USDA Natural Resources Conservation Service

Ecological site F004BX116CA
Sitka spruce-shore pine/California huckleberry, foredunes, mixed eolian sands, sand

Accessed: 05/16/2024

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.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

Similar sites

F004BX110CA	**Sitka spruce-red alder/salmonberry/western swordfern, hills, sandstone and mudstone, clay loam** Ecological site F004BX110CA is also found near the coast and has Sitka spruce has a dominant overstory component; however, F004BX110CA is found on hills overlying sandstone and mudstone parent material, not stabilized dunes, and is much more productive.

Table 1. Dominant plant species

Tree	(1) *Picea sitchensis* (2) *Pinus contorta ssp. contorta*
Shrub	(1) *Vaccinium ovatum*
Herbaceous	Not specified

Physiographic features

This ecological site occupies stabilized sand dunes and longitudinal dunes on dune fields and coastal plains surrounding Humboldt Bay near Eureka, CA and Lake Earl near Crescent City, CA. This site occupies all slope positions of the stabilized dunes so slopes can range from 2 to 75 percent. These longitudinal forested dunes have been formed by the dual processes of subduction and uplift which has provided for new influxes of sand and

stabilization of dunes beyond the coastal strand.

Table 2. Representative physiographic features

Landforms	(1) Foredune (2) Dune
Flooding frequency	None
Ponding frequency	None
Elevation	0–24 m
Slope	2–75%
Water table depth	152 cm
Aspect	NE, SW, W

Climatic features

The climate of this ecological site is humid with cool, foggy summers and cool, rainy winters. Close proximity to the coast limits the diurnal and seasonal range in temperatures. Mean annual precipitation ranges from 35 to 80 inches and usually falls from October to May. Mean annual temperature is 10 to 13 degrees C.

Table 3. Representative climatic features

Frost-free period (average)	330 days
Freeze-free period (average)	330 days
Precipitation total (average)	2,032 mm

Influencing water features

There are no influencing water features on this ecological site. Depressions and deflation basins located on dune toeslopes and in between dune crests should be avoided as they are not within this ecological site.

Soil features

These very deep, somewhat excessively drained soils formed in eolian sand on dune fields and coastal plains. These soils are predominately sand and have an isomesic temperature regime and a udic moisture regime.

Soils in the CA605 North Humboldt and Del Norte Soil Survey Area and CA600 Central Humboldt Soil Survey Area that have been tentatively correlated to this ecosite include:

Map unit Soil component
156 Lanphere

Table 4. Representative soil features

Surface texture	(1) Sand
Drainage class	Somewhat excessively drained
Permeability class	Moderately slow
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.92 cm
Calcium carbonate equivalent (0-101.6cm)	0%

Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The forested dunes in northern Humboldt Bay near Eureka and surrounding Lake Earl outside of Crescent City are unique ecosystems constantly subjected to cycles of disturbance and stabilization. These dune systems exist here because of a steady source of sand (from the Mad River near Eureka and the Smith River near Crescent City), a shoreline perpendicular to prevailing winds, and a low landscape over which dunes can migrate (Friends of the Dunes). Sediments carried to the mouth of the Mad River and other rivers are deposited in the ocean, transported by currents, washed ashore by waves, and subsequently blown overland by northwest prevailing winds to create dune fields (Green 1999). The paleodunes around Humboldt Bay, upon which this ecological site is found, may have been established around 5,000 years ago when sea level rise began to decrease (Clarke and Carver 1992). Around this time local tectonic activity may have shifted the course of the Mad River from an outlet at Humboldt Bay to its present course just north of the bay.

Rapid tectonic subsidence during the last Cascadia subduction zone earthquake approximately 300 years ago may have initiated a tsunami that destroyed existing foredunes but also provided for new sand to blow inland and create the present dune system (Pacific Watershed Associates 1991 and Green 1999). The present forests now override an older system of forested paleodunes derived from one or more past tectonic events (Green 1999). In some areas these buried forests were burned before their burial, but fire does not appear to be a frequent occurrence (Jacoby et al. 1995).

Together the dune stabilization process and continual disturbances provide for a dynamic ecological site. Disturbances to this ecological site include sand movement, wind, invasive species, pathogens, human activity, and infrequent fire. Wind disturbance is the most import disturbance factor in the coastal Sitka spruce zone of the Pacific Northwest (Agee 1993), and these dune forests in particular can be subjected to intense wind exposure coming off the dune fields. Red rings rot (Phellinus pini) has been observed to kill shore pine in the dunes (Green 1999), but this disturbance appears to be of limited extent.

