soils are primarily Spodosols, Andisols, and Inceptisols.

Vegetation is primarily dense forest with some parkland in subalpine and alpine areas. Douglas-fir (Pseudotsuga menziesii) and western hemlock (Tsuga heterophylla) are the dominate tree species found at lower elevations; western redcedar (Thuja plicata) is quite common. Pacific silver fir (Abies amabilis) and mountain hemlock (Tsuga mertensiana) are the primary tree species in the higher elevations; subalpine fir (Abies lasiocarpa) and Alaska

cedar (Callitropsis nootkatensis) can be widespread as well.

Classification relationships

USFS Plant Associations:
western hemlock/Cascade Oregongrape
western hemlock/pinemat manzanita
western hemlock/Pacific rhododendron-salal, Olympic
western hemlock/vine maple/queencup beadlily
western hemlock/Cascade Oregongrape
western hemlock/Pacific rhododendron-salal, Olympic
western hemlock/pinemat manzanita
western hemlock/pinemat manzanita
western hemlock/Cascade Oregongrape

Ecological site concept

This site resides on mountain slopes and in glacial trough valleys at elevations of 2,500 to 4,250 feet on moderate to steep slopes (30-65%). Climate is generally warmer and moist (frost free days average 85 to 120, mean annual precipitation is 50 to 75 inches, and mean annual air temperature is 40 to 43 degrees Fahrenheit. Soils are intergrades of Andisols and Spodosols with combinations of spodic and andic soil materials. Inceptisols on less stable positions also occur. Soils are primarily greater than 60 inches to a restriction; some soils have lithic contacts between 20 and 50 inches. The reference community has an overstory dominated by western hemlock (Tsuga heterophylla) and western redcedar (Thuja plicata) with an understory that can be dominated by vine maple (Acer circinatum) initially but can later include pinemat manzanita (Arctostaphylos nevadensis), Cascade barberry (Mahonia nervosa), Oregon boxleaf (Paxistima myrsinites), pipsissewa (Chimaphila umbellate), thinleaf huckleberry (Vaccinium membranaceum), Saskatoon serviceberry (Amelanchier alnifolia), twinflower (Linnaea borealis), salal (Gaultheria ovatifolia), or western rattlesnake plantain (Goodyera oblongifolia). Seral tree species can be found in the overstory and lower canopy layers and include Douglas fir (Pseudotsuga menziesii) or western white pine (Pinus monticola). Fire is the main disturbance regime and occurs as rare, stand replacement events on a rotational interval of 100 to 200 years. Specifically, the USFS Fire Effects Information System (FEIS) states that western hemlock in the Pacific Northwest has a fire return interval of 150 to 400 years, though in Wenatchee NF it is thought to be 100 to 200 years based on stand ages. LANDFIRE Biophysical Settings (BPS) states all fire types occur in 400-year intervals and stand replacing severity is 99 percent of all fires. Diseases that occur on this site include: Laminated (Armillaria, Annosum) root rots, brown cubical rot, and dwarf mistletoe.

Associated sites

F003XA303WA	**Flood Plain black cottonwood**

Similar sites

F003XB305WA	**Low Mountain Slopes Moist Forest western hemlock**
F003XC305WA	**Low Mountain Slopes Moist Forest western hemlock**

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Thuja plicata*
Shrub	(1) *Arctostaphylos nevadensis* (2) *Mahonia nervosa*
Herbaceous	(1) *Paxistima myrsinites* (2) *Clintonia uniflora*

Physiographic features

This site resides in mountain slopes and glacial trough valleys on mountains at elevations of 2500 to 4250 feet on

moderate to steep slopes (33-64%).

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope (2) Glacial-valley floor
Elevation	2,500–4,250 ft
Slope	30–65%
Aspect	W, NW, N, S, SW

Climatic features

Mean annual air temperature is 40-43 F.

