USDA Natural Resources Conservation Service

Ecological site AX001X02X001
Mesic Udic Riparian Forest

Last updated: 9/09/2023
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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): 001X–Northern Pacific Coast Range, Foothills, and Valleys

This long and narrow resource area stretches along the Pacific Border Province of the Pacific Mountain System in Oregon and Washington. The area is bounded by the Olympic Mountains on the north and the Klamath Mountains on the south. Most of the area consists of hills and low mountains with gentle to steep slopes. The parent materials are composed primarily of young Tertiary sedimentary rocks with some minor volcanic rocks. Glacial till and outwash deposits are found in the northern half of the area within Washington. In the far southern portion of the area, near the Klamath Mountains, the sedimentary rocks are older and some have been metamorphosed. The average annual precipitation ranges from 60 to 200 inches, increasing with elevation.
The dominant soil orders in this MLRA are Andisols, Inceptisols, and Ultisols. Soil depth ranges from shallow to very deep. While most soils in the area are well drained and occur on foothills, mountain slopes and ridges, floodplain and depressional soils can range from well drained to very poorly drained. Soil textures are typically medial, loamy, or clayey. The dominant soils in the area have a mesic or frigid soil temperature regime and a udic soil moisture regime; however, soils with an aquic soil moisture regime or cryic soil temperature regime do occur.

LRU notes

The North Pacific Coast Range land resource unit (LRU 2) of MLRA 1 is located in the northwestern corner on the Olympic Peninsula and within the Olympic National Forest in Washington State. LRU 2 is bounded on the west by MLRA 4a Sitka Spruce Belt and MLRA 2 Willamette and Puget Sound Valleys to the east. LRU 2 encircles the Olympic National Park (LRU 1). Several major rivers have headwaters in this LRU or carved valleys through the landscape depositing more recent alluvium. These include the Duckabush, Elwha, Queets, Quinault, Skokomish, Sol Duc, and Wynoochee Rivers.

Ecological site concept

This ecological site is found on the western Coast Range on the Olympic Peninsula in Washington state. It is found in riparian corridors on stream terraces and flood plain steps on alluvial soils. It is located at low elevations (less than 1,000 ft.) with abundant precipitation. These areas are subject to stream overflow. Riparian ecological sites typically differ in topography, vegetation, geomorphology, and microclimate from the surrounding uplands of the forest ecosystem (Dwire, 2003).
Conifers such as western hemlock (Tsuga heterophylla), Douglas-fir (Pseudotsuga menziesii), western redcedar (*Thuja plicata*), and grand fir (Abies grandis) occur in late seral sites or on terraces. Recently disturbed areas are dominated by hardwoods such as black cottonwood (Populus balsamifera ssp. trichocarpa), red alder (Alnus rubra), and bigleaf maple (Acer macrophyllum).
Regeneration is restricted by canopy cover and often limited to gaps where sunlight is most available and mineral soil is exposed from scouring (Pabst, 1999). Understory species diversity is greatest near the streams as a result of erosion and deposition creating openings for opportunistic species as well as the abundance of microsites which create unique environments (Spies, et. al, 2002). Common understory species include willows (Salix spp.), salmonberry (Rubus spectabilis), thimbleberry (Rubus parviflorus), elderberry (Sambucus racemosa), redosier

dogwood (Cornus sericea), vine maple (Acer circinatum), western swordfern (Polystichum munitum), ladyfern (Athyrium filix-femina), and Oregon oxalis (Oxalis oregana).
The most common natural disturbance is flooding, with the volume and longevity of the flooding determining the effect on the dynamics of the forest. Although wildfire is uncommon in this ecological site (greater than 450-year return interval) when it does occur, it may be stand replacing (Balian, 2005). Fallen trees with exposed root systems and large woody debris is common.

Associated sites

AX001X02X003	**Mesic Aquic Forest** Mesic Udic Riparian Forest is located adjacent to Mesic Aquic Forest. Mesic Udic Riparian Forest is located on flood plain steps and riparian corridors that are affected by flooding. Mesic Aquic Forest is prone to ponding disturbance.

