USDA Natural Resources
Conservation Service

Ecological site AX004A01X401
Isomesic Udic Forest

Last updated: 5/06/2025
Accessed: 03/15/2026

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): 004A–Sitka Spruce Belt

This area consists of a long and narrow band of marine terraces, coastal estuaries, sand dunes, low relief hills, and mountain slopes that parallels the Pacific Ocean. This area is entirely within the Pacific Border Province of the Pacific Mountain System in Oregon and Washington. In Washington, this area ranges in elevation from sea level to a maximum of 1800 feet (550 meters) inland. The portion of this area in northern Washington consists primarily of glacial deposits, with some scattered young Tertiary sedimentary rocks. The climate is cool and moist, with minimal changes between seasons. Summer temperatures are moderated by the proximity of cool ocean water and fog. Sitka spruce forests are characteristic of this area. The average annual precipitation is 52 to 60 inches (1,320 to 1,525 millimeters) near the beach and can be as much as about 150 inches (3,800 millimeters) at the higher elevations along the inland edge of the MLRA. Most of the rainfall occurs during low-intensity, Pacific frontal storms. Precipitation is evenly distributed throughout fall, winter, and spring; summers are cool and dry. Snowfall accumulation is rare on the ocean side of this area, but some snowfall occurs along the eastern boundary. This area lies within the coastal fog belt zone, and heavy fogs are common in summer. Supplemental moisture is provided by fog condensation. Dominant soil orders in this MLRA are Andisols, Inceptisols, Spodosols, and Entisols

Ecological site concept

Isomesic Udic Forest sites occur on less stable landscape positions on colluvial aprons in the isomesic fog belt. Relatively high slope gradients limit water infiltration on these sites, generating runoff to more stable Isomesic Udic Moist Forests, Isomesic Aquic Forests, and Temperate Wet Meadows. As a result, Isomesic Udic Forest sites characteristically favor

the growth and production of moist mesophytic understory species, such as salal (*Gaultheria shallon*) and twinflower (*Linnaea borealis*).

Isomesic Udic Forest sites are characterized by a dense overstory of western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*), accompanied by an understory shrub community of salal and red huckleberry (*Vaccinium parvifolium*). The herbaceous layer is dominated by western swordfern (*Polystichum munitum*) and twinflower (*Linnaea borealis*). Western redcedar (Thuja plicata) may be present as a minor overstory component.

Associated sites

AX004A01X403	**Udic Moist Forest** Isomesic Udic Moist Forest sites may occur downslope of Isomesic Udic Forest sites and generally have more stable slope gradients. Isomesic Udic Moist Forest sites have higher productivity.
AX001X01X200	**Temperate Wet Meadow** Temperate Wet Meadow sites may be found adjacent to or surrounded by Isomesic Udic Forest sites. Temperate Wet Meadows occur on depressions and seeps. Temperate Wet Meadow sites lack tree cover.
AX004A01X404	**Isomesic Aquic Forest** Isomesic Aquic Forest sites may occur downslope or in mosaic with Isomesic Udic Forest sites. Isomesic Aquic Forest sites occur on depressions and seeps and are subject to ponding.

Similar sites

AX001X01X401	**Mesic Udic Forest** Mesic Udic Forest sites are found at higher elevations and lack Sitka spruce (Picea sitchensis).

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Picea sitchensis*
Shrub	(1) *Gaultheria shallon* (2) *Vaccinium parvifolium*
Herbaceous	(1) *Polystichum munitum* (2) *Linnaea borealis*

Legacy ID

F004AA401WA

Physiographic features

This site primarily occurs on colluvial aprons on mountains. These upland forest sites are strongly influenced by slope gradient. Isomesic Udic Forest sites typically are found on less stable slopes and generate run-off that is collected by more stable Isomesic Udic Moist Forest, Isomesic Aquic Forest, or Temperate Wet Meadow sites. These sites lose a moderate amount of moisture from run-off.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Colluvial apron
Flooding frequency	None
Ponding frequency	None
Elevation	100–300 m
Slope	15–60%
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site occurs in an isomesic temperature and udic moisture regime. Precipitation arrives mostly via low-intensity, Pacific frontal storms. Precipitation mostly falls as rain, but some snowfall occurs along the eastern boundary of the area. Precipitation is evenly distributed throughout the fall, winter, and spring, while summers are dry. Heavy fog is very common in the summer, contributing supplemental moisture. The frost-free period of this area is strongly tied to ocean proximity; the eastern edge of the area has a significantly shorter growing season than the western edge. There is relatively little seasonal variation in air temperature due to Pacific ocean influence.

