Ecological site R060AY018SD
Dense Clay

Accessed: 04/23/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

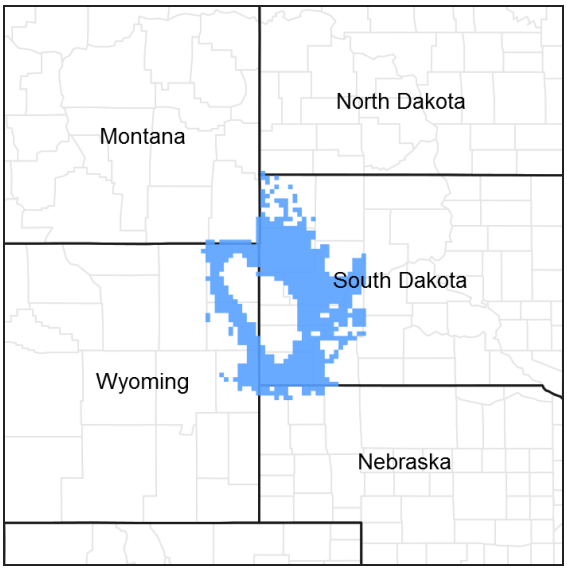


Figure 1. Mapped extent

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.

MLRA notes

Major Land Resource Area (MLRA): 060A–Pierre Shale Plains

MLRA Notes:
The Pierre Shale Plains (MLRA 60A) consists of approximately 10,150 square miles, the majority of which is in South Dakota (70 percent) and small portions are in Montana (2 percent), Nebraska (8 percent), and Wyoming (20 percent). It encircles the Black Hills (MLRA 62) and the Dakota Hogback (MLRA 61). MLRA 60A includes portions of the Oglala, Buffalo Gap, and Thunder Basin National Grasslands. It also includes small sections of the Pine Ridge Indian Reservation, Badlands National Park, and Black Hills National Forest. The Cheyenne and Belle Fourche Rivers flow through the MLRA.

MLRA 60A is in the unglaciated section of the Missouri Plateau, of the Great Plains Province of the Interior Plains. It is an area of old plateaus and terraces that have been deeply eroded. Cretaceous Pierre Shale underlies almost all of this MLRA. This is a marine sediment with layers of volcanic ash that has been altered to smectitic clay. These clays shrink as they dry and swell as they receive moisture. Soils are shallow to very deep and generally are well drained and clayey.
Elevations generally range from 2,620 to 3,610 feet throughout the MLRA, but can range up to 4,260 feet. The average annual precipitation for the western side of the MLRA is 13 to 16 inches, whereas the eastern side receives 16 to 18 inches. A suite of ecological sites have been written specifically for these two precipitation zones. The Locator Map shows the break between the two precipitation zones.

This area supports a mixed natural prairie vegetation consisting of both cool- and warm-season grasses and forbs. Wyoming big sagebrush occurs primarily in the drier western portion of the MLRA, however, small remnant stands can be found in the eastern portion. Dominant land uses of the area are primarily ranching and, to a lesser extent, farming. Major resource concerns to this MLRA are wind erosion and surface water quality.

Classification relationships

USDA - Land Resource Region G – Western Great Plains Range and Irrigated Region, Major Land Resource Area (MLRA) 60A – Pierre Shale Plains.

EPA - Level IV Ecoregions of the Continental United States: 43e – Sagebrush Steppe, 43g Semiarid Pierre Shale Plains, and 43k – Dense Clay Prairie.

Ecological site concept

The Dense Clay ecological site occurs throughout the MLRA. It is located in upland valleys, alluvial fans, and stream terraces. Slopes range from 0 to 15 percent. Soils are formed from dense clayey alluvium or residuum from soft shale. The clay surface layer is 1 to 5 inches thick. Soils are greater than 20 inches deep, with a clay content exceeding 55 percent. When the soil is dry, cracks 1/2 inch to 2 inches wide and several feet long can extend to a depth below 20 inches. Permeability is very slow unless the soil is dry. Bare ground will be common.
Vegetation in the Reference State (1.0) is dominated by cool-season rhizomatous wheatgrasses. Other grasses and grass-likes that occur in minor amounts include green needlegrass, buffalograss, blue grama, Sandberg bluegrass, and sedges. Dominant forbs will include biscuitroot, wild parsley, and western yarrow. Shrubs, primarily occurring in the western portions of the MLRA, include Wyoming big sagebrush, saltbush, cactus, and possibly greasewood.