Similar sites

AX001X03X001	**Mesic Udic Riparian Forest** This site is similar in ecological function and shares many similar vegetative components. However, this site is located further south in the MLRA and is within LRU C. The presence of Oregon Ash (Fraxinus latifolia) is a strong indicator for LRU C.

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Pseudotsuga menziesii*
Shrub	(1) *Rubus spectabilis*
Herbaceous	(1) *Polystichum munitum* (2) *Oxalis oregana*

Legacy ID

F001XB001WA

Physiographic features

This ecological site occurs across many landscape positions in the valleys, floodplains, and terraces. The site is most commonly found between 0 to 10 percent on floodplains and terraces of river valley bottoms.

Table 2. Representative physiographic features

Landforms	(1) River valley > Flood plain (2) River valley > Fluvial terrace
Flooding frequency	None to frequent
Ponding frequency	None
Elevation	0–1,000 ft
Slope	0–10%
Aspect	N, NE, E, SE, S

Climatic features

The climate has warm, moist summers and cool, wet winters. Precipitation occurs as rain, and the mean annual precipitation ranges from 50 to 100 inches. Mean annual temperatures range from 48 to 52 degrees F (PRISM Climate Group, 2019).

Table 3. Representative climatic features

Frost-free period (characteristic range)	149-150 days
Freeze-free period (characteristic range)	215-222 days
Precipitation total (characteristic range)	50-100 in

