Ecological site F004AA400WA
Coastal Upland Forest

Last updated: 9/09/2020
Accessed: 05/02/2024

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): 004A–Sitka Spruce Belt

This resource area is along the coast of the Pacific Ocean. It is characterized by a marine climate and coastal fog belt. The parent material is primarily glacial, marine, or alluvial sediment and some scattered areas of Tertiary sedimentary rock and organic deposits. Glacial deposits are dominant in the northern part of the MLRA in Washington; marine and alluvial deposits and eolian sand are dominant along the southern part of the Washington coast and extending into Oregon. The mean annual precipitation ranges from 52 to 60 inches near the beaches to more than 190 inches in the inland areas of the MLRA.
Andisols and Inceptisols are the dominant soil orders in the MLRA, but Spodosols, Entisols, and Histosols are also present. The soils are shallow to very deep and very poorly drained to somewhat excessively drained. They are on hilly marine terraces and drift plains; coastal uplands, hills, and foothills; flood plains; and coastal dunes, marshes, and estuaries.
The soil temperature regimes of MLRA 4A are moderated by the proximity to the Pacific Ocean, which eases the differences between the mean summer and winter temperatures. The seasonal differences in temperature are more pronounced in adjacent MLRAs further inland. Included in MLRA 4A are soils in cooler areas at higher elevations or on northerly aspects that have an isofrigid temperature regime.
The soil moisture regimes of MLRA 4A are typified by soils that do not have an extended dry period during normal years. Many of the soils further inland in MLRA 2 have a dry period in summer. Soils in low-lying areas and depressions of MLRA 4A are saturated in the rooting zone for extended periods due to a high water table or long or very long periods of flooding or ponding.

LRU notes

The Northern Sitka Spruce Belt land resource unit (LRU A) of MLRA 4A is along the northwest coast of the Olympic Peninsula to the Chehalis River in Washington State. The parent material is dominantly glacial deposits derived from continental or alpine sources. This LRU extends from the northwesternmost corner of the Olympic Peninsula south to the northern edge of Grays Harbor. It is bounded on the west by the Pacific Ocean and on the east by the Olympic Mountains. Several major rivers carved valleys through the glacially derived landscape and deposited more recent alluvium. These include the Sol Duc, Bogachiel, Hoh, Queets, Quinault, and Humptulips Rivers.

Ecological site concept

This ecological site is at low elevations on the western coastline of the Olympic Peninsula. It is on glacial drift plains and terraces in river valleys and on hills at an elevation of less than 500 feet. The site receives abundant precipitation and has prolific fog. The mild temperatures and long growing season provide for highly productive forestland.
The most common overstory species are Sitka spruce (Picea sitchensis), western hemlock (Tsuga heterophylla), Douglas-fir (*Pseudotsuga menziesii*), and western redcedar (*Thuja plicata*). Red alder (Alnus rubra) may be common where there are forest openings. Regeneration is limited by the canopy cover, and it commonly is only in gaps where sunlight is most available. Common understory species include cascara (Frangula purshiana),

evergreen huckleberry (Vaccinium ovatum), salal (Gaultheria shallon), red huckleberry (Vaccinium parvifolium), western swordfern (Polystichum munitum), common ladyfern (Athyrium filix-femina), and Oregon oxalis (Oxalis oregana).
The most common natural disturbance on this site is windthrow following large coastal storms, which creates pockets of forest openings. Wildfires are uncommon, but the site is highly susceptible to catastrophic crown fires that may be stand replacing (Taylor, 1990). The natural fire regime for Sitka spruce is 150 to 350 years or more (Griffith, 1992). White pine weevil (Pissodes strobi) may devastate young to middle aged, even-aged stands of Sitka spruce and impact regeneration of the species entirely (Goheen, 2006).

Table 1. Dominant plant species

Tree	(1) *Picea sitchensis* (2) *Tsuga heterophylla*
Shrub	(1) *Vaccinium ovatum* (2) *Gaultheria shallon*
Herbaceous	(1) *Polystichum munitum* (2) *Oxalis oregana*

Physiographic features

Table 2. Representative physiographic features

Landforms	(1) River valley > Terrace (2) Hills
Elevation	0–152 m
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

The maritime climate is characterized by cool, moist summers and cool, wet winters. The mean annual precipitation is 73 to 185 inches, and coastal fog provides supplemental moisture in summer. Snowfall is rare, and it is not persistent when it occurs. The mean annual air temperature is 47 to 51 degrees F.