Table 3. Representative climatic features

Frost-free period (characteristic range)	87-119 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	52-76 in

Influencing water features

This site is not influenced by water from a wetland or stream.

Soil features

Soils are intergrades of Andisols and Spodosols with combinations of spodic and andic soil materials. Inceptisols on less stable positions also occur. Soils are primarily greather than 60 inches to a restriction; some soils have lithic contacts between 20 and 50 inches. Andic properties occur at 0 to 40 inches depth. Permeability is very low through dense glacial till.

Table 4. Representative soil features

Parent material	(1) Volcanic ash (2) Colluvium (3) Residuum (4) Till
Surface texture	(1) Ashy fine sandy loam (2) Ashy sandy loam (3) Medial fine sandy loam
Family particle size	(1) Ashy over loamy-skeletal (2) Medial over loamy-skeletal (3) Ashy over sandy or sandy-skeletal
Drainage class	Well drained
Permeability class	Very slow to rapid
Depth to restrictive layer	10–60 in
Soil depth	10–60 in
Surface fragment cover <=3"	0–40%
Surface fragment cover >3"	0–20%
Available water capacity (Depth not specified)	0.5–5.1 in

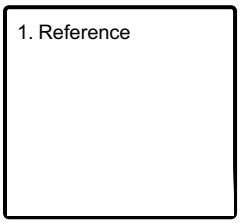
Calcium carbonate equivalent (Depth not specified)	0%
Soil reaction (1:1 water) (Depth not specified)	5.1–7.3

Ecological dynamics

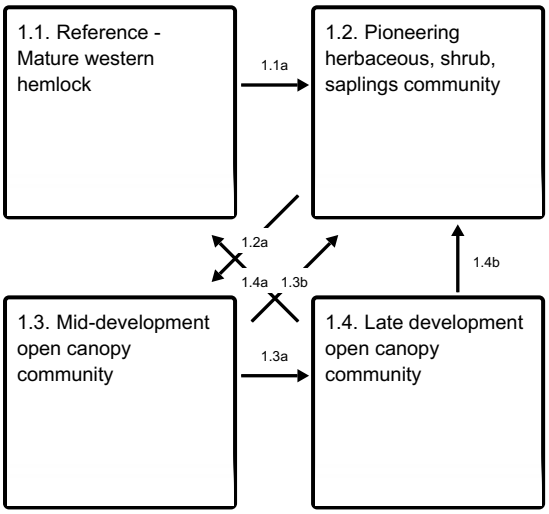
Fire is a rare, stand replacing event in this ecological site. Generally, the fire return interval is believed to be 100 to 200 years in the North Cascades, based on stand ages and 150 to 400 years for western hemlock in the Pacific Northwest as a whole. LANDFIRE BPS models state that stand replacement fires occur in 400-year intervals (300 to 800-year range) for western hemlock forests in Washington and Oregon. Fire is a large patch disturbance while diseases such as Laminated (Armillaria, Annosum) root rots, brown cubical rot, dwarf mistletoe are small patch disturbances that allow the closed continuous canopy to open.

State and transition model

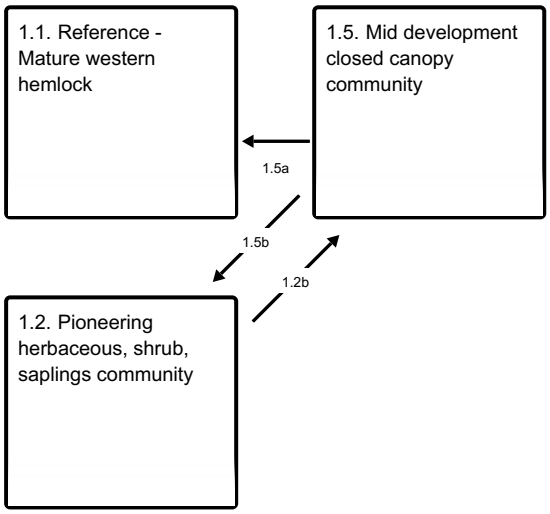
Ecosystem states

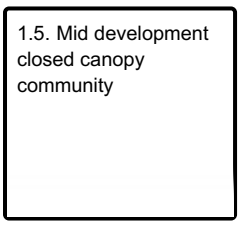


State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)