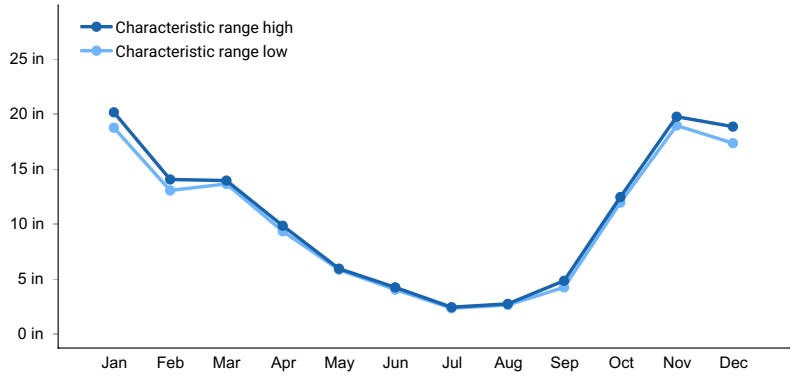


Figure 1. Monthly precipitation range

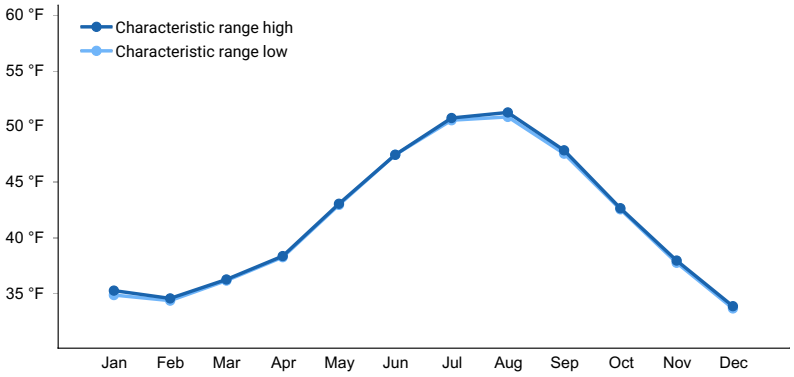


Figure 2. Monthly minimum temperature range

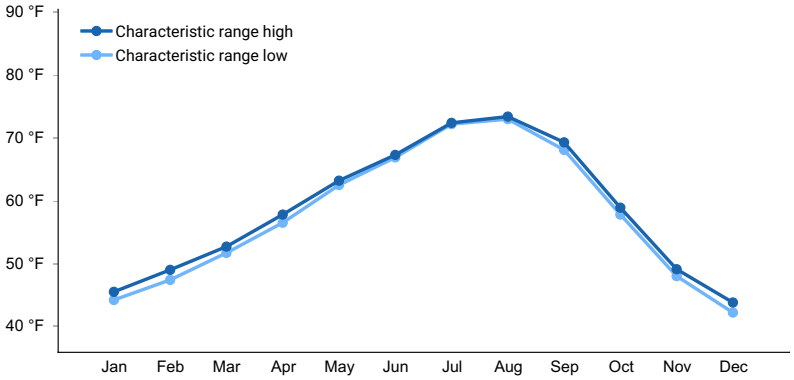


Figure 3. Monthly maximum temperature range

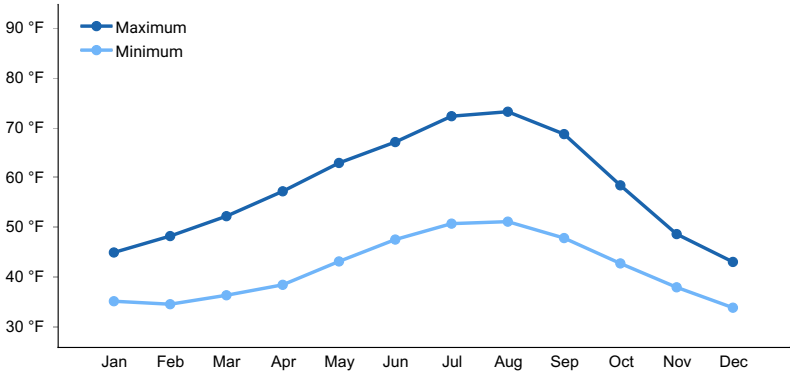


Figure 4. Monthly average minimum and maximum temperature

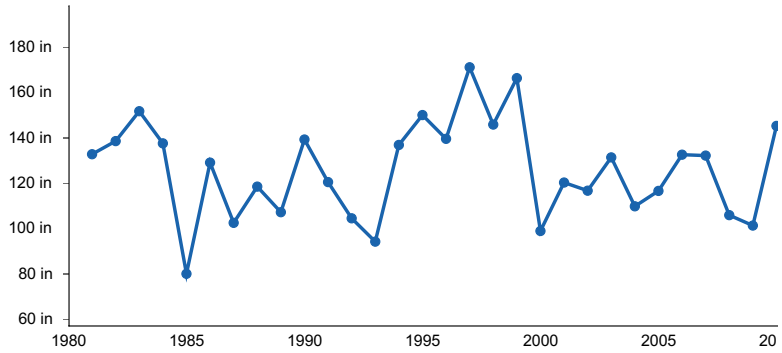


Figure 5. Annual precipitation pattern

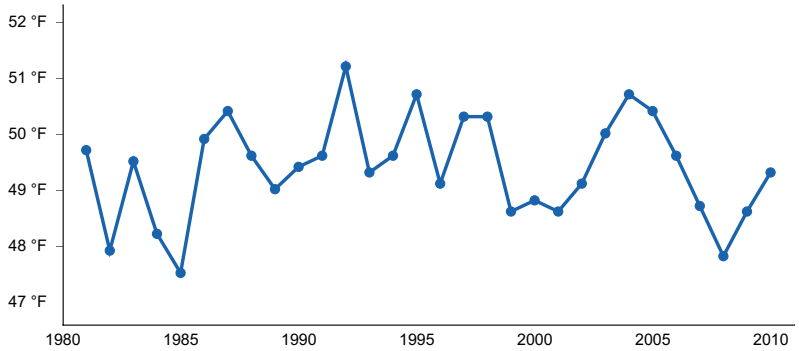


Figure 6. Annual average temperature pattern

Climate stations used

- (1) ABERDEEN 20NNE [USC00450013], Aberdeen, WA
- (2) FORKS 1 E [USC00452914], Forks, WA

Influencing water features

This site is located at low elevations on terraces and floodplains. This site does not experience ponding. Flooding frequency is rare, however 100 or 500-year floods may dramatically alter the landscape. The soils water table will typically rise during the spring months and recede in the fall.