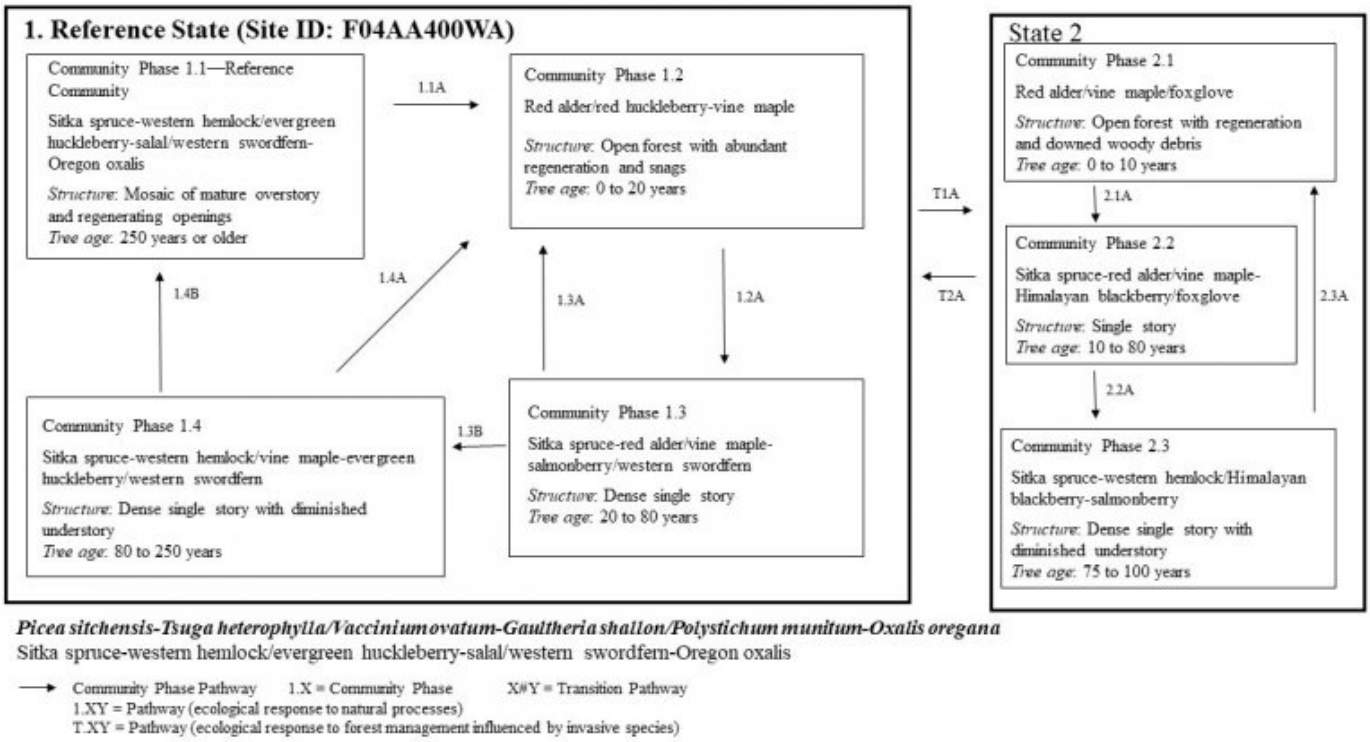
Influencing water features

Soil features

The soils that support this ecological site are in the isomesic soil temperature regime and udic soil moisture regime. Soil moisture is not a limiting factor for forest growth due to the abundance of precipitation and fog that extends into summer. The soils have diverse textures, depths, and drainage.
The soils generally formed in very deep skeletal outwash or loess, moderately deep to deep glacial drift over a densic contact, or moderately deep to very deep glacially modified residuum. The parent material is subject to a heightened weathering regime due to the moderated temperatures and high amount of precipitation. The enhanced weathering combined with organic matter from the dense vegetative cover has resulted in an accumulation of a particular suite of organic and metal oxide compounds, a process called andisolization. As a result, a unique set of soil properties has developed that includes a higher soil water-holding capacity, high organic matter content, and high phosphorous retention. This process is typical of soils that formed in volcanic ash, but a unique combination of climatic conditions and vegetation has resulted in these soil properties in coastal areas of the Pacific Northwest.