Another ecological disturbance process occurring on the dunes is sand migration which continually envelopes the dune forest on the leading edge, but also provides new habitat for stabilizing dune plants. As dunes override the forest on the leading edge, the forest is also slowing advancing on dunes stabilized by the foredune plant community. The foredune community is composed of dune grass (*Leymus mollis*), yellow sand verbena (*Abronia latifolia*), sea rockets (Cakile spp.), and coast buckwheat (*Eriogonum latifolium*) (Sweet). As these plants colonize open dunes and add organic matter to the sands, other plants are able to become established in these debris pockets. Although organic inputs to these sand soils are low, pockets of fertility may develop enough for shrub and tree species to establish. The proximity of this ecological site to the coast also allow for fog deposition and salt spray to provide inorganic nutrients to the system (LaBanca 1993).

The Humboldt Bay area has been inhabited for approximately 10,000 years, and Wiyot villages were located in the dune forests until about the 1850s (Eargle 1986). The Wiyot used the dune ecosystem to gather food and materials, including surf fish, berries, and weaving materials. Grazing does not appear to have occurred in the forested dunes, but trees were occasionally cut for firewood (Green 1999).

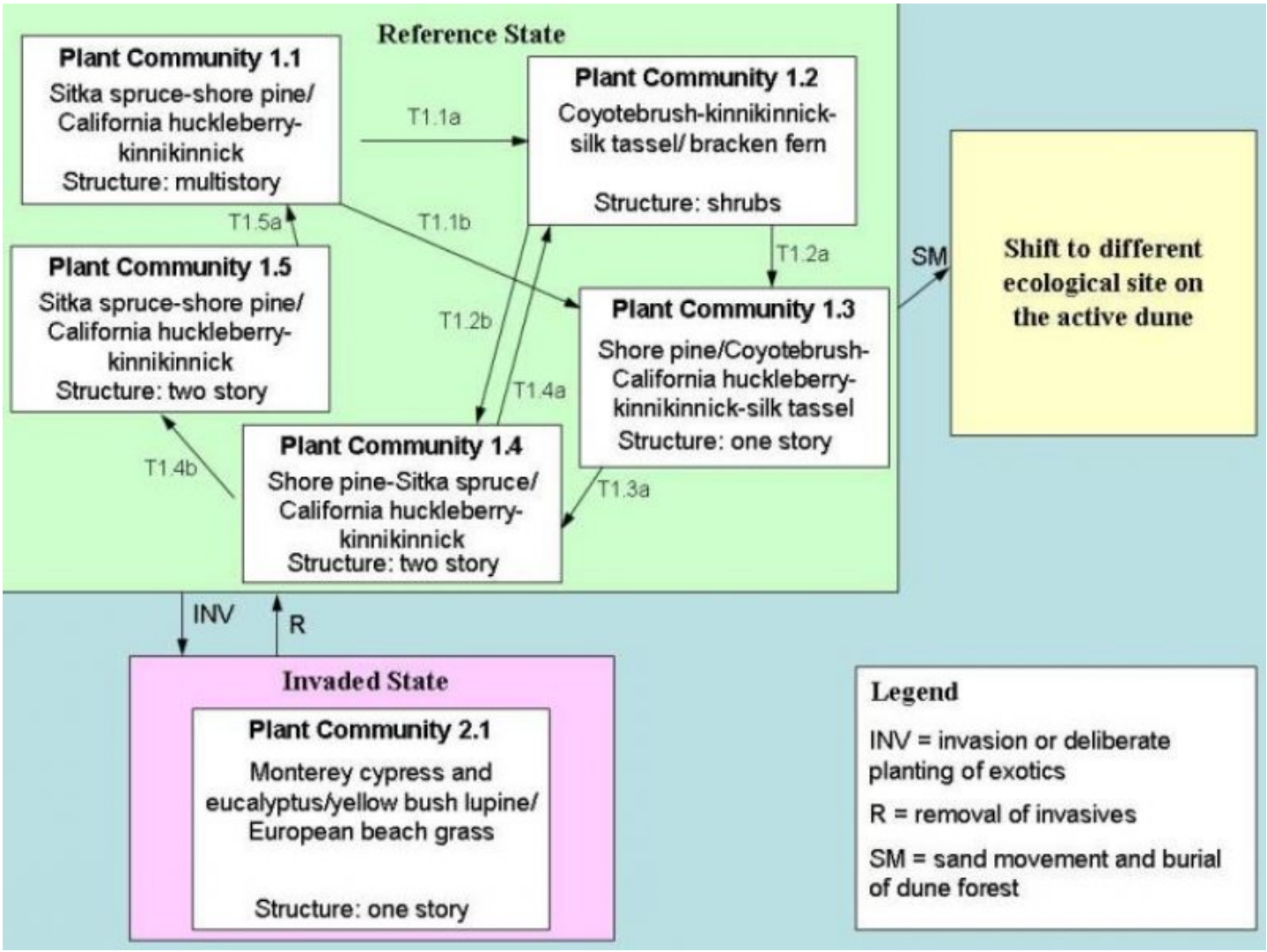
This ecological site is dominated by Sitka spruce (*Picea sitchensis*) and shore pine (*Pinus contorta* var. contorta, a subspecies of lodgepole pine) with occasional grand fir (*Abies grandis*). Green (1999) identified three stand types in the dune forests around Humboldt Bay: a shore pine dominated canopy with high stem density and low basal area, a Sitka spruce dominated forest with low trees per acre but high basal area, and mixed species stands that also included grand fir. These stand types appear to have arisen from differing disturbance pathways and seedling establishment and do not appear to be distinct ecological sites. Shore pine can often be found on nutrient-poor sites, such as dune land, and is often the first conifer species to become established on a newly stabilized dune (Wiedemann 1984). Sitka spruce seedling establishment is slower than that of shore pine, such that Sitka spruce is often ~5 years younger than their shore pine cohorts. Shrubs dominate the understory of this ecological site, including kinnikinnick (*Arctostaphylos uva-ursi*), evergreen huckleberry (Vaccinum ovatum), wavy-leaf silk-tassel

