USDA Natural Resources Conservation Service

Ecological site F043CY503WA
Frigid, Moist-Xeric Loamy, Canyons and Mountains (Grand fir/Moist Shrub)

Last updated: 9/08/2023
Accessed: 05/19/2024

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): 043C–Blue and Seven Devils Mountains

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Description of MLRAs can be found in: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Available electronically at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook

LRU notes

Major land resource area (MLRA): 043C-Blue and Seven Devils Mountains
Modal LRU – 43C04 Dissected Basalt Highlands

This LRU is composed predominantly of mid elevation slopes of foothills, mountains and canyon walls. The soils tend to be loamy Argixerolls and Haploxerolls with minor ash influence in the surface layer. Colluvium and residuum from basalt are the dominant parent materials. Soil climate is a frigid temperature regime and xeric moisture regime with median annual precipitation of 890 mm (35 inches).

Others where occurring – 43A02 – Eastern High Basalt Plateau

Ecological site concept

This ecological site occurs mainly on forested backslopes of mountains and canyon walls. Parent materials are derived from basalt rock mantled by volcanic ash and loess.

Associated sites

F043CY508WA	**Frigid, Xeric, Loamy, Mountains and Plateaus, Mixed Ash Surface Grand fir/pinegrass** frigid, xeric, mixed ash surface, basalt/andesite geology
F043CY509WA	**Frigid, Xeric, Loamy Mountains and Plateaus, Ashy Surface Grand fir/pinegrass** frigid, xeric, ashy surface, basalt/andesite geology.
F043CY510WA	**Frigid, Dry-Udic, Loamy, Hills and Mountains, Basalt, Ashy surface (grand fir/moist herb)** frigid, dry-udic, ashy surface, basalt geology.
F043CY511WA	**Frigid, Dry-Udic, Loamy, Hills, and Canyons, Basalt, Mixed Ash (grand fir/moist herb)** frigid, dry-udic, mixed ash surface, basalt geology.

F043CY512WA	**Frigid, Dry-Udic, Loamy, Hills, and Canyons, Mixed Ash (grand fir/moist herb)** frigid, dry-udic, mixed ash, granitic or metamorphic geology.
F043CY502WA	**Cool-Frigid, Dry-Xeric, Loamy Mountains (Douglas-fir Cool Dry Grass)** cool-frigid, dry-xeric, ashy surface, basalt geology.
F043CY504WA	**Warm-Frigid, Xeric, Loamy, Basalt Mountains and Plateaus (Douglas-fir/warm dry shrub)** warm-frigid, xeric, mixed ash surface, basalt geology.

Similar sites

F043CY508WA	**Frigid, Xeric, Loamy, Mountains and Plateaus, Mixed Ash Surface Grand fir/pinegrass** Mixed ash surface, xeric soil moisture regmie
F043CY509WA	**Frigid, Xeric, Loamy Mountains and Plateaus, Ashy Surface Grand fir/pinegrass** Ashy surface, xeric soil moisture regime
F043CY502WA	**Cool-Frigid, Dry-Xeric, Loamy Mountains (Douglas-fir Cool Dry Grass)** Cool-frigid soil temperature regime, dry-xeric soil moisture regime

Table 1. Dominant plant species

Tree	(1) *Abies grandis* (2) *Pseudotsuga menziesii var. glauca*
Shrub	(1) *Linnaea borealis ssp. longiflora*
Herbaceous	Not specified

Physiographic features

Physiographic Features
This ecological site occurs mainly on forested backslopes of mountains and canyon walls. Parent materials are derived from basalt rock mantled by volcanic ash and loess.

Landscapes: Plateaus, Mountains
Landforms: Plateaus, Canyons, Mountain slopes

Elevation:
Total range = 855 to 1860 m
(2,800 to 6,100 feet)
Central tendency = 1245 to 1510 m
(4,085 to 4,955 feet)

Slope (percent):
Total range = 0 to 100 percent
Central tendency = 20 to 55 percent

Water Table Depth:
>200 cm
(>80 inches)

Flooding:
Frequency: None
Duration: None

Ponding:
Frequency: None
Duration: None

Aspect: 305-15-45

Table 2. Representative physiographic features

Landforms	(1) Plateau > Canyon (2) Mountains > Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	1,245–1,510 m
Slope	20–55%
Water table depth	0 cm
Aspect	NW, N, NE

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	853–1,859 m
Slope	0–100%
Water table depth	0 cm