Ecological dynamics

State and transition model



Picea sitchensis-Tsuga heterophylla/Vaccinium ovatum-Gaultheria shallon/Polystichum munitum-Oxalis oregana
Sitka spruce-western hemlock/evergreen huckleberry-salal/western swordfern-Oregon oxalis

→ Community Phase Pathway 1.X = Community Phase X#Y = Transition Pathway
1.XY = Pathway (ecological response to natural processes)
T.XY = Pathway (ecological response to forest management influenced by invasive species)

State 1
Reference State

Community 1.1
Sitka spruce-western hemlock/evergreen huckleberry-salal/western swordfern-Oregon oxalis
Structure: Mosaic of mature overstory and regenerating openings

Sitka spruce and western hemlock are the most common overstory species in the reference community. Sitka spruce is considered a seral tree species as compared to western hemlock, but several factors have contributed to its dominance in late successional forests (Taylor, 1990). Sitka spruce is highly tolerant of salt spray, and it grows well in mineral-rich soils that have low pH and high cation-exchange capacity (Peterson, 1997). Western hemlock is very shade tolerant; it is perhaps the most shade tolerant of any tree species in North America (Packee, 1990). It is presumed that western hemlock would outcompete Sitka spruce during extraordinary periods without disturbance. Douglas-fir and western redcedar likely are present, but minimal, if any, Douglas-fir regeneration occurs in closed canopy forests. The dense canopy created by multiple age groups of hemlock may block most of the sunlight from the forest floor, leading to sparse understory in some areas. Gaps in the mid canopy and overstory allow sunlight to reach the ground, and a majority of the understory plants establish in these areas. The understory tends to be more continuous in areas that do not have a mid canopy. Common understory species include cascara, evergreen huckleberry, salal, red huckleberry, western swordfern, ladyfern, and Oregon oxalis.

Dominant plant species

- Sitka spruce (*Picea sitchensis*), tree
- western hemlock (*Tsuga heterophylla*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western redcedar (*Thuja plicata*), tree
- Cascara buckthorn (*Frangula purshiana*), tree
- California huckleberry (*Vaccinium ovatum*), shrub
- salal (*Gaultheria shallon*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- redwood-sorrel (*Oxalis oregana*), other herbaceous
- common ladyfern (*Athyrium filix-femina*), other herbaceous

Community 1.2
Red alder/red huckleberry-vine maple Structure: Open forest with abundant regeneration and snags

Community phase 1.2 is an early seral plant community that has been impacted by a stand-replacing disturbance such as a wildfire, a large-scale wind event, mass movement, or a major insect infestation. Nearly all trees are absent, but some fire-resistant trees may survive in the overstory. Standing, decaying snags are prevalent. The understory is dominantly early seral tree, shrub, and forb species such as red alder, red huckleberry, and vine maple. Some grasses will establish, but they will be replaced by shrubs over time. Depending on the severity of a disturbance, tree seedlings and saplings will begin to establish within 3 to 10 years.

Dominant plant species

- red alder (*Alnus rubra*), tree
- red huckleberry (*Vaccinium parvifolium*), shrub
- vine maple (*Acer circinatum*), shrub

Community 1.3
Sitka spruce-red alder/vine maple-salmonberry/western swordfern Structure: Dense single story

Community phase 1.3 is an early seral forest in regeneration. Scattered remnant mature trees may be present. Species composition depends on the natural seed sources present and the intensity of disturbance. After a moderate or severe fire, shrubs likely will outcompete tree seedlings. Depending on the availability of sunlight, vine maple (*Acer circinatum*), red alder, red huckleberry, evergreen huckleberry, western swordfern, and salmonberry (*Rubus spectabilis*) may be abundant in the understory. Seed sources for tree species are surrounding, undisturbed forested areas and survivors of the disturbance. This results in a mixed stand that could include Sitka spruce, Douglas-fir (*Pseudotsuga menziesii*), western hemlock, and western redcedar (*Thuja plicata*). Sitka spruce in this community phase is vulnerable to outbreaks of white pine weevil.

