Ecological site R002XC010OR
Claypan Low Hill Group

Last updated: 11/27/2024
Accessed: 05/11/2025

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): 002X–Willamette and Puget Sound Valleys

The Willamette and Puget Sound Valleys Major Land Resource Area (MLRA 2) is located in western Washington and Oregon. It occupies a forearc basin between coast ranges and the Cascade Mountain volcanic arc. The northern part contains Pleistocene drift, outwash, lacustrine and glaciomarine deposits associated with continental glaciers. The southern part contains Late Pleistocene deposits from glacial outburst floods (Missoula Floods). Climate is mild and moist, with a long growing season. Mean annual precipitation ranges from 20 to 60 inches, falling mostly in fall, winter, and spring. Summers are dry. Soil temperature regime is mesic and soil moisture regimes are xeric and aquic.
Most sites in this MLRA can support forested vegetation, but some were maintained as prairie, savanna, or woodland through cultural burning prior to Euro-American settlement. Puget Sound has a moderating effect on temperatures and humidity can be higher in the northern part of the MLRA. Douglas-fir (*Pseudotsuga menziesii*) is widespread throughout. Oregon white oak (*Quercus garryana*) is common on uplands in the south and on warm, exposed or droughty sites in the north. Pacific madrone (Arbutus menziesii) occurs in areas close to salt water. Western hemlock (Tsuga heterophylla) is codominant with Douglas-fir in the north. Floodplains usually contain black cottonwood (Populus balsamifera ssp. trichocarpa) and red alder (Alnus rubra). Oregon ash (*Fraxinus latifolia*) is typical of forested wetlands in the south. Forestry, urban development, and cultivated agriculture are currently the most extensive land uses (Soil Survey Staff, 2006).

LRU notes

The Willamette Valley land resource unit (LRU C) is located in northwestern Oregon. It is bounded by the Portland Basin to the north and the Umpqua Valley to the south. Topography is generally flat to hilly. Major landforms include floodplains and alluvial terraces, glaciolacustrine terraces, hills, and foothills. The valley floor is underlain by Pleistocene fluvial deposits (Rowland Formation). Valley borders and foothills are underlain by Eocene to Pliocene sedimentary rocks (Yamhill, Spencer, and Nestucca Formations) or, in some western areas, Eocene pillow basalts (Siletz River Volcanics). Other hills consist of Miocene Columbia River Basalt (Yeats et al., 1996; Orr et al., 1992). Locations below 400 feet elevation are covered with late Pleistocene silts deposited by the Missoula Floods (Willamette Silts).
Mean annual precipitation ranges from 35 to 60 inches. Most falls as rain between October and May. The frost-free period ranges from 160 to 210 days. Snowfall occasionally occurs in winter, but snow cover rarely lasts longer than a few days. Ice storms usually occur at least once each winter. Winter storm winds come from the south. Fair-weather winds during summer come from the north.
Prior to Euro-American settlement, fire was used in this LRU to maintain early-seral plant communities for food and fiber. General Land Office (GLO) land surveys conducted between 1851 and 1910 documented widespread prairies and savannas (Hulse et al., 2002). Fire exclusion since Euro-American settlement allowed many of these to succeed to forested communities (Johannessen et al., 1971; Day, 2005). Historic prairies and savannas were less common at the north end of the Willamette Valley, but an island of these types occurred in the Tualitan Valley. In general, fire frequency decreased with distance from human settlements (Christy and Alverson, 2011).
Presence of Oregon white oak and absence of western hemlock distinguish this area from the coast range (MLRA

1) and Cascade mountains (MLRA 3). This LRU is distinguished from Portland Basin and Hills (LRU B) by low-frequency occurrence of species common in the Umpqua and Rogue valleys, including California black oak (Quercus kelloggii), Pacific madrone (Arbutus menziesii), incense cedar (Calocedrus decurrens), and white alder (Alnus rhombifolia) (Franklin and Dyrness, 1973).