Soil features

Soils that support this ecological site occur in the mesic soil temperature regime and the udic soil moisture regime. They are formed in alluvium on flood plain step and steam terrace positions. Soil moisture is not a limiting factor to forest growth due to the abundance of precipitation. These soils are typically subject to flood events from November to April. The smaller, more frequent flood events typically only cause minor scouring in comparison with greater-magnitude 100- to 500-year floods.

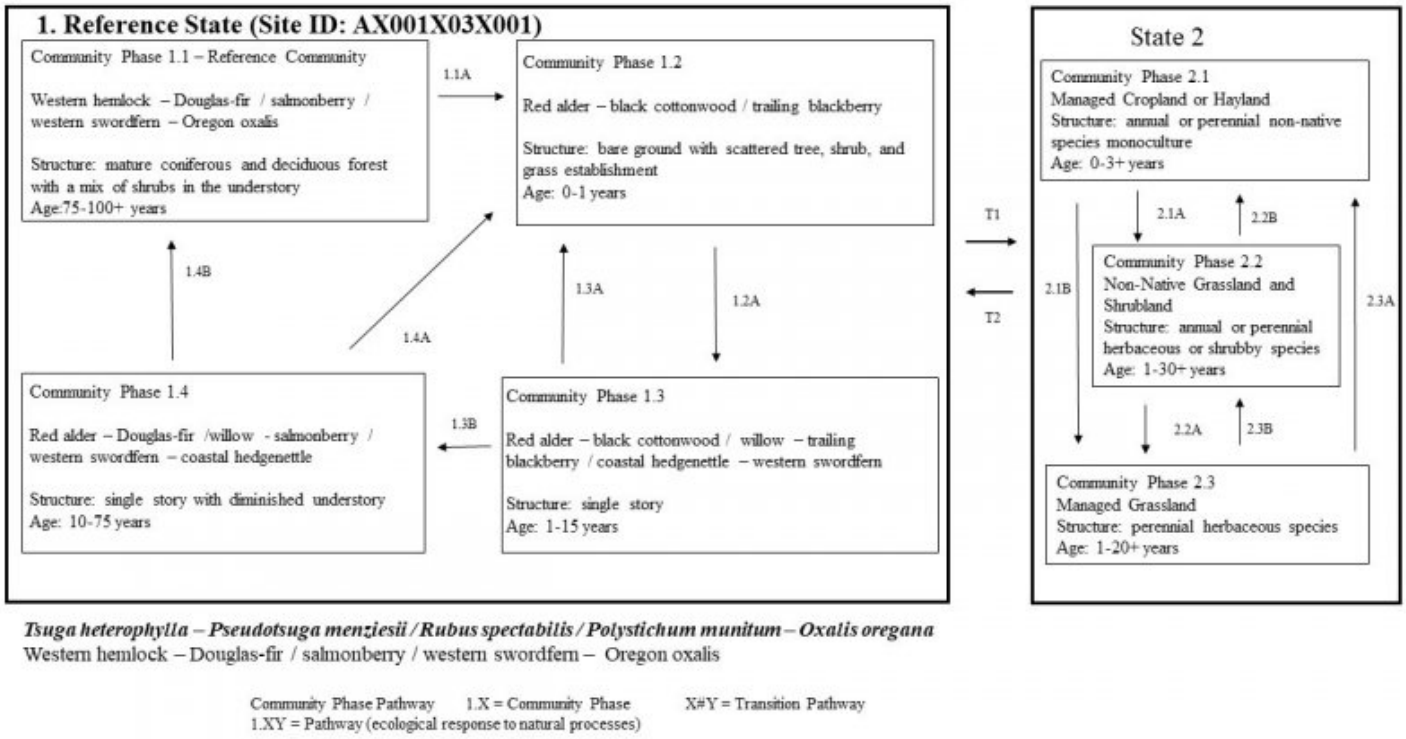
Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam (2) Loamy sand (3) Sandy loam
Family particle size	(1) Sandy or sandy-skeletal (2) Medial
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	60 in

Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0–2%
Clay content (Depth not specified)	3–30%
Subsurface fragment volume <=3" (Depth not specified)	3–40%
Subsurface fragment volume >3" (Depth not specified)	0–3%

Ecological dynamics

State and transition model



State 1
Reference State

Community 1.1
Reference Community

Western hemlock – Douglas-fir /salmonberry/western swordfern-Oregon oxalis Structure: Mature coniferous and deciduous forest with a mix of shrubs in the understory Western hemlock and Douglas-fir are the dominant overstory species in the reference community. Black cottonwood is long-living (up to 200 years) and remains a dominant deciduous species in the overstory along the riparian edge; however, regeneration is limited as the forest matures and the canopy cover increases. Red alder remains a major component in most mature stands, but it will start to actively decline after 40 to 70 years. Alder regeneration typically is limited to pockets of disturbance where sunlight is abundant (Balian, 2005). Western hemlock (typically in stands older than 100 years), bigleaf maple, and western redcedar (*Thuja plicata*) may be present in the stand. Herbivory on western hemlock and western redcedar by elk (Cervus elaphus) and black-tailed deer (Odocoeleus hemionus columbianus) may greatly impact the prominence of these species (Stolnack, 2010). The reference community represents a lack of major flooding for at least 75 years, which allows the pioneering species to form a mature canopy. It also allows for growth of a vigorous understory of shrubs and forbs, including vine maple, salmonberry, western swordfern, and Oregon oxalis. Common disturbances include small gap dynamics (1/2-acre openings or smaller) following the decline of the red

alder canopy and minor scouring from flooding. Soil deposition following minor scouring from flooding temporarily affects the understory community, but it does not alter the composition of the overstory. Beaver (Castor canadensis) activity can be a significant driver in small-scale disturbances, affect hydrologic morphology, and contribute to large woody debris in riparian edges and corridors.

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western redcedar (*Thuja plicata*), tree
- red alder (*Alnus rubra*), tree
- black cottonwood (*Populus balsamifera ssp. trichocarpa*), tree
- bigleaf maple (*Acer macrophyllum*), tree
- grand fir (*Abies grandis*), tree
- salmonberry (*Rubus spectabilis*), shrub
- vine maple (*Acer circinatum*), shrub
- thimbleberry (*Rubus parviflorus*), shrub
- red elderberry (*Sambucus racemosa*), shrub
- redosier dogwood (*Cornus sericea*), 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-black cottonwood/trailing blackberry Structure: Bare ground with scattered tree, shrub, and grass establishment Community phase 1.2 represents a riparian forest that is undergoing regeneration or stand initiation immediately following flooding. The soil surface is gravelly and highly variable depending on the intensity and frequency of flooding and aggradation from flooding (Fonda, 1974). Scattered remnant mature trees may be in some areas, and woody debris is abundant. Successful regeneration is dependent on the local seed source, an adequate seedbed, and sufficient light and water (Nierenberg, 2000). Red alder can establish quickly as compared to conifers. It can sprout and establish in full sunlight and fixes nitrogen in shallow flood plain soils, which provide an early competitive advantage (Villarin, 2009). Seeds of deciduous species are light and can be transported long distances by wind and water, allowing for rapid recolonization. Black cottonwood will establish quickly on gravel bars, and it commonly develops into a thick, even-aged stand. Trailing blackberry (*Rubus ursinus*) is commonly established in this community phase. Plant cover is relatively sparse; it ranges from 5 to 20 percent during this stage (Fonda, 1974). Introduced grass species such as creeping bentgrass (*Agrostis stolonifera*) may be present. Infestation by invasive species such as Japanese knotweed (*Polygonum cuspidatum*) and giant knotweed (*Polygonum sachalinense*) is a concern during this community phase.

