USDA Natural Resources
Conservation Service

Ecological site R058AC052MT
Shale (Sh) RRU 58A-C 11-14" p.z.

Last updated: 6/14/2023
Accessed: 05/12/2025

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.

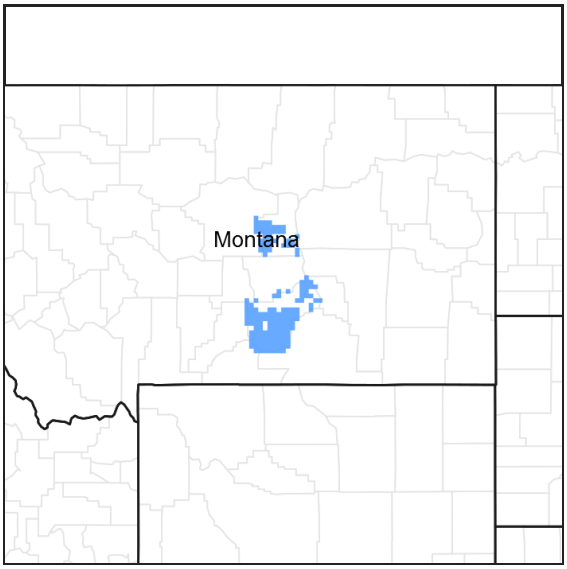


Figure 1. Mapped extent

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.

Associated sites

R058AC059MT	**Shallow Clay (SwC) RRU 58A-C 11-14" p.z.**
R058AC614MT	**Coarse Clay (CC) RRU 58A-C 11-14" p.z.**

Similar sites

R058AC050MT	**Saline Upland (SU) RRU 58A-C 11-14" p.z.** The Saline Upland site is dominated by salt tolerant plants.
R058AC054MT	**Claypan (Cp) RRU 58A-C 11-14" p.z.** The Claypan site is moderately deep to very deep soils that have a hard claypan layer at about 2-8 inches from the surface. These sites are all more productive and have a more diverse plant community.
R058AC053MT	**Dense Clay (DC) RRU 58A-C 11-14" p.z.** The Dense Clay site has moderately deep to deep nongranular heavy clays that are overlain by thin ineffectual layers.
R058AC614MT	**Coarse Clay (CC) RRU 58A-C 11-14" p.z.** The Coarse Clay differs mainly by having a more diverse community of plants that are typically on a Sandy site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Sarcobatus vermiculatus* (2) *Atriplex nuttallii*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Pascopyrum smithii*

Physiographic features

This ecological site occurs on hills, plains, and terraces in shale uplands. Outcroppings of shale often occur. This is a very
barren and extremely low-producing ecological site.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Terrace
Flooding frequency	None
Ponding frequency	None
Elevation	686–1,372 m
Slope	0–45%
Ponding depth	0 cm
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

Major Land Resource Area (MLRA) 58AC in Montana is considered to have a continental climate characterized by cold winters, hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are typical. The climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains and the winds move freely across the plains and account for rapid changes in temperature. Seasonal precipitation is often limiting for plant growth. Annual fluctuations in species composition and total production are typical depending on the amount and timing of rainfall.
Temperatures can be very extreme in this part of Montana. Summer daytime temperatures are typically quite warm, generally averaging in the mid to upper 80º's F for July and August. Summertime temperatures will typically reach in the 100º's F at some point during the summer, and can reach 90º F any month between May and September. Conversely, winter temperatures can be cold, averaging in the mid teens to mid 20º's F for December and January. There will typically be several days of below zero temperatures each winter. It is not uncommon for temperatures to reach 30–40º F below zero, or even colder, most any winter.

Spring can be windy throughout this MLRA, with winds averaging over 10 mph about 15 percent of the time. Speeds of 50 mph or stronger can occasionally occur as a weather system crosses this part of Montana.

The majority of the rangeland in MLRA 58AC is within the 11 to 14 inch Mean Annual Precipitation (MAP) range. During an average year, 70 to 75 percent of the annual precipitation falls between April and September, which are the primary growing season months.

Snowfall is not heavy in the area, averaging 28 total inches in the Yellowstone Valley. Heavy snowfall occurs infrequently, usually late in the winter or early spring. Snow cover is typically 1 to 3 inches.

The frost-free (32º F.) season averages about 105 to 145 days each year in the uplands, to nearly 170 days along the Yellowstone River Valley.

For local climate station information, refer to http://www.wcc.nrcs.usda.gov/cgibin/state.pl?state=mt.