Classification relationships

This ecological site group fits within the following LANDFIRE Biophysical Setting (BpS):
• LANDFIRE Biophysical Setting: Willamette Valley Upland Prairie and Savanna (0211200)

Ecological site concept

This site occurs on footslopes of hills, high terraces, and alluvial fans around the edges of the Willamette Valley. Soils often contain a textural discontinuity that perches water and restricts rooting depth such that soils saturated in early spring become droughty in early summer.

Table 1. Dominant plant species

Tree	(1) *Quercus garryana*
Shrub	Not specified
Herbaceous	(1) *Danthonia californica* (2) *Forb, perennial*

Physiographic features

Landform: footslopes on hills, high terraces, alluvial fans
Parent material: silty glaciolacustrine deposits or local alluvium over residuum
Elevation: 200 to 600 feet
Slope: 0 to 50 percent
Flooding: none
Ponding: none

This site occurs on the Brateng and Dolph geomorphic surfaces at the edges of the Willamette Valley (Balster and Parsons, 1968; Reckendorf, 1993).

Table 2. Representative physiographic features

Hillslope profile	(1) Footslope
Landforms	(1) Hill (2) Alluvial fan (3) Terrace
Flooding frequency	None
Ponding frequency	None
Elevation	200–600 ft
Slope	0–50%

Climatic features

Mean annual air temperature: 50 to 54 degrees F
Mean annual precipitation: 40 to 55 inches
Frost free period: 165 to 210 days

Influencing water features

This site occurs on footslopes of hills, high terraces, and alluvial fans. Soils often contain a textural discontinuity that perches water and restricts rooting depth such that soils saturated in early spring become droughty in early summer. There is a seasonal water table.

Wetland description

None

Soil features

Drainage class: somewhat poorly or poorly drained
Parent material: silty glaciolacustrine deposits or local alluvium over residuum
Soil restrictive feature(s): (see below)
Soil moisture regime: xeric or aquic
Soil temperature regime: mesic
Particle-size family(s): fine or very-fine
Soil mineralogy: smectitic or mixed
Cation exchange capacity: superactive (when used)
Soil reaction: moderately or strongly acid

Soils often contain a discontinuity that perches water and restricts rooting depth such that soils saturated in early spring become droughty by early summer. Discontinuities between soil layers may not qualify as root-limiting layers as defined in Soil Taxonomy (Soil Survey Staff, 2014). Nonetheless, roots often run laterally above these features. These soils belong to a variety of soil orders.

Soils correlated with this site include Chehalem, Dupee, Hazelair, Helmick, Linslaw, Panther, Pengra, Suver, and Witham.

Table 3. Representative soil features

Parent material	(1) Alluvium (2) Residuum (3) Glaciolacustrine deposits
Family particle size	(1) Fine (2) Very-fine
Drainage class	Somewhat poorly drained to poorly drained

Ecological dynamics

Central Concept

This site occurs on footslopes of hills, high terraces, and alluvial fans around the edges of the Willamette Valley. Soils often contain a textural discontinuity that perches water and restricts rooting depth such that soils saturated in early spring become droughty in early summer. The seasonal water table favors the development of deciduous forest, but the reference plant community is a savanna maintained through cultural burning. This savanna consists of Oregon white oak / California oatgrass - forbs.

Range in Variability

Variation in soils may define subtypes with distinct reference communities. A perched water table is typical but soils such as Chehalem and Witham are endosaturated.

Disturbance

This site developed under a cultural burning regime. Fire return interval was approximately 1 to 10 years (Christy and Alverson, 2011). Fire has been generally excluded from this site since Euro-American settlement began around 1850. Tree-throw occurs in forested communities. Camas pocket gophers (Thomomys bulbivorus) make burrows

and mounds in early-seral communities (Oregon Department of Fish and Wildlife).

Plant Composition

Savanna (prairie with scattered trees) was typical prior to Euro-American settlement, but forested vegetation tends to develop in the absence of fire. Agee (1993) suggested 20 trees per acre as the maximum tree density for savannas in the Pacific Northwest. Day (2005) found as few as 7 trees per acre in savannas located on the Willamette National Forest. Early season saturation alternating with mid-to-late season droughtiness create favorable conditions for bulbs and forbs by reducing competition from perennial grasses.