Climatic features

Climatic Features
During the spring and summer, a circulation of air around a high-pressure center brings a prevailing westerly and northwesterly flow of comparatively dry, cool and stable air into the region. As the air moves inland, it becomes warmer and drier which results in a dry season beginning in the late spring and reaching a peak in mid-summer. In the fall and winter, a circulation of air around two pressure centers over the ocean brings a prevailing southwesterly and westerly flow of air into the Pacific Northwest. This air from over the ocean is moist and near the temperature of the water. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains or highlands. This results in a wet season beginning in October, reaching a peak in winter, then gradually decreasing in the spring.
The elevation within the LRU varies from approximately 1,500 feet in the lower river valleys to over 7,000 feet in the higher terrain. The annual precipitation increases from 12 inches in the valleys to over 52 inches over the higher mountains. Winter season snowfall varies from 30 to 50 inches. Both rainfall and snowfall increase in the higher elevations. Snow can be expected after the first of November and to remain on the ground from the first of December until March or April.
In January, the average maximum temperature is near 31° F and the minimum temperature is 18° F. Minimum temperatures from -10° to -20°F are recorded almost every winter and temperatures ranging to -30° F have been recorded. In July, the average maximum temperature is 85° to 90° and the minimum temperature 45° to 50° F. Maximum temperatures reach 100° F on a few afternoons each summer and temperatures between 105° to 110° F have been recorded. Temperatures in the mountains decrease three to five degrees Fahrenheit with each 1,000 feet increase in elevation. The average date of the last freezing temperatures can be expected by mid-May and before mid-October in the warmer areas.
(Compiled from WRCC: Climate of Washington and available station data)
Frost-free period (days):
Total range = 50 to 110 days
Central tendency = 70 to 90 days

Mean annual precipitation (cm):
Total range = 415 to 1640 mm
(16 to 65 inches)
Central tendency = 725 to 1135 mm
(29 to 45 inches)
MAAT (C)
Total range = 4.7 to 9.1
(40 to 48 F)

Central tendency = 6.4 to 7.5
(44 to 46 F)

Climate stations: none

Table 4. Representative climatic features

Frost-free period (characteristic range)	70-90 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	737-1,143 mm
Frost-free period (actual range)	50-110 days
Freeze-free period (actual range)	
Precipitation total (actual range)	406-1,651 mm
Frost-free period (average)	80 days
Freeze-free period (average)	
Precipitation total (average)	940 mm

Influencing water features

Water Table Depth:
>200 cm
(>80 inches)

Flooding:
Frequency: None
Duration: None

Ponding:
Frequency: None
Duration: None

Soil features

Representative Soil Features
This ecological site is associated with several soil components (Crackercreek, Harl, Limberjim, Olot, Syrupcreek, Tamara, Tolo) The soil components are Alfic Vitrixerands, Typic Vitrixerands and Alfic Udivitrands. These soils have developed in colluvium and/or residuum from basalt or andesite with a mantle of tephra and loess.

Parent Materials:
Kind: Tephra (volcanic ash)
Origin: mixed
Kind: loess
Origin: mixed
Kind: residuum and colluvium
Origin: Basalt, or Andesite

Surface Texture: (<2mm fraction)
(1) Ashy Silt Loam

Table 5. Representative soil features

Parent material	(1) Volcanic ash (2) Loess (3) Residuum–basalt (4) Colluvium–basalt (5) Residuum–andesite (6) Colluvium–andesite
Surface texture	(1) Ashy silt loam
Drainage class	Well drained
Permeability class	Moderate
Depth to restrictive layer	0 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	16.26 cm
Calcium carbonate equivalent (0-152.4cm)	0%
Electrical conductivity (0-152.4cm)	0 mmhos/cm
Sodium adsorption ratio (0-152.4cm)	0
Soil reaction (1:1 water) (0-152.4cm)	6.5
Subsurface fragment volume <=3" (25.4-152.4cm)	10%
Subsurface fragment volume >3" (25.4-152.4cm)	1%

Table 6. Representative soil features (actual values)

Drainage class	Well drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	0–51 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.92–28.19 cm
Calcium carbonate equivalent (0-152.4cm)	0%
Electrical conductivity (0-152.4cm)	0 mmhos/cm
Sodium adsorption ratio (0-152.4cm)	0
Soil reaction (1:1 water) (0-152.4cm)	5.6–7.3
Subsurface fragment volume <=3" (25.4-152.4cm)	0–27%
Subsurface fragment volume >3" (25.4-152.4cm)	0–13%

Ecological dynamics

The grand-fir (*Abies grandis*) potential vegetation type (PVT) that typifies this Grand-fir/Moist Shrub (GF-MS) ecological site is the modal grand-fir/twinflower (*Linnaea borealis*) (ABGR/LIBO) plant association. ABGR/LIBO is the most extensive singular forested plant association in MLRA 43C. Less extensive plant associations that are included in this ecological site are grand-fir/big huckleberry (*Vaccinium membranaceum*) (ABGR/VAME), and grand-fir /Pacific yew (*Taxus brevifolia*)/twinflower (ABGR/TABR/LIBO).