Associated sites

R060AY007SD	**Saline Lowland** May be adjacent to the Dense Clay site but located along drainage areas.
R060AY011SD	**Clayey 13-16" P.Z.** The Clayey 13-16” site may occur adjacent to the Dense Clay site.
R060AY015SD	**Thin Claypan** May be located adjacent to or mix with the Dense Clay site as a mosaic.
R060AY021SD	**Clayey Overflow** May be adjacent to the Dense Clay site but located in and along drainage areas.
R060AY025SD	**Shallow Dense Clay** May occur adjacent to the Dense Clay site but on steeper slopes.
R060AY026SD	**Saline Upland** May be located adjacent to the Dense Clay site.
R060AY040SD	**Clayey 16-18" P.Z.** The Clayey 16-18” site may occur adjacent to the Dense Clay site.
R060AY042SD	**Lowland** May be adjacent to the Dense Clay site but located along drainage areas.

Similar sites

R060AY011SD	**Clayey 13-16" P.Z.** Higher production; more short grasses
R060AY015SD	**Thin Claypan** More shortgrass and plains pricklypear; contains slick spots
R060AY025SD	**Shallow Dense Clay** Steeper slopes and higher on landscape; lower production
R060AY040SD	**Clayey 16-18" P.Z.** Higher production; more short grasses

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Elymus lanceolatus*

Physiographic features

This site occurs on nearly level to sloping uplands.

Table 2. Representative physiographic features

Landforms	(1) Terrace (2) Fan (3) Plain
Flooding frequency	None
Ponding frequency	None
Elevation	2,500–4,300 ft
Slope	0–15%
Aspect	Aspect is not a significant factor

Climatic features

The climate in this MLRA is typical of the drier portions of the Northern Great Plains, where sagebrush steppes to the west yield to grassland steppes to the east. Annual precipitation for the entire MLRA ranges from 13 to 18 inches per year, with most occurring during the growing season. Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air masses from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. Extreme storms may occur during the winter, but the more severe occur during late fall, late winter, and spring. The normal average annual temperature is about 46°F. January is the coldest month with average temperatures ranging from about 19°F (Moorcroft CAA, WY) to about 22°F (Belle Fourche, SD). July is the warmest month with temperatures averaging from about 70°F (Moorcroft CAA, WY) to about 72°F (Belle Fourche, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 51°F. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds generally are stronger than nighttime, and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour. Growth of cool-season plants begins in early to mid-March, slowing or ceasing in late June. Warm-season plants begin growth about mid-May and can continue to early or mid-September. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (average)	115 days
Freeze-free period (average)	133 days
Precipitation total (average)	17 in

Climate stations used

- (1) REDBIRD [USC00487555], Lance Creek, WY
- (2) ARDMORE 1 NW [USC00390236], Edgemont, SD
- (3) UPTON [USC00489205], Upton, WY

- (4) BELLE FOURCHE [USC00390559], Belle Fourche, SD
- (5) WASTA [USC00398911], Owanka, SD
- (6) MOORCROFT 3S [USW00024088], Moorcroft, WY

Influencing water features

No significant water features influence this site.

Soil features

The soils in this site are moderately well to well drained and formed in clayey alluvium or residuum from soft shale. The clay surface layer is 1 to 5 inches thick. The soils have a slow to very slow infiltration rate except after dry periods when initial uptake may be rapid due to cracking of the surface. Gilgai microrelief occurs in most areas. When dry these soils crack. Surface compaction can occur with heavy traffic when soils are wet. This site typically should show slight to no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers. The soil surface is stable and intact. Subsurface soil layers are restrictive to water movement and root penetration.

Soils correlated to the Dense Clay ecological site include: Absher, Bahl, Broadhurst, Swanboy, Topeman, Twotop, Wasa, and Winler.

These soils are susceptible to wind and water erosion. The hazard of water erosion increases on slopes greater than about 6 percent. More information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more detail specific to your location.