Representative native plants are listed below. Not all species are present within the same community phase. Plant lists (especially for grasses, grasslikes, and forbs) are incomplete. An asterisk (*) indicates plant species representative of the pre-settlement reference community (Christy and Alverson, 2011).

GRASSES:
California oatgrass (*Danthonia californica*) *
Roemer's fescue (Festuca roemeri) *
Sandberg bluegrass (*Poa secunda*) *
prairie Junegrass (*Koeleria macrantha*) *
slender wheatgrass (*Elymus trachycaulus*) *

GRASSLIKES:
sedge (Carex spp.) *
rush (Juncus spp.) *

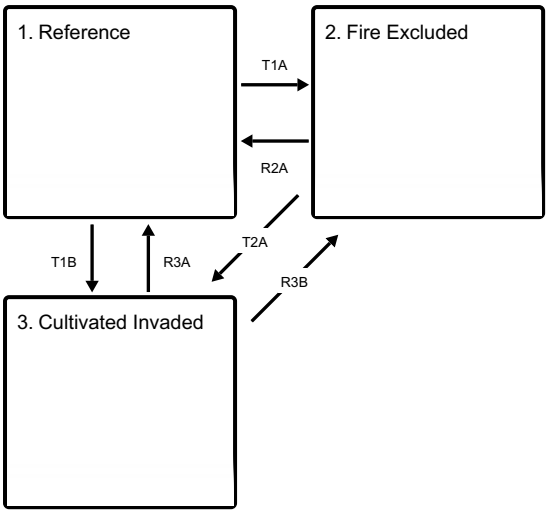
FORBS:
small camas (*Camassia quamash* ssp. maxima) *
Suksdorf's large camas (*Camassia leichtlinii* ssp. suksdorfii) *
brodiaea (Brodiaea spp.) *
triteleia (Triteleia spp.) *
checker lily (*Fritillaria affinis*) *
desertparsley (Lomatium spp.) *
yampah (Perideridia spp.) *
tarweed (Madia spp.) *
balsamroot (Balsamorhiza spp.) *

TREES:
Oregon white oak (*Quercus garryana*) *
Oregon ash (*Fraxinus latifolia*) *
ponderosa pine (*Pinus ponderosa*) *
Douglas-fir (*Pseudotsuga menziesii*) *
bigleaf maple (*Acer macrophyllum*)
grand fir (*Abies grandis*)
cascara buckthorn (*Frangula purshiana*)

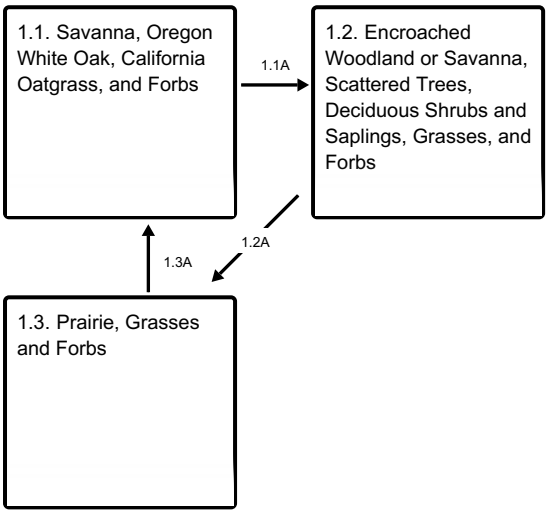
SHRUBS:
common snowberry (*Symphoricarpos albus*)
creeping snowberry (*Symphoricarpos mollis*)
Saskatoon serviceberry (*Amelanchier alnifolia*)
beaked hazelnut (*Corylus cornuta*)
Indian plum (*Oemleria cerasiformis*)
rose (Rosa spp.)
California blackberry (*Rubus ursinus*)
black hawthorn (*Crataegus douglasii*)
Oregon crab apple (*Malus fusca*)
Pacific poison oak (*Toxicodendron diversilobum*)
oceanspray (*Holodiscus discolor*)
hollyleaved barberry (*Mahonia aquifolium*)