The plant association(s) of the GF-MS ecological site are part of a broader “Moist-Mixed Conifer forest” plant association group (PAG) of the western United States.

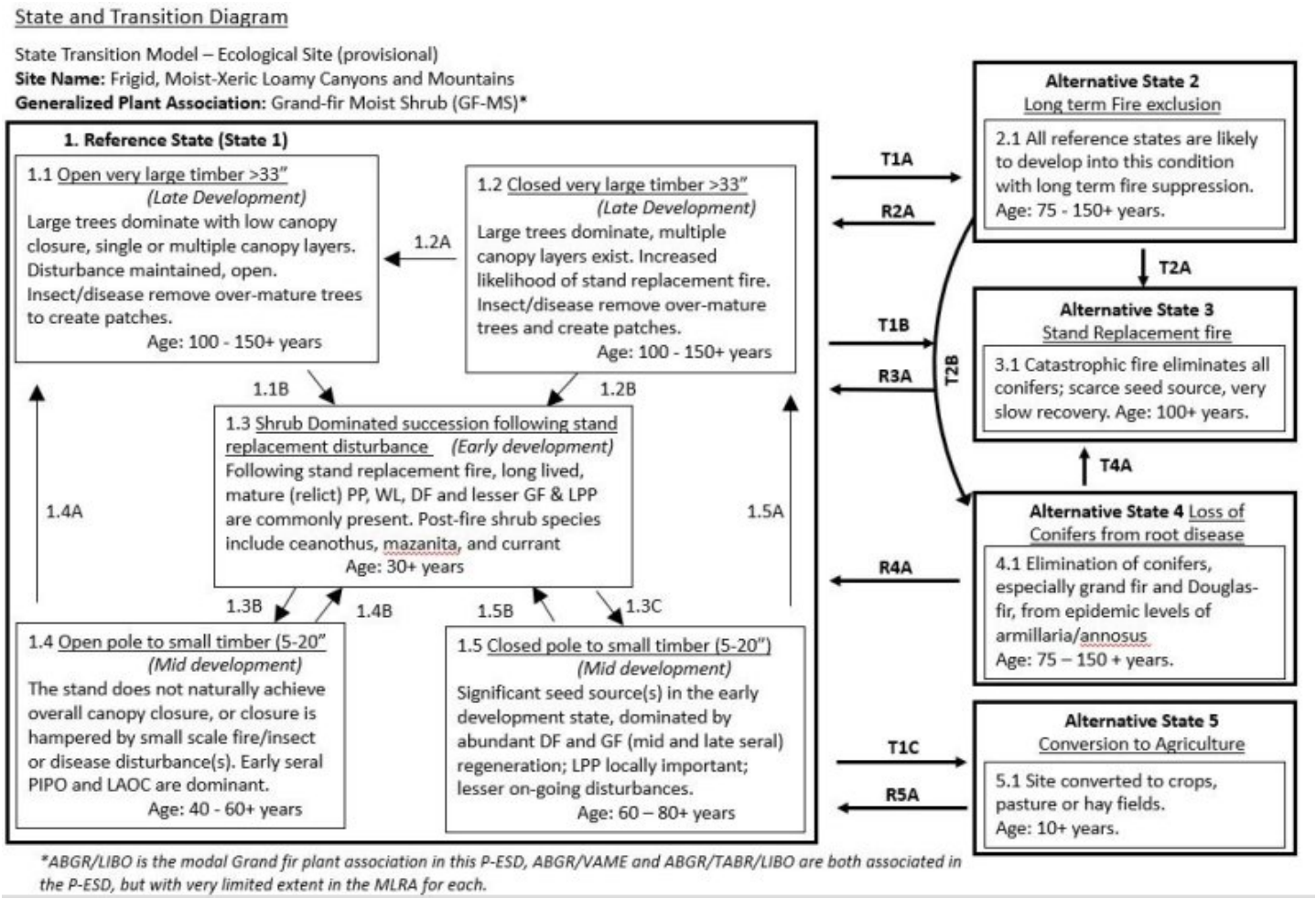
This Grand fir/Moist Shrub ecological site is diverse and floristically rich. It occurs in the progression from the dry Ponderosa pine (*Pinus ponderosa*) ecological sites, which in turn give way to the warm/dry representations of Douglas-fir (Pesudotsuga menziesii) and similar grand fir (*Abies grandis*) ecological sites. Those specific Douglas-fir and grand-fir plant associations, which sit directly below this particular GF-MS site in terms of temperature/moisture climatic influences encompass the dryer and warmer end of the Douglas-fir and grand-fir plant associations (that is, the Douglas-fir and grand-fir series with elk sedge (*Carex geyeri*), pinegrass (*Calamagrostis rubescens*), snowberry (*Symphoricarpos albus*) and ninebark (*Physocarpus malvaceus*) phases. The broader collective name of this latter group of plant associations is referred to as the “Dry Mixed Conifer forest” group.