State 1
Reference

Community 1.1
Reference - Mature western hemlock

This phase has an overstory dominated western hemlock, with western redcedar, and Douglas-fir, with a lower tree canopy of these species; an understory of tall shrubs, and cool, moist adapted herbaceous species. Thick tall and medium statured shrubs include: vine maple initially but can later include pinemat manzanita, Cascade barberry,

Oregon boxleaf, pipsissewa, thinleaf huckleberry, Saskatoon serviceberry. Overstory structure is a closed canopy, with large trees (diameter at breast height averages 20-30 inches) that are mature (at least 150 to 200 years old).

Community 1.2
Pioneering herbaceous, shrub, saplings community

Immediately post-fire, on-site and windblown tree seeds establish, shrub and herbaceous plants resprout and pioneering herbaceous plants establish on mineral soil interspaces. This is a short duration community phase that transitions to shrubs after about three years. Within three years, the pioneering herbaceous community transitions to the shrub community which is predominantly perennial shrubs. This plant community contains a high diversity of shrubs including vine maple, pinemat manzanita, Cascade barberry, thinleaf huckleberry, Saskatoon serviceberry, snowbush ceanothus), seedlings establish: Douglas fir, western hemlock, western redcedar. Seedlings mature to saplings. This community spans 0-20 years post-disturbance.

Community 1.3
Mid-development open canopy community

This phase is dominated by a mix of Douglas fir, western hemlock, western redcedar that are pole sized (diameter at breast height is less than 20 inches) and are in an open canopy due to windthrow, insects and disease. The trees age 20 to 100 years old. The understory has thinleaf huckleberry, devilsclub, vine maple, Pacific rhododendron and western swordfern.

Community 1.4
Late development open canopy community

This phase is dominated by a mix of large Douglas fir, western hemlock, western redcedar that are pole sized and are in an open canopy due to windthrow, insects and disease. Trees are 100 to 150 years old. The understory can have a mix of shrubs including: vine maple, thinleaf huckleberry, Oregon boxleaf, pipsissewa, Saskatoon serviceberry, twinflower and bride's bonnet.

Community 1.5
Mid development closed canopy community

This phase is dominated by a mix of Douglas fir, western hemlock, western redcedar and some deciduous trees that are pole sized and are in a closed canopy configuration, that precludes much sunlight reaching the understory rendering it generally depauperate. Trees are generally mid-sized (less than 20 inches at diameter breast height) and usually 20 to 100 years old. After approximately eighty years, this community becomes the reference community.

Pathway 1.1a
Community 1.1 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Pathway 1.2a
Community 1.2 to 1.3

With time, the tree seedlings and small saplings go to the mid development community and due to the occurrence of mixed severity fire the canopy is in an open configuration.

Pathway 1.2b
Community 1.2 to 1.5

With time, the tree seedlings and small saplings go to the mid development community grow into the closed canopy configuration.

Pathway 1.3b
Community 1.3 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Pathway 1.3a
Community 1.3 to 1.4

With time, the pole sized trees develop to large mature trees in the late development phase.

Pathway 1.4a
Community 1.4 to 1.1

With time, the large mature trees develop into the closed configuration of the reference phase without the occurrence of mixed severity fire.

Pathway 1.4b
Community 1.4 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Pathway 1.5a
Community 1.5 to 1.1

With time, the large mature trees develop into the closed configuration of the reference phase without the occurrence of mixed severity fire.