Table 4. Representative soil features

Surface texture	(1) Clay
Family particle size	(1) Clayey
Drainage class	Moderately well drained to well drained
Permeability class	Very slow
Soil depth	20–60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	2–4 in
Calcium carbonate equivalent (0-40in)	0–15%
Electrical conductivity (0-40in)	0–16 mmhos/cm
Sodium adsorption ratio (0-40in)	0–13
Soil reaction (1:1 water) (0-40in)	5.6–9
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

This site developed under Northern Great Plains climatic conditions, natural influences of large herbivores, occasional fire, and other biotic and abiotic factors that typically influence soil/site development. Changes will occur in the plant communities due to short-term weather variations, impacts of native and/or exotic plant and animal

species, and management actions. While the following plant community descriptions specify more typical transitions between communities that will occur, severe disturbances, such as periods of well-below average precipitation, can cause significant shifts in plant communities and/or species composition.

Black greasewood and saltbush may occur on this site where there is higher salt content. These are typically drier areas in association with the Saline Upland ecological site (e.g., west of Highway 85 in Butte County, SD). Slick spots are associated with Swanboy and Wasa soils. Slick spots are bare ground areas that are affected by high sodium concentrations. The soil properties are the dominant influence and grazing management does not affect these areas.

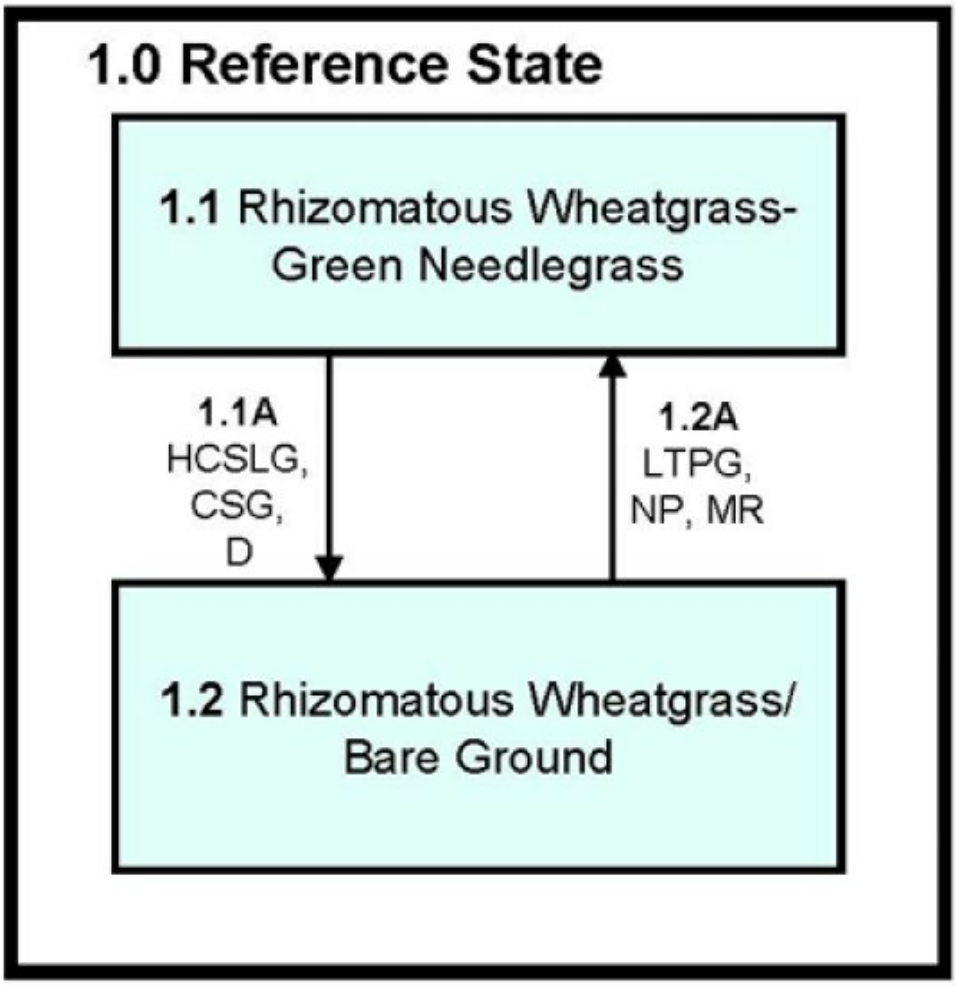
These soils are high in clay and have a low available water capacity. The shrink-swell potential is very high, resulting in cracks greater than 2 inches wide during dry periods. The native wheatgrasses have strong rhizomes, high drought tolerance, and are able to thrive in these soils. Wheatgrasses dominate the site and production is closely related to the vigor of the native wheatgrass. Green needlegrass is more prevalent on this site in the western portions of the MLRA and may be codominant with the wheatgrasses. Wyoming big sagebrush is also common on this site in the western portions of the MLRA.