This Grand-fir/Moist Shrub ecological site is transitional to cold upland forests, typified by subalpine fir plant associations, that support understory species with higher moisture and cooler temperature thresholds.

Compared to the forest associations of the drier ecological sites, the occurrence and impacts of the natural historic fire disturbance(s) become more variable in the GF-MS ecological site. This site is described as a “mixed” fire regime . In this regime, wildfire disturbances occur at longer fire return interval periods and result in different levels of burn severity. The precise outcome of any given fire episode depends on a myriad of factors at the time of a particular event—fire is a predictable but uncertain dynamic process. The historic expression of these wildfires shaped the basic ecological function and forest structural attributes of the pre-European forest in a relatively constant manner over long periods of time.
It is possible that small representations of the lodgepole pine (*Pinus contorta* var. lat.)/grand-fir big huckleberry-twinflower (PICO(ABGR)/VAME-LIBO) plant association may be found within this provisional ESD. Single aged, dense lodgepole pine dominated stands typically occupy cold air drainages (i.e. “frost pockets”) on gentle slopes within the landscape, where early seral lodgepole pine establishes following replacement fires. Lesser amounts of grand fir will often be found intermingled with the lodgepole pine. Big huckleberry and twinflower are usually present, with other small shrubs such as grouse huckleberry (*Vaccinium scoparium*), pachistima (Pachistima myrsinites), and prince’s pine (*Chimaphila umbellata*), along with elk sedge and pinegrass herbaceous species in the understory.
The most common historic expression of the Grand-fir/Moist Shrub ecological site is represented as a late development stand structure stand largely comprised of very large mature and over-mature early and mid-seral tree species. Conifer species include Douglas-fir, scattered (late seral) overstory grand-fir , western larch (*Larix occidentalis*) and Ponderosa pine, with limited amounts of lodgepole pine and western white pine (*Pinus monticola*). Engelmann spruce (Picea Engelmannii) occurs as a late seral conifer. The older long-lived (over mature) and very large early/mid seral relict trees (those that survived the last major stand replacement disturbance) may be present, but at a much lower density within the stand. These relict species were predominately Ponderosa pine, larch and Douglas-fir. Depending on the stand history of various disturbance(s) events, these stands either developed as closed or open as they established and progressed to maturity.
Insect and disease impacts and disturbances become more widespread as stands mature, typically in the mid and late closed structural phases, where stocking stress can predispose stands to increased mortality.
Ponderosa pine is damaged by bark beetles, pine engraver, mistletoe and other agents. Douglas-fir is weakened or killed from Douglas-fir beetle (sometimes as secondary fire mortality), wood borers, tussock moth, and western spruce budworm. Western larch is susceptible to damage from dwarf mistletoe, needlecast and a host of fungi. Larch casebearer, sawfly, spruce budworm and tussock moth are common larch defoliators. Western white pine is greatly reduced from its historic expression by the impacts of white pine blister rust. Lodgepole pine is commonly impacted by western gull rust, mistletoe, and bark beetles, among other agents. Both Douglas-fir and grand-fir are very susceptible to root diseases (i.e. annosus and armillaria) and subsequent insect mortality, especially where stands become overstocked in combination with lower quality soils, and when seasonal climatic or weather conditions are poor. Common causes of insect damage to grand fir is from spruce budworm, tussock moth and the fir engraver beetle. Grand fir is also susceptible to a variety of pathogens and other injurious agents. Engelmann

spruce is commonly impacted by wood-rotting fungi and broom rusts. Spruce beetle can cause serious mortality during outbreaks.
In the early stages of stand development, root diseases cause small scale patches to develop. The impact from diseases or subsequent insect infestation can be small and endemic, or larger scaled over time when these root disease and damage agents actually become epidemic.
Fire exclusion within the past 100 years (the Post-European period) has drastically changed the structural expression of the present forest in this ecological site, resulting in an increase in the proportion of mid to late serial tree species, and corresponding in increases in crown density and continuity. Fuel loads have increased at all levels on the majority of present day stands.