Dominant plant species

- Sitka spruce (*Picea sitchensis*), tree
- red alder (*Alnus rubra*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- vine maple (*Acer circinatum*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- California huckleberry (*Vaccinium ovatum*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

Community 1.4
Sitka spruce-western hemlock/vine maple-evergreen huckleberry/western swordfern Structure: Dense single story with diminished understory

Community phase 1.4 is a forest in the competitive exclusion stage. Scattered remnant mature trees may be

present. Competition among individual trees for available water and nutrients is increasing. Sitka spruce and western hemlock are dominant in the overstory canopy; however, more shade-intolerant species such as Douglas-fir and western redcedar may make up a large portion of the overstory. The canopy closure is almost 100 percent, leading to diminished shrub and forb layers. Some understory species better adapted to at least partial shade begin to increase. Over time, the forest will begin to self-thin due to the elevated competition.

Dominant plant species

- Sitka spruce (*Picea sitchensis*), tree
- western hemlock (*Tsuga heterophylla*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western redcedar (*Thuja plicata*), tree
- vine maple (*Acer circinatum*), shrub
- California huckleberry (*Vaccinium ovatum*), shrub
- salal (*Gaultheria shallon*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, timber management, a large-scale wind event, a major insect infestation, or large mass movement that leads to the stand initiation phase of forest development.

Pathway 1.2A
Community 1.2 to 1.3

This pathway represents growth over time with no further significant disturbance.

Pathway 1.3A
Community 1.3 to 1.2

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, timber management, a large-scale wind event, a major insect infestation, or large mass movement that leads to the stand initiation phase of forest development.

Pathway 1.3B
Community 1.3 to 1.4

This pathway represents growth over time with no further major disturbance.

Pathway 1.4B
Community 1.4 to 1.1

This pathway represents growth over time with no further major disturbance.

Pathway 1.4A
Community 1.4 to 1.2

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, timber management, a large-scale wind event, a major insect infestation, or large mass movement that leads to the stand initiation phase of forest development.

State 2

Community 2.1
Red alder/vine maple/foxglove Structure: Open forest with regeneration and downed woody

debris

Community phase 2.1 represents a recently disturbed forest that is naturally regenerating. Large woody debris is commonly prolific following large-scale disturbances. This inhibits establishment of vegetation under natural conditions. Areas that are not replanted immediately (1 to 3 years) following timber harvesting or a large-scale disturbance may become vulnerable to an infestation of invasive species. Typically, commercially managed forests will be replanted following disturbance. Species preference depends on site conditions and long-term economic decisions. Overall, species biodiversity is diminished in forests managed for short-rotation timber. Natural reforestation depends on available seed sources following disturbance. Early seral species such as red alder and vine maple will regenerate quickly under abundant sunlight. Foxglove (Agalinis spp.) commonly is prolific following logging.

Dominant plant species

- red alder (*Alnus rubra*), tree
- vine maple (*Acer circinatum*), shrub
- false foxglove (*Agalinis*), grass

Community 2.2
Sitka spruce-red alder/vine maple-Himalayan blackberry/foxglove Structure: Single story

Community Phase 2.2 represents an even-aged regenerating forest. Sitka spruce, western hemlock, shore pine, and Douglas-fir can regenerate quickly on nurse logs or in recently disturbed soil. A higher soil temperature favors seed germination of Sitka spruce, which commonly is the first coniferous tree species to re-establish following logging (Peterson, 1997). Shade-intolerant red alder remains a large component in the overstory until it reaches maturity (Fonda, 1974). The plant community in areas that have been replanted commonly is dense and even-aged, and understory species are sparse in areas that have a high percentage of canopy cover. Vine maple and salmonberry are common understory species, but invasive species increase in prominence. Himalayan blackberry (*Rubus armeniacus*) has the potential to greatly impact the shrubby understory and outcompete native species. Foxglove will remain in pockets until eventually it is shaded out by the overstory shrubs or trees. Management techniques such as pre-commercial or commercial thinning and mitigation of invasive species will accelerate the maturation and improve the health of the forest.