State and transition model

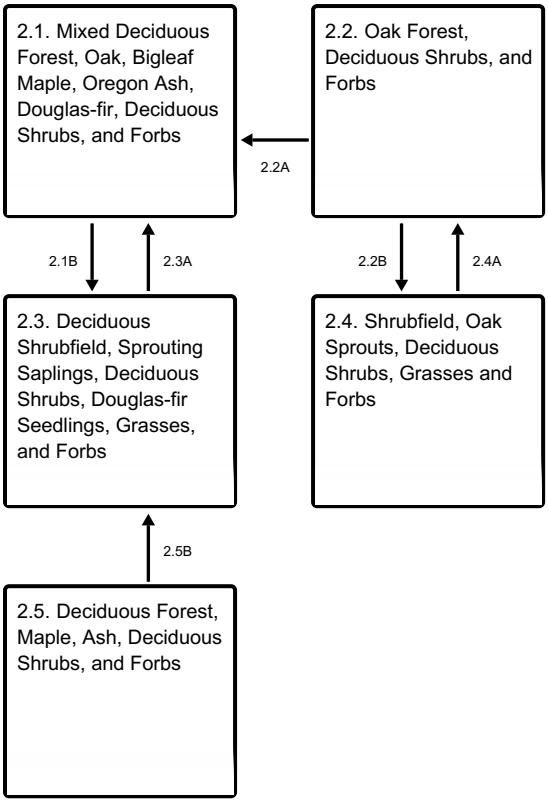
Ecosystem states



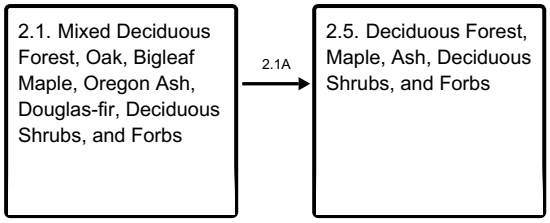
State 1 submodel, plant communities



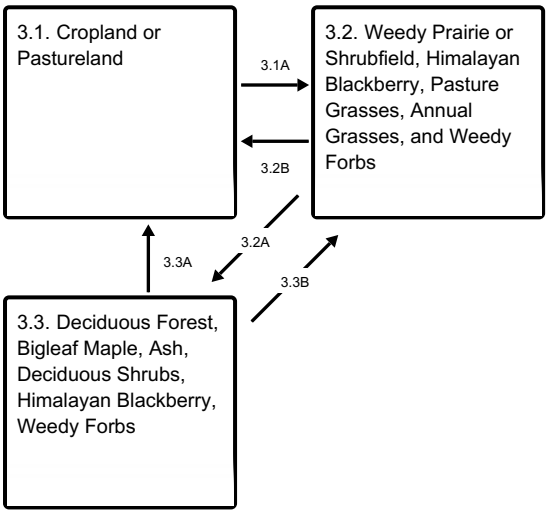
State 2 submodel, plant communities



Communities 1 and 5 (additional pathways)



State 3 submodel, plant communities



State 1
Reference

This state represents the disturbance regime prior to Euro-American settlement and the absence of invasive plant species. Typical fire return interval is approximately 1 to 10 years.

Community 1.1
Savanna, Oregon White Oak, California Oatgrass, and Forbs

Structure: grass and forbs with scattered trees (savanna) Trees consist of scattered, mature, fire-tolerant species. Oak is typical, but ponderosa pine and perhaps Oregon ash also occur. GLO records indicate bearing (witness) trees of all species were typically 41-61 cm in diameter (Christy and Alverson, 2011). Cool-season perennial grasses including California oatgrass and Roemer's fescue are abundant. Shade-intolerant bulbs and other forbs are also present. Fire return interval 1-10 years

Community 1.2

Encroached Woodland or Savanna, Scattered Trees, Deciduous Shrubs and Saplings, Grasses, and Forbs

Structure: Encroached savanna or woodland. Grasses, forbs, deciduous shrubs, young trees and saplings, with scattered mature trees. Deciduous shrubs and saplings grow from seed and sprouts. Conifer saplings regenerate from seed. However, grasses and forbs persist and are not completely shaded out.