Table 3. Representative climatic features

Frost-free period (average)	132 days
Freeze-free period (average)	107 days
Precipitation total (average)	330 mm

Influencing water features

Soil features

The soils associated with this ecological site are developed in consolidated (acidic and non-acidic) shales. Shale fragments often occur near the surface. These soils are mainly less than 20 inches deep, and typically have a water holding capacity of less than 2 inches. Colors are often dark due to the parent material (lithochromic) and not organic matter. Textures tend to be clayey.

Table 4. Representative soil features

Surface texture	(1) Clay
Surface fragment cover <=3"	0–5%
Electrical conductivity (0-101.6cm)	4–16 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	5–13
Soil reaction (1:1 water) (0-101.6cm)	3.5–6.5

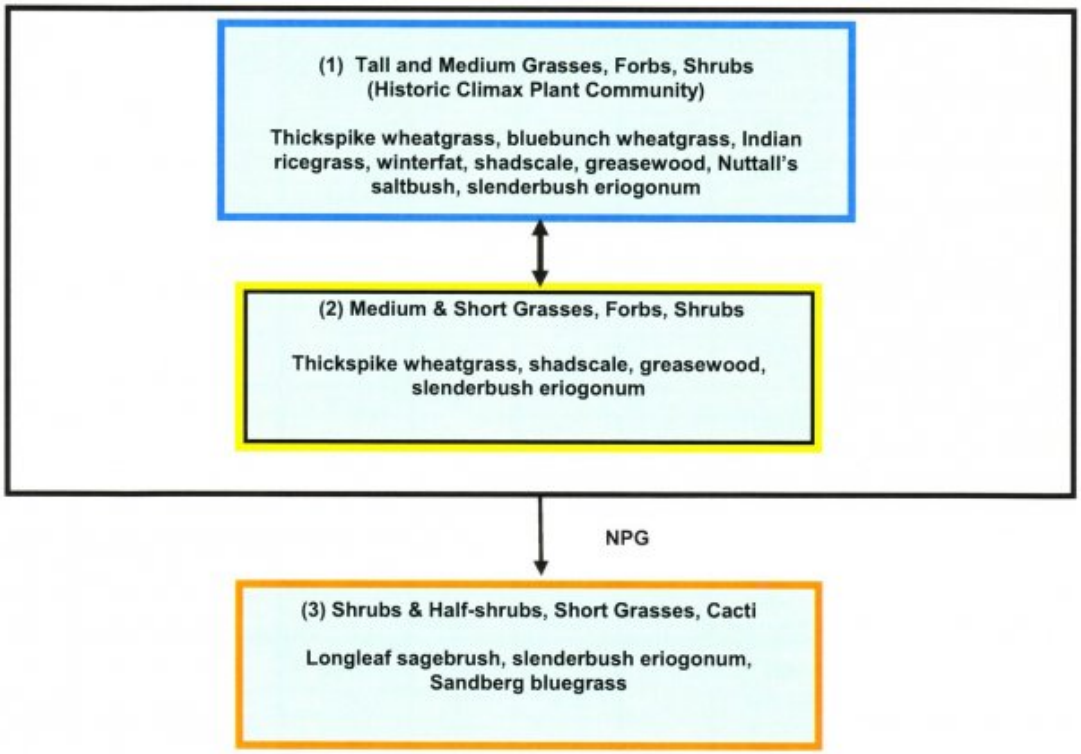
Ecological dynamics

The physical aspect of this site is that of a mixed grassland/shrubland that is typically dominated by medium to short grasses and sedges with a scattered amount of shrubs. Approximately 40–60% of the annual production is from grasses and sedges, 1–5% from forbs, and 20–35% is from shrubs and half-shrubs. Canopy cover of shrubs is 10-15%. The following are descriptions of several plant communities that may occupy this site:

State and transition model

MLRA: 58AC – Sedimentary Plains, Central
R058AC052MT

5c. Plant Communities and Transitional Pathways (diagram)



Smaller boxes within a larger box indicate that these communities will normally shift among themselves with slight variations in precipitation and other disturbances. Moving outside the larger box indicates the community has crossed a threshold (heavier line) and will require intensive treatment to return to Community 1 or 2. Dotted lines indicate a reduced probability for success. Yellow boxes indicate caution that the community may be in danger of crossing a threshold. Orange boxes represent communities that have crossed over thresholds from the HCPC and may be difficult to restore with grazing management alone. Red boxes represent communities that have severely shifted away from the HCPC and probably cannot be restored without mechanical inputs.

NOTE: Not all species present in the community are listed in this table. Species listed are representative of the plant functional groups that occur in the community.

PG = Prescribed Grazing: Use of a planned grazing strategy to balance animal forage demand with available forage resources. Timing, duration, and frequency of grazing are controlled and some type of grazing rotation is applied to allow for plant recovery following grazing.