The plant community upon which interpretations are primarily based is the Reference Plant Community (1.1). The Reference Plant Community has been determined by studying rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been used. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following diagram illustrates the common plant communities and vegetation states commonly occurring on the site and the transition pathways between communities and states. The ecological processes are discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Dense Clay – R060AY018SD 5/05/17



CSG – Continuous seasonal grazing
D – Drought
HCSLG – Heavy, continuous season-long grazing without adequate recovery periods
LTPG – Long-term prescribed grazing with adequate recovery opportunity
MR – Mechanical renovation
NP – Return to normal precipitation patterns

Figure 6. Dense Clay - R060AY018SD

Diagram Legend - Dense Clay - R060AY018SD		
CP 1.1A	1.1 - 1.2	Heavy, continuous season-long grazing, above recommended stocking rates and without adequate rest and recovery, continuous seasonal grazing, and/or drought.
CP 1.2A	1.2 - 1.1	Long-term prescribed grazing including change in season of use, proper stocking and adequate rest and recovery, normal precipitation following drought, or possible mechanical renovation.

Figure 7. Dense Clay - R060AY018SD

State 1
Reference State

This state represents what is believed to represent the natural range of variability that dominated the dynamics in this ecological site prior to European settlement. This site is dominated by cool-season grasses. In pre-European times the primary disturbances included fire and grazing by large ungulates and small mammals. Favorable growing conditions occur during the spring and the warm months of June through August. This State can be found on areas having a history of proper grazing management, including adequate recovery periods between grazing events.

Community 1.1
Rhizomatous Wheatgrass-Green Needlegrass

Figure 8. Plant Community Phase 1.1 (16-18" PZ).

Figure 9. Plant Community Phase 1.1 (13-16" PZ).

The plant community upon which interpretations are primarily based is the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1). This is also considered the Reference Plant Community. This plant community

can be maintained with proper grazing management. The potential vegetation is made up of about 80 to 90 percent grasses or grass-like plants, 5 to 10 percent forbs, and 5 to 10 percent shrubs. Cool- season grasses dominate the plant community. Major grasses include western wheatgrass, Montana wheatgrass, thickspike wheatgrass, and green needlegrass. Plant diversity tends to be low because the site is dominated by rhizomatous wheatgrasses. Other grasses and grass-like species occurring in the plant community may include Sandberg bluegrasses, buffalograss, blue grama, and sedge. The dominant forbs include biscuitroot, wild parsley, scarlet globemallow, and western yarrow. Shrubs that may occur in the plant community include Wyoming big sagebrush, cactus, greasewood, saltbush, and winterfat. In the western portion of the MLRA, Wyoming big sagebrush is almost always present. In the central to eastern portions of the MLRA, greasewood will decrease with grazing pressure, while in the western portion greasewood encroaches from adjacent sites and will increase with grazing pressure. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. However, two to three years of drought can greatly reduce the vigor and abundance of the green needlegrass and wheatgrasses, increasing the percentage of bare ground, and creating moderate to high potential of soil erosion. Species composition may not be greatly changed, but production decreases greatly. With a few years of average to above average precipitation, the plant community will make a fast recovery. If disturbed, the dense clay site is resilient. Transects done on sites with high vigor averaged a 10 percent basal cover. Water infiltration is low, and runoff is moderate to high because of the high clay content in the soil. Plant litter is properly distributed with some movement off-site, and natural plant mortality is low. As this plant community moves to the Rhizomatous Wheatgrass/Bare Ground Plant Community (1.2), one to possibly several intermediate stages can occur. Drought and moderate to heavy spring use will lower basal density of green needlegrass and native wheatgrasses, creating opportunities for invasive species such as sweetclover and annuals brome. Mechanical practices such as deep ripping and furrowing have been used to improve the hydrology of the site, and stimulate the recovery of the plant community. As the soils are made of active clays, this type of accelerative practice has limited longevity without proper grazing management. This practice may not provide a positive economic return.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	680	1104	1530
Shrub/Vine	60	98	135
Forb	60	98	135
Total	**800**	**1300**	**1800**