Community 1.3
Prairie, Grasses and Forbs

Structure: prairie Grass and forb vigor is renewed by the removal of litter, competition, and shade.

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents an unusually long period without fire during which woody vegetation begins to grow within the savanna.

Pathway 1.2A
Community 1.2 to 1.3

This pathway represents renewed cultural burning. Woody vegetation fuels fire severe enough to kill mature savanna trees.

Pathway 1.3A
Community 1.3 to 1.1

This pathway represents a return to typical cultural burning frequency. Scattered trees growing from seed or sprout survive to the age of fire tolerance, but the development of woody vegetation is generally prevented.

State 2
Fire Excluded

This state represents fire-exclusion with minimal ground disturbance. The impact of invasive species is small.

Community 2.1
Mixed Deciduous Forest, Oak, Bigleaf Maple, Oregon Ash, Douglas-fir, Deciduous Shrubs, and Forbs

Structure: closed deciduous forest The overstory contains an overstory of oak, bigleaf maple, and Oregon ash. Large savanna trees are crowded by fast-growing bigleaf maple and Oregon ash. Antecedent savanna oaks and pines can be recognized by a spreading habit and large lower branches. A few Douglas-fir may be present, but seasonally saturated soils limit their rooting depth. Individuals may die or blow over after they reach a certain size. The understory consists of shade-tolerant deciduous shrubs, saplings (especially in canopy gaps), and shade-tolerant forbs.

Community 2.2
Oak Forest, Deciduous Shrubs, and Forbs

Structure: closed oak forest This community contains an even-aged oak overstory. Unlike oaks that developed in savannas, these crowded trees have a narrow and tall habit. The understory consists of shade-tolerant deciduous shrubs and forbs. Light penetrating the thick oak canopy may be sufficient for grand fir but insufficient for Douglas-fir establishment. On sites too dry for grand fir or lacking a seed source, Community Phase 2.2. may last a long time until canopy oak die or fall over. Investigation is needed to substantiate this idea.

Community 2.3
Deciduous Shrubfield, Sprouting Saplings, Deciduous Shrubs, Douglas-fir Seedlings,

Grasses, and Forbs

Structure: deciduous shrubfield This community consists of deciduous shrubs and saplings, some conifer regeneration, and shade-intolerant grasses and forbs.

Community 2.4
Shrubfield, Oak Sprouts, Deciduous Shrubs, Grasses and Forbs

Structure: deciduous shrubfield (oak sprouts) This community consists of vigorously resprouting oak bushes, shade-intolerant deciduous shrubs, grasses and forbs.

Community 2.5
Deciduous Forest, Maple, Ash, Deciduous Shrubs, and Forbs

Structure: closed mixed forest This community consists of an overstory of bigleaf maple and Oregon ash with an understory of shade-tolerant shrubs and forbs. This is the late-successional community expected to form in the absence of disturbance.

Pathway 2.1B
Community 2.1 to 2.3

This pathway represents tree removal.

Pathway 2.1A
Community 2.1 to 2.5

This pathway represents growth over time.

Pathway 2.2A
Community 2.2 to 2.1

This pathway requires mortality of some decadent oaks with replacement by deciduous trees.

Pathway 2.2B
Community 2.2 to 2.4

This pathway represents tree removal.

Pathway 2.3A
Community 2.3 to 2.1

This pathway represents growth over time.

Pathway 2.4A
Community 2.4 to 2.2

This pathway represents growth over time.

Pathway 2.5B
Community 2.5 to 2.3

This pathway represents tree removal.

State 3
Cultivated Invaded

This state represents post-cultivation conditions that may best fit within land-use models in future work. Weedy

invasive species are usually present and competitive. Fire is excluded. Hydrology is not altered by draining or filling.

Community 3.1
Cropland or Pastureland

Structure: annual or perennial crop, tame pasture, or orchard.