Dominant plant species

- red alder (*Alnus rubra*), tree
- black cottonwood (*Populus balsamifera ssp. trichocarpa*), tree
- bigleaf maple (*Acer macrophyllum*), tree
- California blackberry (*Rubus ursinus*), shrub

Community 1.3

Red alder-black cottonwood/willow-trailing blackberry/coastal hedgenettle-western swordfern Structure: Single story Community phase 1.3 is an early seral forest in regeneration. Scattered remnant mature trees may be present. Competition among individual trees for available water, light, and nutrients is increased. Red alder, black cottonwood, and willows (Salix spp.) are dominant in the overstory. Trailing blackberry is a major component of the understory along with coastal hedgenettle (*Stachys chamissonis*), Mexican hedgenettle (Stachys Mexicana), and western swordfern. The understory is grassy with a mixture of introduced and native species.

Dominant plant species

- red alder (*Alnus rubra*), tree

- black cottonwood (*Populus balsamifera ssp. trichocarpa*), tree
- bigleaf maple (*Acer macrophyllum*), tree
- willow (*Salix*), shrub
- California blackberry (*Rubus ursinus*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- coastal hedgenettle (*Stachys chamissonis*), other herbaceous
- Mexican hedgenettle (*Stachys mexicana*), other herbaceous

Community 1.4

Red alder–Douglas-fir/willow-salmonberry/western swordfern-coastal hedgenettle Structure: Single story with diminished understory Community phase 1.4 is a forest in the competitive exclusion stage. Scattered remnant mature trees may be present. Black cottonwood and red alder are dominant in the overstory. Red alder will begin to die 40 to 70 years following disturbance and more light will penetrate the newly nitrogen-rich soil (Naiman, 2009). As a result, conifer regeneration is more prevalent in this community phase. Seedlings of Douglas-fir and western hemlock will begin to establish sporadically, especially in areas that have more shade. Large woody debris, which are more prevalent in established stands, are an important component for conifer establishment (Villarin, 2009). About 60 to 90 years following disturbance, conifers begin to flourish and replace red alder (Van Pelt, 2006). During this phase, the canopy closure will mature to 100 percent and the understory will diminish. Some understory species that are better adapted to at least partial shade, such as vine maple and western swordfern, will begin to flourish in the community. Farther from the flood plain, the shrub community decreases and a closed-canopy forest develops (Villarin, 2009). If red alder regeneration is in this community phase, it may be inferred that frequent minor flooding has been influencing the site dynamics (Nierenberg, 2000). Over time, the forest begins to self-thin as a result of competition and a decrease in species that are intolerant of shade.

Dominant plant species

- red alder (*Alnus rubra*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- black cottonwood (*Populus balsamifera ssp. trichocarpa*), tree
- western hemlock (*Tsuga heterophylla*), tree
- willow (*Salix*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- vine maple (*Acer circinatum*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous
- coastal hedgenettle (*Stachys chamissonis*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a stand-replacing wildfire or major 100- or 500-year flood that scours the stream channel, removes understory and overstory vegetation, and may alter the streamflow. This type of disturbance may completely reconfigure sediment loads and dramatically reduce or eliminate the forest overstory.

Pathway 1.2A
Community 1.2 to 1.3

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

Pathway 1.3A
Community 1.3 to 1.2

This pathway represents a stand-replacing wildfire or a major 100- or 500-year flood that scours the stream channel, removes the understory and overstory vegetation, and may alter the streamflow. This type of disturbance may completely reconfigure sediment loads and dramatically reduce or eliminate the forest overstory.

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 an area with no further major disturbance. Continued growth over time and ongoing mortality lead to increased vertical diversification. The community begins to resemble the structure of the reference community, including small pockets of regeneration (both deciduous and coniferous species) and a more diversified understory.

Pathway 1.4A
Community 1.4 to 1.2

This pathway represents a stand-replacing wildfire or a major 100- or 500-year flood that scours the stream channel, removes the understory and overstory vegetation, and may alter the streamflow. This type of disturbance may completely reconfigure sediment loads and dramatically reduce or eliminate the forest overstory.

State 2

Community 2.1
Managed Cropland or Hayland

Structure: Annual or perennial non-native species monoculture Community Phase 2.1 may consist of a range of crops, including annually planted species, short-lived perennial species, and more permanent shrubby species. Hay and grasses and legumes for silage are included in this community phase.