Table 3. Representative climatic features

Frost-free period (characteristic range)	180-240 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	2,007-2,997 mm

Influencing water features

There are no dominant water features influencing plant community dynamics on site.

Soil features

The soils are very deep, have very high or high Ksat throughout, and are well drained. The

soils are formed colluvium derived from metasedimentary rock. The soil surface texture is gravelly loam or sandy loam. Clay content is eight to 17 percent throughout. The soil series for this ecological site is Saghalie. Although representative of this site, these soils may exist across multiple ecological sites because of naturally variable slope, texture, rock fragments, and pH. An on-site soil pit and the most current ecological site key are necessary to classify a site.

Table 4. Representative soil features

Parent material	(1) Colluvium–metasedimentary rock
Surface texture	(1) Gravelly loam (2) Silt loam
Drainage class	Well drained
Soil depth	201 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	6.35–10.16 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5–5.5
Subsurface fragment volume <=3" (0-50.8cm)	25–50%
Subsurface fragment volume >3" (0-50.8cm)	5–15%

Ecological dynamics

Frequent, small-scale disturbance from windthrow events create a mosaic fabric of early-seral patches within late-seral communities. Canopy gaps created by windthrow favor shade-intolerant understory species such as red alder (*Alnus rubra*) and red elderberry (*Sambucus racemosa*). Dominant conifers on this site are susceptible to a variety of root and butt rot fungi. Wood decay fungi exacerbate mature trees' vulnerability to windthrow events.

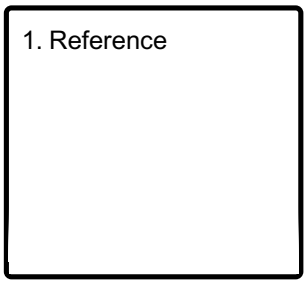
Infrequent, large-scale disturbances may occur in the form of stand-replacing wildfires, cataclysmic wind events, or large mass movement events. High force windstorms are a major source of large-scale disturbance in these forests. These blowdown events may be stand replacing and conditions tend to favor shade intolerant species in their aftermath (Van Pelt, 2007). The fire regime of this site is characterized by high-intensity, stand replacing fires with a long return interval – greater than 100 years (FEIS). Though infrequent, wildfires have a profound influence on the composition of these forests. Sitka spruce is a relatively shade-intolerant species and regenerates quickly in the aftermath of

a stand-replacing wildfire. In the absence of large-scale disturbance, more shade-tolerant western hemlock regenerates successfully. Large mass-movement events also provide conditions favorable for early seral species. Landslides are a significant source of disturbance, owing to the steep terrain and sedimentary geology of the park. (Gavin, 2014).