Figure 11. Plant community growth curve (percent production by month). SD6001, Pierre Shale Plains, cool-season dominant. Cool-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

Community 1.2
Rhizomatous Wheatgrass/Bare Ground

This plant community develops under heavy, continuous season-long grazing, heavy spring grazing, or droughty conditions. The potential vegetation is made up of 70 to 85 percent grass, 10 to 20 percent forbs, and 5 to 10 percent shrubs. The grass component consists almost entirely of rhizomatous wheatgrasses. Other perennial grasses have greatly diminished. Forbs found in this plant community include pennycress, annual mustards, curlycup gumweed, sweet clover, and annual brome. When compared to the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1), rhizomatous wheatgrass production has greatly decreased. Green needlegrass and short warm-season grasses, such as blue grama and buffalograss have become minor components in the plant community. Annual and biennial forbs have increased. Plant diversity is extremely low and bare ground is extensive. This plant community can be moved back towards the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1) through long- term prescribed grazing and favorable climatic conditions. This recovery can potentially be accelerated through mechanical treatment.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	345	480	610
Forb	55	90	125
Shrub/Vine	0	80	100
Total	**400**	**650**	**835**

Figure 13. Plant community growth curve (percent production by month). SD6001, Pierre Shale Plains, cool-season dominant. Cool-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	12	25	36	10	5	4	4	0	0

Pathway 1.1A
Community 1.1 to 1.2

Heavy, continuous season-long grazing (overstocked situations) or repeated seasonal grazing (early season), along with below average precipitation, will move this plant community to the Rhizomatous Wheatgrass/Bare Ground Plant Community Phase (1.2).

Pathway 1.2A
Community 1.2 to 1.1

With long-term prescribed grazing, above average precipitation, or severe disturbance (such as mechanical ripping and chiseling), this plant community will move towards the Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1).

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrasses**			520–780	
	Montana wheatgrass	ELAL7	*Elymus albicans*	390–780	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	390–780	–
	western wheatgrass	PASM	*Pascopyrum smithii*	390–780	–
2	**Warm-Season Grasses**			0–130	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–130	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–65	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–65	–
3	**Cool-Season Grass/Grass-Like**			0–65	
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–65	–
	sedge	CAREX	*Carex*	0–65	–
	squirreltail	ELEL5	*Elymus elymoides*	0–39	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–39	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–39	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–26	–
4	**Cool-Season Mid Grasses**			65–390	
	green needlegrass	NAVI4	*Nassella viridula*	65–390	–

Forb					
6	**Forbs**			65–130	
	American vetch	VIAM	*Vicia americana*	0–65	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–65	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	0–65	–
	American bird's-foot trefoil	LOUNU	*Lotus unifoliolatus var. unifoliolatus*	0–65	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–65	–
	common yarrow	ACMI2	*Achillea millefolium*	0–39	–
	onion	ALLIU	*Allium*	0–39	–
	pussytoes	ANTEN	*Antennaria*	0–26	–
	milkvetch	ASTRA	*Astragalus*	0–26	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–26	–
	bastard toadflax	COUM	*Comandra umbellata*	0–26	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–26	–
	bladderpod	LESQU	*Lesquerella*	0–26	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–26	–
	bluebells	MERTE	*Mertensia*	0–26	–
	tufted evening primrose	OECAC2	*Oenothera caespitosa ssp. caespitosa*	0–26	–
	scarlet beeblossom	OESU3	*Oenothera suffrutescens*	0–26	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–26	–
	phlox	PHLOX	*Phlox*	0–26	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–26	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–26	–
	Forb, perennial	2FP	*Forb, perennial*	0–26	–
Shrub/Vine					
7	**Shrubs**			65–130	
	big sagebrush	ARTR2	*Artemisia tridentata*	0–140	–
	pricklypear	OPUNT	*Opuntia*	0–130	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–65	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–65	–
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–65	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–65	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–26	–