NPG = Non-Prescribed Grazing: Grazing which has taken place that does not control the factors as listed above, or animal forage demand is higher than the available forage supply.

Fire: Prescribed fire or non-prescribed wildfire. Matted: > 50% cover

State 1
Plant Community 1: Tall and Medium Grasses/ Forbs/ Shrubs (HCPC)

Community 1.1
Plant Community 1: Tall and Medium Grasses/ Forbs/ Shrubs (HCPC)

This is the interpretive plant community and is considered to be the Historic Climax Plant Community (HCPC) for this site. This plant community contains a low diversity of medium cool season grasses (bluebunch wheatgrass, thickspike wheatgrass, Montana wheatgrass, and Sandberg bluegrass). A few forbs occur in small percentages. Shrubs that can occur on this site include Nuttall's saltbush, winterfat, greasewood, and shadscale. This site does not allow for very high production. This plant community is well adapted to the Northern Great Plains climatic

conditions. The diversity in plant species and presence of tall, deep-rooted perennial grasses allows for drought tolerance. Plants on this site have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. Abundant plant litter is available for soil building and moisture retention. Plant litter is properly distributed with very little movement off-site and natural plant mortality is very low. This plant community provides for soil stability and a functioning hydrologic cycle.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	336	381	448
Shrub/Vine	56	78	90
Forb	11	17	22
Total	**403**	**476**	**560**

Table 6. Ground cover

Tree foliar cover	0-10%
Shrub/vine/liana foliar cover	5-10%
Grass/grasslike foliar cover	30-50%
Forb foliar cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 7. Soil surface cover

Tree basal cover	0-1%
Shrub/vine/liana basal cover	0-1%
Grass/grasslike basal cover	3-7%
Forb basal cover	1-2%
Non-vascular plants	0%
Biological crusts	0-1%
Litter	15-25%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	60-80%

Table 8. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	–	–
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	5-10%	30-50%	1-5%
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	0-10%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

State 2
Plant Community 2: Medium and Short Grasses and Shrubs/ Subshrubs

Community 2.1
Plant Community 2: Medium and Short Grasses and Shrubs/ Subshrubs

Slight degradation in the historic climax plant community, including a beginning response to non-prescribed grazing, will tend to change the HCPC to a community represented by an increase in grasses such as Sandberg bluegrass, plains reedgrass, and inland saltgrass. Grasses such as bluebunch wheatgrass, alkali sacaton and thickspike wheatgrass may still be present, sometimes in relatively large amounts. The desirable shrubs/subshrubs such as Nuttall's saltbush and winterfat will be present, along with increasing amounts of other shrub species. Grass biomass production and litter become reduced on Community 2 as the taller grasses become less prevalent, increasing evaporation and reducing moisture retention. Additional open space in the community can result in undesirable invader species. These plant communities provide for moderate soil stability.

State 3
Plant Community 3: Shrubs, Short Grasses, Half-shrub, Cactus

Community 3.1
Plant Community 3: Shrubs, Short Grasses, Half-shrub, Cactus

With continued heavy disturbance, the site will become dominated by species such as longleaf sagebrush, slenderbush eriogonum, and Sandberg bluegrass. There may still be remnant amounts of some of the mid-seral species such as thickspike and Montana wheatgrass. Taller grasses (bluebunch wheatgrass, alkali sacaton) may still be present, but in much smaller amounts and often under shrubs or mixed in with cactus. Nuttall's saltbush will often still be present. The amount of bare ground between plants also tends to increase. Plant Communities 3 is much less productive than Plant Communities 1 or 2, and has lost many of the attributes of a healthy rangeland. The loss of deep perennial root systems reduces total available moisture for plant growth. Reduction of plant litter will result in higher surface soil temperatures and increased evaporation losses. Annual species are often aggressive and competitive with seedlings of perennial plants. This community can respond positively to improved grazing management but it will take additional inputs to move it towards a community similar in production and composition to that of Plant Community 1 or 2. The landscape features often associated with this ecological site as well as the droughty nature of the soils severely limits the use of most common structural improvement practices.