Community 3.2
Weedy Prairie or Shrubfield, Himalayan Blackberry, Pasture Grasses, Annual Grasses, and Weedy Forbs

Structure: weedy shrubfield or prairie This community consists mainly of weeds such as Himalayan blackberry (*Rubus armeniacus*), naturalized pasture grasses, or non-native annual grasses. Himalayan blackberry is aggressive following ground disturbance. Introduced perennial pasture grasses including tall fescue (*Schedonorus arundinaceus*) and creeping bentgrass (*Agrostis stolonifera*) are competitive in open conditions. Winter-annual grasses such as ripgut brome (*Bromus diandrus*) are common in frequently-disturbed areas. Forbs such as Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*) are common. Scotch broom (*Cytisus scoparius*) is characteristic of clearcut forest.

Community 3.3
Deciduous Forest, Bigleaf Maple, Ash, Deciduous Shrubs, Himalayan Blackberry, Weedy Forbs

Structure: Closed deciduous forest The overstory consists mainly of bigleaf maple and Oregon ash. The understory has low species diversity and consists of weedy, shade-tolerant shrubs and forbs. Himalayan blackberry may persist under forest canopy. Shining geranium (*Geranium lucidum*) and slender false brome (*Brachypodium sylvaticum*) invade forest understories. English holly (*Ilex aquifolium*) and sweet cherry (*Prunus avium*) do not require ground disturbance in order to establish. English ivy (*Hedera helix*) is also shade-tolerant.

Pathway 3.1A
Community 3.1 to 3.2

This pathway represents abandonment. Tillage and other management ceases.

Pathway 3.2B
Community 3.2 to 3.1

This pathway represents resumed tillage and agricultural management.

Pathway 3.2A
Community 3.2 to 3.3

This pathway represents continued abandonment and growth over time. Soils develop a litter layer.

Pathway 3.3A
Community 3.3 to 3.1

This pathway represents tree and stump removal with resumed tillage and agricultural management.

Pathway 3.3B
Community 3.3 to 3.2

This pathway represents tree removal alone.

Transition T1A
State 1 to 2

T1A: This pathway represents cessation of fire over a period long enough that grasses and forbs present in the reference community do not recover dominance following removal of woody vegetation. Tree seedlings, including conifers, establish and begin to cast shade, leaf, and needle litter. Soils develop a litter layer. Consequently, forbs shift to mesic, shade-tolerant species (Thilenius, 1964). T1B: This pathway is similar to Transition Pathway T1A with additional conditions favoring the development of a pure oak forest stand. Thilenius (1964, 1968) points out from early records that savannas briefly converted to wheat production or cleared for forage were abandoned by the mid-1880's and "reverted to oak scrub." Top-growth removal without root destruction promotes sprouting and could have led to dense, monotypic oak forest stands. It is also possible that a cohort of dense oak trees developed from seed once fires ceased. Along this transition pathway, oaks regenerate and begin to cast shade, leaf, and needle litter. Soils develop a litter layer. Consequently, the forb layer succeeds to mesic, shade-tolerant species (Thilenius, 1964).

Transition T1B
State 1 to 3

This pathway represents tree and stump removal and tillage to the extent that root systems and seed banks of native plants are depleted. Invasive plant species are introduced.

Restoration pathway R2A
State 2 to 1

R2A: This pathway represents tree thinning, prescribed fire or mowing, seeding native grass, and weed control. Restoration may be easier compared with adjacent sites because rooting depth is limited for competitors such as tall fescue which usually compete strongly with native bulbs and forbs (personal observation). R2B: This pathway represents tree thinning (or oak renewal by cutting and leaving stumps intact), prescribed fire or mowing, seeding native grass, and weed control. Restoration may be easier compared with adjacent sites because rooting depth is limited for competitors such as tall fescue which usually compete strongly with native bulbs and forbs (personal observation).

Transition T2A
State 2 to 3

This pathway represents tree and stump removal and tillage to the extent that root systems and seed banks of native plants are depleted. Soil litter layer is removed. Invasive plant species are introduced.

Restoration pathway R3A
State 3 to 1

This pathway represents controlling weeds, seeding native grasses, replanting savanna trees, and prescribed fire or mowing.

Restoration pathway R3B
State 3 to 2

This pathway represents weed control and replanting forest trees.

Additional community tables

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Approval

Kirt Walstad, 11/27/2024

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	10/03/2023
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