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Wheatgrasses**			300–420	
	western wheatgrass	PASM	*Pascopyrum smithii*	240–420	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	240–360	–
	Montana wheatgrass	ELAL7	*Elymus albicans*	120–240	–

2	**Warm-Season Grasses**			0–30	
	buffalograss	BODA2	*Bouteloua dactyloides*	0–30	–
	blue grama	BOGR2	*Bouteloua gracilis*	0–30	–
3	**Cool-Season Grass/Grass-Like**			0–30	
	sedge	CAREX	*Carex*	0–18	–
	squirreltail	ELEL5	*Elymus elymoides*	0–18	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–6	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–6	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–6	–
5	**Non-Native Grasses**			0–30	
	cheatgrass	BRTE	*Bromus tectorum*	0–30	–
Forb					
6	**Forbs**			60–120	
	sweetclover	MELIL	*Melilotus*	0–120	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	0–18	–
	curlycup gumweed	GRSQ	*Grindelia squarrosa*	0–18	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–18	–
	common yarrow	ACMI2	*Achillea millefolium*	0–18	–
	mustard	BRASS2	*Brassica*	0–18	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	0–18	–
	field pennycress	THAR5	*Thlaspi arvense*	0–18	–
	yellow salsify	TRDU	*Tragopogon dubius*	0–18	–
	American vetch	VIAM	*Vicia americana*	0–18	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	0–12	–
	Forb, perennial	2FP	*Forb, perennial*	0–12	–
	sanddune wallflower	ERCAC	*Erysimum capitatum var. capitatum*	0–12	–
	onion	ALLIU	*Allium*	0–12	–
	pussytoes	ANTEN	*Antennaria*	0–12	–
	white heath aster	SYER	*Symphyotrichum ericoides*	0–12	–
	phlox	PHLOX	*Phlox*	0–12	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–12	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–12	–
	bladderpod	LESQU	*Lesquerella*	0–6	–
	purple locoweed	OXLA3	*Oxytropis lambertii*	0–6	–
	milkvetch	ASTRA	*Astragalus*	0–6	–
	bastard toadflax	COUM	*Comandra umbellata*	0–6	–
Shrub/Vine					
7				0–80	
	big sagebrush	ARTR2	*Artemisia tridentata*	0–80	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–30	–
	pricklypear	OPUNT	*Opuntia*	0–30	–
	Subshrub (<.5m)	2SUBS	*Subshrub (<.5m)*	0–12	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	0–6	–

	fourwing saltbush	ATCA2	*Atriplex canescens*	0–6	–

Animal community

The following table lists annual suggested initial stocking rates with average growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of conservation planning. Often, the current plant composition does not entirely match any particular plant community (as described in this Ecological Site Description). Therefore, a resource inventory is necessary to document plant composition and production. More accurate carrying capacity estimates should eventually be calculated using the following stocking rate information along with animal preference data and actual stocking records, particularly when grazers other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

Plant Community = Rhizomatous Wheatgrass-Green Needlegrass Plant Community (1.1)
Average Annual Production (lbs./ac, air-dry) = 1300
Stocking Rate (AUM/ac) = 0.36

Plant Community = Rhizomatous Wheatgrass/Bare Ground Plant Community (1.2)
Average Annual Production (lbs./ac, air-dry) = 650
Stocking Rate (AUM/ac) = 0.18

*Based on 912 lbs./acre (air-dry weight) per Animal Unit Month (AUM), and a 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA NRCS, National Range and Pasture Handbook).

Total annual production on-site may contain vegetation deemed undesirable or untargeted by the grazing animal. Therefore, AUM values may have been reduced to reflect only preferred or desirable forage species.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements, and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed.

Hydrological functions

Precipitation is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration is very slow and runoff potential for this site varies from negligible (in concave areas) to very high, depending on slope and ground cover. In many cases, areas with greater than 75 percent ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where short grasses form a strong sod. Normally areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an aesthetic value that appeals to visitors.

Other products

Seed harvest of native plant species can provide additional income on this site.