Dominant plant species

- Sitka spruce (*Picea sitchensis*), tree
- red alder (*Alnus rubra*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- beach pine (*Pinus contorta var. contorta*), tree
- vine maple (*Acer circinatum*), shrub
- Himalayan blackberry (*Rubus armeniacus*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- false foxglove (*Agalinis*), other herbaceous

Community 2.3
Sitka spruce-western hemlock/Himalayan blackberry-salmonberry Structure: Dense single story with diminished understory

Community phase 2.3 represents a maturing forest that has increased plant diversity. Western hemlock will regenerate under a dense, shrubby canopy and begin to establish in the overstory canopy along with Sitka spruce. Invasive species will inhibit the overall health and structure of the forest, creating an ecosystem in which Sitka spruce is more susceptible to devastation by white pine weevil. The dense, shrubby understory is prone to wildfires. Commercial logging operations commonly take place during this phase as trees reach economical maturity in size and volume. It is presumed that without timber management during this community phase, an old-growth Sitka spruce and western hemlock stand will develop.

Dominant plant species

- Sitka spruce (*Picea sitchensis*), tree

- western hemlock (*Tsuga heterophylla*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- Himalayan blackberry (*Rubus armeniacus*), shrub
- salmonberry (*Rubus spectabilis*), shrub

Pathway 2.1A
Community 2.1 to 2.2

This pathway represents growth over time with no further major disturbance or active forest management.

Pathway 2.2A
Community 2.2 to 2.3

This pathway represents growth over time with no further major disturbance or active forest management.

Pathway 2.3A
Community 2.3 to 2.1

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, timber harvesting or other logging activities, a large-scale wind event, a major insect infestation, or large mass movement that leads to the stand initiation phase of forest development.

Transition T1A
State 1 to 2

This pathway represents a major disturbance that has removed most of the overstory. Large-scale disturbances have the potential to increase the vulnerability to infestations by invasive species when the seed source is nearby or introduced into the site. This type of disturbance will impact the natural feedbacks that maintained the reference state.

Restoration pathway T2A
State 2 to 1

This pathway represents intensive management to restore the historic plant community.

Additional community tables

Inventory data references

National vegetation classification: G751 North Pacific Western Hemlock-Sitka Spruce-Western Red Cedar Seasonal Rainforest Group
Ecological Systems of Washington State community type: North Pacific Seasonal Sitka Spruce Forest
Forest Service plant association: Sitka spruce/western swordfern-Oregon oxalis

Other references

Fonda, R.W. 1974. Forest succession in relation to river terrace development in Olympic National Park, Washington. Ecology. Volume 55, number 5, pages 927-942.
Franklin, J.F., and C.T. Dyrness. 1973. Natural vegetation of Oregon and Washington. Oregon State University Press, Corvallis, OR.
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, Series R6-NR-FID-PR-01-06.
Griffith, R.S. 1992. Picea sitchensis. In Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.
Henderson, J., D. Peter, R. Lesher, and D. Shaw. 1989. Forested plant associations of the Olympic National Forest. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region Technical Paper R6 ECOL 001-88.
Packee, E.C. 1990. Tsuga heterophylla. In Silvics of North America. U.S. Department of Agriculture, Forest

Service, Northeastern Area.
Peterson, E.B., N.M. Peterson, G.F. Weetman, and P.J. Martin. 1997. Ecology and management of Sitka spruce: Emphasizing its natural range in British Columbia. University of British Columbia Press, Vancouver, British Columbia.
Pojar, J., and A. MacKinnon. 1994. Plants of the Pacific Northwest coast. Lone Pine Publishing, Vancouver, British Columbia.
PRISM Climate Group. Oregon State University. http://prism.oregonstate.edu. Accessed February 2015.
Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436.
Soil Survey Staff. 2014. Keys to soil taxonomy. 12th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.
Taylor, A. 1990. Disturbance and persistence of Sitka spruce (Picea sitchensis) in coastal forests of the Pacific Northwest, North America. Journal of Biogeography. Volume 17, number 1, pages 47-58.
United States National Vegetation Classification. 2016. United States national vegetation classification database, V2.0. Federal Geographic Data Committee, Vegetation Subcommittee, Washington, D.C. Accessed November 28, 2016.
Washington Department of Natural Resources, Natural Heritage Program. 2015. Ecological systems of Washington State. A guide to identification.

Contributors

Erin Kreutz
Erik Dahlke
Jason Martin
Marty Chaney
Carri Gaines

Approval

Kendra Moseley, 9/09/2020

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	05/02/2024
Approved by	Kendra Moseley
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:**