Additional community tables

Table 9. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Native grasses**			291–448	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	56–168	–
	tufted wheatgrass	ELMA7	*Elymus macrourus*	39–140	–
	western wheatgrass	PASM	*Pascopyrum smithii*	39–140	–
	alkali sacaton	SPAI	*Sporobolus airoides*	39–112	–
	saltgrass	DISP	*Distichlis spicata*	1–84	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	20–56	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	20–56	–
	Sandberg bluegrass	POSE	*Poa secunda*	20–56	–
	Grass, perennial	2GP	*Grass, perennial*	1–3	–
2	**Native grasses and sedges**			1–28	
	Grass, perennial	2GP	*Grass, perennial*	1–28	–
	sedge	CAREX	*Carex*	1–28	–
Forb					
3	**Native forbs**			1–28	
	Forb, perennial	2FP	*Forb, perennial*	1–28	–
	pussytoes	ANTEN	*Antennaria*	1–28	–
	buckwheat	ERIOG	*Eriogonum*	1–28	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	1–28	–
	desertparsley	LOMAT	*Lomatium*	1–28	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	1–28	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	1–28	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	1–28	–
	American vetch	VIAM	*Vicia americana*	1–28	–
Shrub/Vine					
4	**Native shrubs and half-shrubs**			39–84	
	Nuttall's saltbush	ATNU2	*Atriplex nuttallii*	20–56	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	20–56	–
5	**Native shrubs and half-shrubs**			1–28	
	Shrub, broadleaf	2SB	*Shrub, broadleaf*	1–28	–
	longleaf wormwood	ARLO7	*Artemisia longifolia*	1–28	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	1–28	–
	shadscale saltbush	ATCO	*Atriplex confertifolia*	1–28	–
	slender buckwheat	ERMI4	*Eriogonum microthecum*	1–28	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	1–28	–
	prairie rose	ROAR3	*Rosa arkansana*	1–28	–
6	**Native shrubs and half-shrubs**			1–3	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	1–3	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–3	–

Animal community

Livestock Grazing Interpretations:

Managed livestock grazing is suitable on this site as it has the potential to produce high quality forage. However, forage production can be severely limited by the soil properties. Management objectives should include maintenance or improvement of the plant community. Shorter grazing periods and adequate re-growth after grazing are recommended for plant maintenance and recovery. Heavy stocking and season-long use of this site can be detrimental and will alter the plant community composition and production over time.

Whenever Plant Community 2 (medium and short grasses and sedges) occurs, grazing management strategies need to be implemented to avoid further deterioration. This community is still stable, productive, and healthy provided it receives proper management. This community will respond fairly quickly to improved grazing management, including increased growing season rest of key forage plants. Grazing management alone can usually move this community back towards the potential community.

Plant Communities 3 and 4 have substantially reduced forage production, and a high percentage of aggressive, non-palatable species. Once these plant communities become established, it will be much more difficult to restore the site to a community that resembles the potential with grazing management alone. Additional growing season rest is often necessary for re-establishment of the desired species and to restore the stability and health of the site. Practices such as range seeding or mechanical treatment are generally not recommended on this site.

Wildlife Interpretations:

The Shale ecological site, with its range of slope and aspect, provides habitat diversity where it occurs adjacent to large expanses of relatively level to rolling grassland. Historic wildlife populations were probably very similar to the modern day species composition. Winter range value for mule deer and pronghorn can be high when steep topography provides thermal cover and a variety of nutritious shrubs and half-shrubs are available on warm, open slopes. Overall production is fairly low on this severe site; however, the variety of plant growth forms provides habitat diversity for many wildlife species, particularly when this site occurs in a mosaic pattern with other, more productive ecological sites.

Plant Community 1: Tall Grasses/ Forbs/ Shrubs (HCPC):

A variety of grasses, forbs and woody plants provides a relatively long flowering period for pollinating insects. Short-horned lizards and the prairie rattlesnake are representative reptiles. Ground-nesting bird habitat is limited. Common nighthawks, loggerhead shrikes and Brewer’s sparrows are potential breeding birds. A variety of raptors hunt small mammals, insects and birds in this habitat.

The high percentage of nutritious shrubs and half-shrubs favors browsers and mixed feeders like mule deer and pronghorn, particularly on winter range. Seed production from shadscale, greasewood and other shrubs and half-shrubs supports seed-eating small mammals such as deer mice and kangaroo rats.

Plant Community 2: Medium and Short Grasses and Sedges/ Shrubs and Half-shrubs:

Insect diversity is reduced as plant variety declines. Reptile populations are probably little affected at this stage. Brewer’s sparrow may increase with increasing big sagebrush cover. Big game habitat value declines with the reduction of winterfat and other browse plants. Small mammal population diversity is reduced; the ubiquitous deer mouse is the dominant species present.

Plant Community 3: Shrubs/ Short Grasses/ Half-shrubs/ Cacti:

General wildlife habitat values are quite low in this impoverished community. Insect population diversity further declines as the plant community is simplified. Reptile cover is very sparse. Breeding bird diversity is very low. Pronghorn and mule deer may find some browse species on winter range but nutritional levels are inadequate with the loss of valuable species such as winterfat and Nuttall’s saltbush.