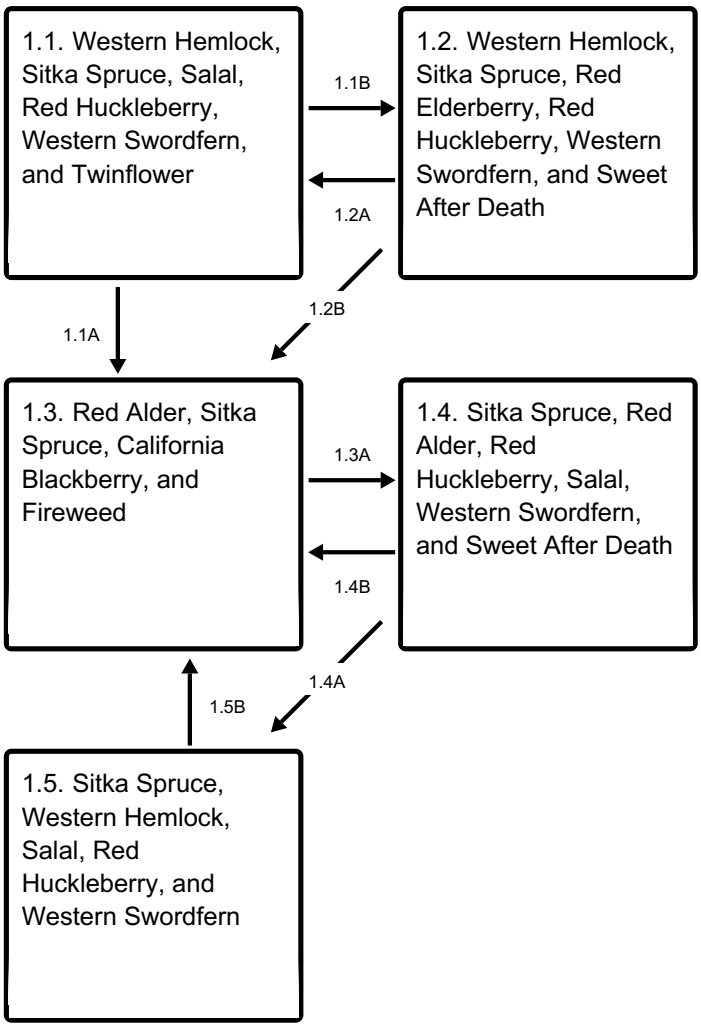
Red alder and Sitka spruce recruits regenerate in the aftermath of stand-replacing disturbance, accompanied by California blackberry (*Rubus ursinus*) and fireweed (*Chamerion angustifolium*). As Sitka spruce (*Picea sitchensis*) and red alder (*Alnus rubra*) grow and form a discrete canopy, the understory community diversifies. Shrub and forb layers develop, dominated by red huckleberry and salal (*Gaultheria shallon*), and western swordfern (*Polystichum munitum*) and sweet after death (*Achlys triphylla*), locally known as deerfoot vanilla leaf, respectively. Canopy stratification will be encouraged by tree maturation, as well as by mortality induced by small-scale disturbances. Increased vertical stratification promotes diversity and abundance of shrubs and forbs, allowing a return to reference community conditions.

State and transition model

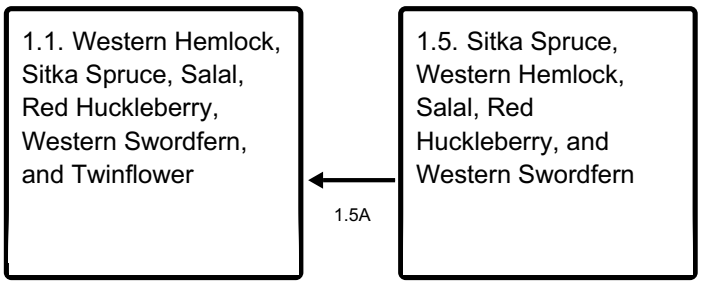
Ecosystem states



State 1 submodel, plant communities



Communities 1 and 5 (additional pathways)



1.1B - Minor disturbance

1.1A - High-intensity disturbance

1.2A - Time without disturbance

1.2B - High-intensity disturbance

1.3A - Time without disturbance

1.4B - High-intensity disturbance

1.4A - Time without disturbance

1.5A - Time without disturbance

1.5B - High-intensity disturbance

State 1

Reference

The reference state is comprised of five communities in varying stages of regeneration following either small-scale or large-scale disturbance.

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- Sitka spruce (*Picea sitchensis*), tree
- red alder (*Alnus rubra*), tree
- salal (*Gaultheria shallon*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- California blackberry (*Rubus ursinus*), shrub
- red elderberry (*Sambucus racemosa*), shrub
- rusty menziesia (*Menziesia ferruginea*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous
- sweet after death (*Achlys triphylla*), other herbaceous
- false lily of the valley (*Maianthemum dilatatum*), other herbaceous
- deer fern (*Blechnum spicant*), other herbaceous
- fireweed (*Chamerion angustifolium*), other herbaceous

Community 1.1
Western Hemlock, Sitka Spruce, Salal, Red Huckleberry, Western Swordfern, and Twinflower

Structure: Multistory with small gap dynamics Western hemlock and Sitka spruce are the dominant overstory species in the reference community. Common understory species include salal (*Gaultheria shallon*), red huckleberry (*Vaccinium parvifolium*), western swordfern (*Polystichum munitum*), deer fern (*Blechnum spicant*), rusty menziesia (*Menziesia ferruginea*), false lily of the valley (*Maianthemum dilatatum*), and twinflower (*Linnaea borealis*). High vertical stratification in the canopy and the presence of small gaps favors an abundant understory.