Pathway 1.5b
Community 1.5 to 1.2

Rare, stand-replacement fire that kills significant number of mature trees and top-kills shrubs and herbaceous plants. This disturbance causes a return to the pioneering, herbaceous community with resprouting shrubs.

Additional community tables

Other references

Scientific Literature:
WENATCHEE N.F.
Lillybridge, Terry R., et al. "Field guide for forested plant associations of the Wenatchee National Forest." Gen. Tech. Rep. PNW-GTR-359. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 335 p. In cooperation with: Pacific Northwest Region, Wenatchee National Forest 359 (1995).
OLYMPIC N.F.
Henderson, Jan A., et al. "Forested plant associations of the Olympic National Forest." (1989).
GIFFORD PINCHOT N.F.
Brockway, Dale G. Plant association and management guide for the Pacific silver fir zone: Gifford Pinchot National Forest. US Department of Agriculture, Forest Service, Pacific Northwest Region, 1983.
Topik, Christopher, Nancy M. Halverson, and Dale G. Brockway. Plant association and management guide for the western hemlock zone: Gifford Pinchot National Forest. US Department of Agriculture, Forest Service, Pacific Northwest Region, 1986.
Topik, Christopher. Plant association and management guide for the grand fir zone: Gifford Pinchot National Forest. Vol. 6. No. 88. US Department of Agriculture, Forest Service, Pacific Northwest Region, 1989.
Diaz, Nancy M. "Plant association and management guide for the mountain hemlock zone: Gifford Pinchot and Mt. Hood National Forests." (1997).
MT. BAKER-SNOQUALMIE N.F.
Henderson, Jan A. Field guide to the forested plant associations of the Mt. Baker-Snoqualmie National Forest. Vol.

28. No. 91. USDA, Forest Service, Pacific Northwest Region, 1992.

National Forest. Vol. 28. No. 91. USDA, Forest Service, Pacific Northwest Region, 1992.
FIRE
Landfire, USFS FEIS.
LANDFIRE, 2007, Biophysical Settings Model Descriptions, LANDFIRE 1.1.0, U.S. Department of the Interior, USDA Forest service, Accessed 20 April 2020 at https://www.landfire.gov/bps-models.php
WETLAND/RIPARIAN
Kovalchik, Bernard L., and Rodrick R. Clausnitzer. "Classification and management of aquatic, riparian, and wetland sites on the national forests of eastern Washington: series description." Gen. Tech. Rep. PNW-GTR-593. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 354 p. In cooperation with: Pacific Northwest Region, Colville, Okanogan, and Wenatchee National Forests 593 (2004).
Rocchio, F. Joseph, and Rex C. Crawford. "Conservation Status Ranks for Washington's Ecological Systems." (2015).
Rocchio, F. J., and R. C. Crawford. "Draft field guide to Washington's ecological systems." Washington Natural Heritage Program, Washington Department of Natural Resources. Olympia, WA (2008).

Franklin, J., & Dyrness, C. Natural vegetation of Oregon and Washington. : Portland, Or., Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Dept. of Agriculture.
National Forest. Vol. 28. No. 91. USDA, Forest Service, Pacific Northwest Region, 1992.
FIRE
Landfire, USFS FEIS.
LANDFIRE, 2007, Biophysical Settings Model Descriptions, LANDFIRE 1.1.0, U.S. Department of the Interior, USDA Forest service, Accessed 20 April 2020 at https://www.landfire.gov/bps-models.php

Rocchio, F. J., and R. C. Crawford. "Draft field guide to Washington's ecological systems." Washington Natural Heritage Program, Washington Department of Natural Resources. Olympia, WA (2008).

Franklin, J., & Dyrness, C. Natural vegetation of Oregon and Washington. : Portland, Or., Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Dept. of Agriculture.

Contributors

Stephanie Shoemaker
Erik Dahlke
Erin Kreutz
Steve Campbell

Approval

Kirt Walstad, 9/09/2023

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	05/09/2024
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:**