(*Garrya elliptica*), California wax myrtle (*Morella californica*), salal (*Gaultheria shallon*), and dune willow (*Salix hookeriana*). Green (1999) found regeneration of conifer species to be higher under kinnikinnick than dense thickets of evergreen huckleberry and salal. The reindeer lichen (*Cladina portentosa* ssp. pacifica) is also commonly found in the dune forest and provides ground cover and forage in less disturbed areas of this site.

This dune forest ecological site has been subject to ecological changes wrought by several invasive plants including yellow bush lupine (*Lupinus arboreus*) and European beach grass (*Ammophila arenaria*). As a nitrogen fixer, yellow bush lupine not only physically outcompetes native vegetation but also inputs nutrient-rich organic matter into the traditionally nutrient-poor dune forest ecosystem (Humboldt Bay National Wildlife Refuge Complex). These biogeochemical changes could subsequently affect the cycling of other nutrients and the composition of the plant community. European beach grass was intentionally introduced to the west coast in the late 1800s as a sand stabilizer; however, this non-native proved to be too effective at stabilizing the dynamic nature of the dune system (Buell 1992). European beach grass forms dense colonies on foredunes and prevents sand movement inland, thus endangering dune communities which require continued additions of fresh sand.

Direct human disturbance has also greatly influenced this ecological site as the site occupies land adjacent to coast and bay desired for both residential and commercial uses. Planting of Monterey cypress (Callitropsis macrocarpa) and eucalyptus (*Eucalyptus globulus*) on more developed areas has changed the plant composition in areas of this site. Yellow bush lupine and coyotebrush (*Baccharis pilularis*) often colonize disturbed but still stabile dunes. As dune land has low resistance to mechanical degradation, any construction efforts could greatly jeopardize the stability and functioning of the ecosystem. Unregulated recreation and off highway vehicle use could greatly degrade this site, and land managers have attempted to contain and control recreation use on the dune forest land.

State and transition model



State 1
Reference State - Plant Community 1.1

Community 1.1
Reference State - Plant Community 1.1

The reference plant community for this site is the presumed historic plant community prior to European settlement. This reference plant community is characterized by an overstory dominated by Sitka spruce (*Picea sitchensis*) and shore pine (*Pinus contorta* spp. contorta) with occasional grand fir (*Abies grandis*), and an understory dominated by shrubs including kinnikinnick (*Arctostaphylos uva-ursi*), evergreen huckleberry (Vaccinum ovatum), wavy-leaf silk-tassel (*Garrya elliptica*), California wax myrtle (*Morella californica*), and salal (*Gaultheria shallon*). Plant community transition pathways: T1.1a) Clearing of overstory trees for harvest or firewood or stand-replacing fire would open up light and nutrients for pioneer species and shrubs to dominate the site. T1.1b) Selective harvest of valuable Sitka spruce or windthrow could open up gaps in the dune forest canopy for shrubs and more easily regenerating shore pine to colonize.

Forest overstory. The overstory consists mainly of Sitka spruce and shore pine.