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil
Group D. The infiltration rates for these soils will normally be slow. The runoff potential for this site is high to very high, depending on slope and ground cover/health. Runoff curve numbers generally range from 85 to 94.

Other information

The following is an example of how to calculate the recommended stocking rate. This example does not use production estimates from this specific ecological site. You will need to adjust the annual production values and run the calculations using total annual production values from the ecological sites encountered on each individual ranch/pasture. Before making specific recommendations, an on-site evaluation must be made.

Example of total annual production amounts by type of year:
Favorable years = 2200 lbs/acre
Normal years = 1480 lbs/acre
Unfavorable years = 1200 lbs/acre

It is recommended that on slopes of 30% or less, stocking rate should be derived from the total annual production pounds minus 500 pounds for residual dry matter and 25% harvest efficiency. On slopes over 30%, stocking rate is derived from total annual production pounds minus 800 pounds for residual dry matter and 25% harvest efficiency. Refer to the NRCS National Range and Pasture Handbook for a list of Animal Unit Equivalents.

Sample Calculations using Favorable Year production amounts:

< 30% slopes: AUM/AC = [(2200-500)(0.25)]/915 lbs/month for one AU = 0.46 AUM/AC
AC/AUM = (1.0 AU)/(0.46AUM/AC) = 2.2 AC/AUM

> 30% slopes: AUM/AC = [(2200-800)(0.25)]/915 lbs/month for one AU = 0.38 AUM/AC
AC/AUM = (1.0 AU)/(0.38 AUM/AC) = 2.6 AC/AUM

NOTE: 915 lbs/month for one Animal Unit is used as the baseline for maintenance requirements. This equates to 30 lbs/day of air-dry forage (1200 lb cow at 2.5% of body weight).

Inventory data references

Supporting Data for Site Development:

NRCS Production & Composition Record for Native Grazing Lands (Range-417): 8

BLM Soil & Vegetation Inventory Method (SVIM) Data: 2

NRCS Range Condition Record (ECS-2): 25

NRCS Range/Soil Correlation Observations & Soil 232 notes: 13

Ecological Site Reference: NRCS 417 No.: Golden Valley County 520

Field Offices where this site occurs within the state:

Big Sandy
Big Timber
Billings
Chinook
Columbus
Crow Agency

Fort Belknap
Hardin
Harlowton
Joliet
Lewistown
Malta
Roundup
Stanford
White Sulphur Springs
Winnett

Other references

Site Documentation:

Authors:
Original: NRCS, 1983

Revised: Matthew J. Ricketts, Robert E. Leiland, Rhonda Sue Noggles, Peter O. Husby, 2003

Contributors

MJR, REL, RSN, POH
RSN

Approval

Kirt Walstad, 6/14/2023

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)	Loretta Metz
Contact for lead author	
Date	04/10/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Minor rills (less than 1.0 to 3.0 inches in depth; less than 10 feet long) may be present in the reference state when slopes are greater than 8%. Plant community 2 has more rills than Plant community 1.

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2. **Presence of water flow patterns:** Water flow patterns are evident. Following heavy thunderstorms, or on slopes over 8%, flow patterns less than 20 feet long may be apparent.

3. **Number and height of erosional pedestals or terracettes:** These are generally not common but may occur. Terracettes less than 2.0-inch depth are apparent on slopes less than 20%.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is between 60-80%.

5. **Number of gullies and erosion associated with gullies:** Gully erosion is not evident.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement varies by size and depth of litter. In the reference state, litter should be coarse and will not move more than a couple of feet from where it originated.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability values of 2-3 in plant interspaces. Stability values of 3-4 under plant canopies and at plant bases.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Weak or moderate granular structure. A-horizon is approximately 2.0 to 4.0 inches thick. Organic matter in A-horizon approximately 1-3%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Rather “open” plant community with a mix of perennial bunchgrasses, shrubs and some trees, contribute to slow infiltration and a high runoff rate.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer present in the reference state.

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: mid- and short-height, native perennial bunchgrasses >> native shrubs >> warm season rhizomatous grasses > native forbs >> trees.

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Plant mortality is low (<5-15%); decadence is minimal except in prolonged periods of drought.

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):** 350 – 500 #/acre.

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:** Sandberg bluegrass, longleaf sagebrush, slender eriogonum, greasewood, fringed sagewort, plains pricklypear.

17. **Perennial plant reproductive capability:** This is not impaired in the reference state. Except in extended periods of drought, plants are able to reproduce sexually or vegetatively.