State and transition model



Plant Community, Transition(s) and Restoration Pathways

Reference State:

(Refer again to Appendix 1 for tree-size classes)

Low intensity naturally occurring ground fires maintain the mature, late development (open) expression of the reference state across the landscape (Community Phase 1.1). These events occur on a regular basis in this disturbance dependent community, without altering the basic structure of the overall stand.
1.1B - Stand replacement fire shifts the stand to the early development phase. Secondary succession is initiated.
1.2A - Mixed fire events or endemic insect/disease impacts shift the stand structure to the mature, late development open, very large timber structural phase. DF and WL are important components.
1.2B - Stand replacement fire changes the stand to the early development phase; early stand development begins.
Reburn(s) occur in early development phase, eliminating young conifer recruitment and/or mature conifer seed tree sources at this time. Multiple reburn(s) can occur to maintain Community Phase 1.3. Persistent shrub fields may develop due to loss of conifer recruitment.
1.3B – The absence of larger scale fire disturbance for – 40 years, along with a scattered seed source of adapted conifers, results in occasional conifer recruitment (spotty recruitment and low-density development of conifers may also occur due to impacts of other on-going disturbance events). Under these conditions, the stand develops to the open mid-development structure phase.
1.3C – Absence of larger scale fire disturbance for – 40 years, with abundant (mainly early seral) conifer recruitment (with low levels of other disturbance events, results in the progression to the closed mid-development structure phase.
1.4A – Canopy closure does not occur in the young stand, or additional small patches are created by mixed fire or insect/disease disturbances, retaining the open nature of the stand. Succession to large/very large timber (open) state occurs - 50 years.
1.4B - Large scale stand replacement fire changes the stand back to the early development conditions. Secondary succession is initiated.
1.5A - With an absence of fire or other significant disturbance for - 40 years, the stand develops to the closed, late development phase. Mid to late seral species increase in the secondary (understory) stand as seedlings, saplings, and pole size trees.
1.5B - Large scale stand replacement fire shifts the stand back to early development again.

Transitions:

T1A - Long term fire exclusion (50-100+) years, (results in Alternative State 2).
T1B - A widespread stand replacing fire event occurs as a natural event in any phase of the reference state. Approximately ¾ or more of the cone producing age confer species are killed across all age/size classes. There is potential of a long-term deficiency of seed source(s) necessary for the re-establishment of the early, mid, and late seral species (this results in Alternative State 3).
T1C – Stand converted to agricultural use, annually tilled cropland, or longer-term pasture or hay production.
T2A – Fuels which build-up in Alternative State 2 lead to a catastrophic wildfire, similar to that of T1B, but the likelihood, intensity, and impact to the basic natural resources from the event is much greater in scope (i.e., losses in soil quality, organic matter, LOD, snags, etc).
T2B - In the absence of catastrophic fire, the long-term build-up of mid to late seral Douglas-fir and grand-fir leads to increased levels of root disease, especially on poor quality sites, (i.e., lower fertility soils or soils with depth/water holding limitations, sites with late summer excessive heat and drought). The eventual loss of all conifer species results in development of long-term persistent brush fields.
T4A - Widespread catastrophic fire occurs similar to that of T2A, with varying levels of live and dead conifer individuals, along with abnormal levels of native brush species.

Restoration Pathways:

R2A - Treatment practices commonly used to rehabilitate forest lands and reduce fuels is applied (e.g., thinning, pruning, installing fuel breaks, species shift to early seral).
R3A – Reforestation (with planting of ponderosa pine, Douglas-fir, western larch and western white pine) is applied in the immediate aftermath of a catastrophic wildfire. Native understory species rebound naturally unless the fire damage to the soil resource was excessive.
R4A – Where conifer reduction or elimination has occurred from excessive build-up of root disease, the site will retain infected root material in the soil for 100 years or longer. When soil infestation levels have receded, Afforestation practices can re-establish early seral conifer components. Site preparation may be necessary.
R5A – Replanting with native early and mid-seral tree species (afforestation) is applied to sites that have been in agricultural uses for long periods of time. Site preparation may be necessary.

References

Powell, D.C., C.G. Johnson, E.A. Crowe, A. Wells, and D.K. Swanson. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west-central Idaho. Gen. Tech. Rep. PNW-GTR-709.. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station., Portland, OR.

Other references

USNVC [United States National Vegetation Classification]. 2020. United States National Vegetation Classification Database, V2.03. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. USNVC: http://usnvc.org/

Contributors

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Approval

Kirt Walstad, 9/08/2023

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	05/19/2024
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:

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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:**