Average percent canopy cover:

Sitka spruce 30%
shore pine 25%
grand fir 5%

Forest understory. The understory is dominated by shrubs tolerant to the nutrient-poor sandy soil.

Average percent canopy cover:

California huckleberry 35%
kinnikinnick 10%
California wax myrtle 8%
bracken fern 8%
salal 5%
dune willow 3%
wavyleaf silk tassel 2%
California polypody 2%
western rattlesnake plantain 2%

State 2
Plant Community 1.2

Community 2.1
Plant Community 1.2

This early seral stage plant community is dominated by shrubs. This plant community is also highly suseptible to invasion by non-natives such as yellow bush lupine, seen in the foreground of the typical plant community photo. Dune willow and wax myrtle may also be present in significant amounts. Plant community transition pathways: T1.2a) If seed sources are present, shore pine will establish in the shrub understory a couple years before Sitka spruce establishment. During the initial stage of stand regeneration, shore pine seedlings will become established among shrubs and pioneer species. T1.2b) Manual planting of Sitka spruce, direct seeding, or manual shrub control could hasten the establishment of conifer recruits on the site.

State 3
Plant Community 1.3

Community 3.1

Plant Community 1.3

Shore pine will be the first conifer to regenerate into the site among coyotebrush, kinnikinnick, California huckleberry and silk tassel. The site will continue to function as a dense thicket until the shore pine exceeds the height of the shrubs to create a multi-story canopy structure. Plant community transition pathways: T1.3a) If seed sources are present, Sitka spruce will establish viable seedlings about five years after shore pine regeneration. This difference in regeneration rates will create a several year age gap between shore pine and Sitka spruce in the same stand cohort.

State 4
Plant Community 1.4

Community 4.1
Plant Community 1.4

Sikta spruce establishment will follow that of shore pine to create a more diverse and full overstory canopy. Plant community transition pathways: T1.4a) A large scale wind event could bring down established but spindly conifers and release light and nutrients for shrubs to dominate the site. T1.4b) Continued growth of established saplings will provide the opportunity for the younger but straighter-formed Sitka spruce to reach and exceed the height of the shore pine canopy. As the overstory canopy coalesces and light penetrating through the canopy decreases, the understory shrub layer may begin to thin out.

State 5
Plant Community 1.5

Community 5.1
Plant Community 1.5

The straight form of Sikta spruce will allow it to exceed the shore pine in height. The development of a two story canopy will help to create the structural characteristics present in the reference plant community. Plant community phase transition pathway: T1.5a) Time and an intermediate disturbance regime could create the opportunity for the site to transition towards the Sitka spruce-shore pine reference plant community with a multi-layered canopy a diverse understory.

State 6
Plant Community 2.1

Community 6.1
Plant Community 2.1

The invaded state of this ecological site is characterized by non-native species dominating the landscape. European beach grass forms dense colonies on foredunes and prevents sand movement inland, thus endangering dune communities which require continued additions of fresh sand. As a nitrogen fixer, yellow bush lupine not only physically outcompetes native vegetation but also inputs nutrient-rich organic matter into the traditionally nutrient-poor dune forest ecosystem. Allelopathic chemicals release by eucalyptus can prevent species growth in the understory. Invasion or deliberate planting of invasive species to create an invaded state: The prime location of this ecological site between the coast and bay has subjected these fragile dunes to clearing and leveling for commercial and residential development. Monterey cypress and eucalyptus were planted for aesthetics, as wind breaks, and as a firewood source. These non-native tree species can spread seed quickly and prohibit the establishment of regenerating native conifers. Clearing and deliberate planting also introduced yellow bush lupine and European beach grass to this site. The nutrient enrichment brought by yellow bush lupine and the stabilization brought by dense European beach grass cover would even further prohibit establishment of native vegetation. Invasive plant removal to transition back to reference state: Manual removal of non-native vegetation could provide the opportunity for native species to become established on the site. Removal of yellow bush lupine requires significant effort because of its large root systems and woody structure. European beach grass is also very difficult to remove because its dense rhizomes below the sand surface can sprout shoots even after above ground plants have been removed. This invasive is difficult to keep from establishing on an area because rhizomes washed ashore by waves

are viable. Removal of invasives and planting of native dune grasses such as *Leymus mollis* would help accelerate recovery of the site.