Community 1.2
Western Hemlock, Sitka Spruce, Red Elderberry, Red Huckleberry, Western Swordfern, and Sweet After Death

Structure: Mosaic of overstory and openings in varying states of regeneration This community is initiated in the wake of small-scale disturbance which creates small canopy openings. Red elderberry (*Sambucus racemosa*) frequently establishes in regenerating canopy gaps. Western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*) recruits will eventually establish in the canopy openings and regenerate the canopy. Twinflower (*Linnaea borealis*) is diminished in these less-shaded gaps. Sweet after death (*Achlys triphylla*) frequently establishes in small canopy gaps.

Community 1.3
Red Alder, Sitka Spruce, California Blackberry, and Fireweed

Structure: Open forest with shrubby regeneration and snags This community is an early seral stage, occurring after a stand-replacing disturbance. Nearly all trees have been removed. Red alder (*Alnus rubra*) establishes quickly in recently opened areas. Sitka spruce (*Picea sitchensis*) seedlings are quick to establish on site after disturbance. Big leaf maple (*Acer macrophyllum*) may also establish post-disturbance. Shrubs and forbs are often able to outcompete tree saplings for several years post-disturbance. California blackberry (*Rubus ursinus*), locally known as trailing blackberry, and fireweed (*Chamerion angustifolium*) are frequently the first to establish in early seral communities.

Community 1.4
Sitka Spruce, Red Alder, Red Huckleberry, Salal, Western Swordfern, and Sweet After Death

Structure: Dense single-story Sitka spruce (*Picea sitchensis*) can regenerate successfully in the years following a stand-replacing disturbance. As time progresses, understory species regenerate and diversify. Red huckleberry (*Vaccinium parvifolium*) and salal (*Gaultheria shallon*) often establish on this site, accompanied by western swordfern (*Polystichum munitum*) and sweet after death (*Achlys triphylla*). Western hemlock (*Tsuga heterophylla*) is slower to establish post-disturbance and may not begin successful regeneration until a canopy has been established.

Community 1.5
Sitka Spruce, Western Hemlock, Salal, Red Huckleberry, and Western Swordfern

Structure: Dense single stratum canopy with diminished understory Continued Sitka spruce (*Picea sitchensis*) growth forms a dense canopy. Western hemlock (*Tsuga heterophylla*) gradually regenerates under the canopy. The understory continues to develop. Salal (*Gaultheria shallon*) and red huckleberry (*Vaccinium parvifolium*) dominate the shrub layer, while western swordfern (*Polystichum munitum*) is common in the herbaceous layer. While the species composition of the understory begins to resemble the Reference community, understory productivity is diminished due to low canopy stratification and dense tree growth, limiting available sunlight at the forest floor. Additional time will be required for the stand to develop vertical stratification. Individual tree mortality will promote age class diversity.

Pathway 1.1B
Community 1.1 to 1.2

Minor disturbances, often caused by individual tree mortality, create small gaps in the forest canopy.

Pathway 1.1A
Community 1.1 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Pathway 1.2A
Community 1.2 to 1.1

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

Pathway 1.2B
Community 1.2 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Pathway 1.3A
Community 1.3 to 1.4

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

Pathway 1.4B
Community 1.4 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Pathway 1.4A
Community 1.4 to 1.5

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

Pathway 1.5A
Community 1.5 to 1.1

Time without disturbance allows regeneration, growth, and progression to the reference community. Individual tree mortality gradually leads to a varied-age stand.

Pathway 1.5B
Community 1.5 to 1.3

Stand-replacing disturbances such as high-intensity fire, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Additional community tables

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Contributors

Alec Haulotte
Erin Kreutz
Abigail Field
Max Ross
Erik Dahlke

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	03/15/2026
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:**

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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:**