Community 2.2
Non-native Grassland and Shrubland

Structure: Annual or perennial herbaceous or shrubby species Community phase 2.2 is characterized by low-level agronomic or management activity such as adding fertility, intensive grazing management, regular mowing, or weed control. This plant community commonly consists dominantly of introduced weedy species. Areas that have extremely low fertility or are subject to heavy grazing pressure have a higher proportion of annual, stoloniferous, or rhizomatous species. Wetland areas commonly support dominantly non-native rhizomatous grasses. The plant community may include remnants of introduced pasture species that are commonly seeded.

Community 2.3
Managed Grassland

Structure: Perennial herbaceous species Community phase 2.3 receives regular agronomic inputs, including adding soil nutrients and other soil amendments such as lime, implementing grazing management plans or regular mowing, controlling weeds, and reseeding as needed. This plant community typically includes introduced perennial pasture and hay species that are commonly seeded. In areas of historic native grassland, mixtures of perennial and annual native species may be seeded and managed by appropriate agronomic and livestock management activities. Minor amounts of introduced species that are commonly in non-native grassland and shrub communities (community phase 2.2) are in this phase.

Pathway 2.1A
Community 2.1 to 2.2

In the absence of agronomic and livestock management activities, seeds from surrounding weedy plant communities will be transported to the site by wind, flood water, animals, or vehicle traffic. Adapted species will become established. Management activities include tilling, adding soil nutrients and other soil amendments such as lime, mowing, burning, harvesting or chemically controlling vegetation, planting to desirable herbaceous species, and implementing grazing management plans.

Pathway 2.1B
Community 2.1 to 2.3

This pathway represents agronomic and livestock management activities, including tilling, adding soil nutrients and other soil amendments such as lime, mowing, burning, harvesting or chemically controlling vegetation, planting to desirable herbaceous species, and implementing grazing management plans.

Pathway 2.2B
Community 2.2 to 2.1

This pathway represents agronomic activities such as tilling, adding soil nutrients and other soil amendments such as lime, mowing, burning, harvesting or chemically controlling vegetation, and planting to desirable crop species.

Pathway 2.2A
Community 2.2 to 2.3

This pathway represents agronomic and livestock management activities, including tilling, adding soil nutrients and other soil amendments such as lime, mowing, burning, harvesting or chemically controlling vegetation, planting to desirable herbaceous species, and implementing grazing management plans.

Pathway 2.3A
Community 2.3 to 2.1

This pathway represents agronomic activities, including tilling, adding soil nutrients and other soil amendments such as lime, mowing, burning, harvesting or chemically controlling vegetation, and planting to desirable crop species.

Pathway 2.3B
Community 2.3 to 2.2

In the absence of agronomic and livestock management activities, seeds from surrounding weedy plant communities will be transported to the area by wind, floodwater, animals, or vehicle traffic. Adapted species will become established. Management activities include tilling, adding soil nutrients and other soil amendments such as lime, mowing, burning, harvesting or chemically controlling vegetation, planting to desirable herbaceous species, and implementing grazing management plans.

Transition T1
State 1 to 2

This pathway represents a change in land use, including modifications to the hydrologic function to develop pasture and agriculture. Non-native seed disbursement is introduced (intentionally or unintentionally), which alters the reference community.

Transition T2
State 2 to 1

This pathway represents restoration of the natural hydrologic function and native plant habitat. Native seed sources and extensive management and mitigation of brush and invasive species are needed to restore the community.

Additional community tables

Inventory data references

Other Established Classifications for Ecological Site

National vegetation classification: G851 North-Central Pacific Lowland Riparian Forest
Forest alliance: A3746 Sitka Spruce-Western Hemlock-Red Alder Forest Alliance and A3745 Bigleaf Maple- Red alder Riparian Forest Alliance

Ecological Systems of Washington State community type: North Pacific Lowland Riparian Forest and Shrubland

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Contributors

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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	04/28/2024
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):**

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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:**