State 7
Active dune ecological site

Community 7.1
Active dune ecological site

Another ecological site, yet undeveloped, would represent the plant communities establishing on the active duneland. Sand movement: The continual process of dune creation involves sand blowing overland from the northwest and burial of the dune forest. As this ecological site is buried under sand on the leading edge of the migrating sand, the site is subsequently expanding onto dune land stabilized by sand binding plants. The buried dune forest transitions to a different ecological site because the sand burial creates a new landform, an active dune without soil profile development, which supports different kinds and amounts of vegetation than the original ecological site.

Additional community tables

Animal community

The coastal dune system provides habitat for a wide range of animal species. The dune forest provides forage and cover for small mammals and predators including coyote, gray fox, raccoon, and skunk. Deer can also be found browsing in the dune forest.

Many bird species can be found in the dune forest ecosystem including bald eagles, blackbirds, warblers, and sparrows.

Hydrological functions

The soils of this ecological site are very deep and somewhat excessively drained. As these soils are dominantly sand, they have high to very high capacity to transmit water. Ponding or flooding does not occur on these soils.

This ecological site is often adjacent to depressions or deflation basins which can be found in between dune crests or on dune toeslopes. These soils have a higher water table and should be avoided when considering the dune forest ecological site.

Hydrologic Group:

156--Lanphere--A

Recreational uses

Much of the extent of this ecological site lies within publicly managed land. Many areas are open to hiking and/or pack animals. As the sandy soils are easily erodible, efforts are made to encourage trail usage to reduce adverse recreational impacts.

The use of off highway vehicles (OHV) is permitted in some dunelands adjacent to this ecological site.

Wood products

In the past, cutting for firewood occured occasionally in this ecological site to provide fuel for nearby settlements and homesteads. However, timber harvest does not appear to have occured in this ecological site in the areas adjacent to Humboldt Bay (Green 1999).

The relatively low biomass production on these sandy soils has limited timber extraction from this ecological site. In addition the variable growth forms and low quality wood of shore pine may deter harvest.

Other products

California huckleberries can be made into wine, and used by home and commercial processors for pie fillings. Foliage of the California huckleberry and salal are often used by florists in floral arrangements and to make Christmas decorations. Many plants were used by indigenous groups for food, medicine, clothing, tools, and basketry. Roots from Sitka spruce and willow were used in basket making.

Other information

Site indices are based on the following curves:

Species Curve# Base age

Sitka spruce 490 100 years
shore pine 520 100 years
grand fir 35 50 years

Table 5. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
grand fir	*ABGR*	90	90	217	217	–	–	–	
Sitka spruce	*PISI*	85	130	95	176	–	–	–	
beach pine	*PICOC*	85	110	74	99	–	–	–	

Inventory data references

Data was collected with forest plots at or near the location of soil pits. Plots numbers correspond to forest plots.

Lanphere-156

08F053
08F054 - at soil pit 02CA600015
08F057
08F058
02028 - at soil pit 02CA605REDW028T

Type locality

Location 1: Humboldt County, CA	
Township/Range/Section	T5N R1W S35
UTM zone	N
UTM northing	4524377
UTM easting	0402327
Latitude	40° 51′ 55″
Longitude	-124° 9′ 32″
General legal description	Located in Ma-le'l Dunes about 3 miles west of the town of Arcata. USGS Eureka Quadrangle.

Other references

Agee J.K. 1993. Fire ecology of Pacific Northwest forests. Island Press. Covelo, CA.

Buell, A.C. 1992. A History of the Introduction and Spread of *Ammophila arenaria* on the North Spit of Humboldt

Bay, CA. Master's Thesis, Humboldt State University, Arcata, CA.

Clarke S.H. and Carver G.A. 1992. Late Holocene tectonics and paleoseismicity, Southern Cascadia subduction zone. Science v255 pp 199-192.

Eargle D. 1986. The earth is our mother: a guide to the Indians of California, their locales, and historic sites. Trees Company Press.

Friends of the Dunes. http://www.friendsofthedunes.org.

Green, S. 1999. Structure and Dynamics of a coastl dune forest at Humboldt Bay, CA. Master's Thesis, Humboldt State University, Arcata, CA.

Humboldt Bay National Wildlife Refuge Complex, http://www.fws.gov/humboldtbay.

LaBanca, T. 1993. Vegetation changes at coastal dunes between Mad River and Little River, Humboldt County, CA. Master's Thesis, Humboldt State University, Arcata, CA.

Pacific Watershed Associates. 1991. Physical Process, Geomorphology and Management Options for Coastal Sand Dunes of Humboldt Bay.

Sweet, S. Plants of the Lanphere-Christensen Dunes

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. USFWS FWS/OBS-84/04. 130 pp.

Contributors

Emily Sinkhorn

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	
Approved by	
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:**