Other information

Site Development and Testing Plan:
Future work, as described in a Project Plan, is necessary to upgrade this site to the Correlated level. This will include field activities to collect high-intensity sampling of vegetation, and analysis of that data. The final field

review, peer review, quality control, and quality assurance reviews of the ESD will be required to produce the final “Correlated” document.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site description include: Everet Bainter, Range Management Specialist, NRCS; Stan Boltz, Range Management Specialist, NRCS; Brandon Brazee, Range Management Specialist, NRCS; Darrel DuVall, Range Management Specialist, NRCS; Jill Epley, Range Management Specialist, NRCS; Mitch Faulkner, Range Management Specialist, NRCS; Glen Mitchell, Range Management Specialist, NRCS; Cheryl Nielsen, Range Management Specialist, NRCS; Rick Peterson, Range Management Specialist, NRCS; and Mike Stirling, Range Management Specialist, NRCS.

Other references

EPA – Level III and Level IV Ecoregions of the Continental United States, (https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions- continental-united-states). Available online. Accessed 01/03/17

High Plains Regional Climate Center, University of Nebraska, (http://www.hprcc.unl.edu/). Available online. Accessed 02/27/17.

USDA, NRCS. Soil Survey Staff. Official Soil Series Descriptions. Available online. Accessed 04/25/17.

USDA, NRCS. Soil Survey Staff. Web Soil Survey. Available online. Accessed 04/25/17.

USDA, NRCS. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. Ag Handbook 296.

USDA, NRCS. 2014. National Ecological Site Handbook, 1st Ed.

USDA, NRCS. National Water and Climate Center. (http://www.wcc.nrcs.usda.gov/). Available online. Accessed 02/27/17.

USDA, NRCS. 1997, rev. 1, 2003. National Range and Pasture Handbook.

USDA, NRCS. National Soil Information System, Information Technology Center. (http://nasis.nrcs.usda.gov).

USDA, NRCS. 2017. The PLANTS Database (http://plants.usda.gov, 2017). Available online. Accessed 5/3/17.

USDA, NRCS. Various Published Soil Surveys.

Contributors

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ESD updated by Rick L. Peterson, 5/8/17.

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)	Stan Boltz, Ryan Beer, Mitch Iverson, Thad Berrett, Cheryl Nielsen
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Date	06/04/2008
Approved by	Stan Boltz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Soil cracking is natural and not caused by erosion.

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2. **Presence of water flow patterns:** None, or barely visible and discontinuous.

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3. **Number and height of erosional pedestals or terracettes:** None.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5 to 30 percent is typical; the higher bare ground levels would appear during extended dry periods.

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5. **Number of gullies and erosion associated with gullies:** None should be present.

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

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement of smallest size class litter is possible, but not normal.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability ratings should typically be 3 or greater. Surface organic matter usually adheres to the soil surface. Soil surface fragments will typically retain structure at least for short periods when dipped in distilled water. Some fragments will dissolve in less than 1 minute.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 3 to 6 inches thick but with light to dark gray colors when moist. Structure typically is platy parting to subangular blocky or occasionally fine granular in the upper 1/2 inch.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid rhizomatous grasses, tufted perennial cool-season grasses, and short warm-season grasses) with fine and coarse roots positively influences infiltration. Infiltration is not often affected by a change in plant composition as the rhizomatous cool-season species typically dominate.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** A-horizon naturally has some platy structure. Compaction layers, if formed by management, do not typically persist. Compaction will be difficult to determine. Evidence of compaction can sometimes be confirmed by signs of recent concentration of livestock.

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

    Dominant: Rhizomatous wheatgrasses >>

    Sub-dominant: Tall cool-season bunchgrasses >

    Other: Short warm-season grasses = forbs = shrubs

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs are vigorous.

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14. **Average percent litter cover (%) and depth (in):** Lower litter levels would occur during extended dry periods. Normal levels are roughly > 40%.

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

production): Production ranges from 800-1,800 lbs./acre (air-dry weight). Reference value production is 1,300 lbs./acre (air-dry weight).

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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:** State and local noxious weeds

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17. **Perennial plant reproductive capability:** All species exhibit high vigor relative to climatic conditions. Do not rate based solely on seed production. Perennial grasses should have vigorous rhizomes or tillers.
