USDA Natural Resources
Conservation Service

Ecological site R058AC053MT
Dense Clay (DC) RRU 58A-C 11-14" p.z.

Last updated: 6/14/2023
Accessed: 05/18/2024

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.

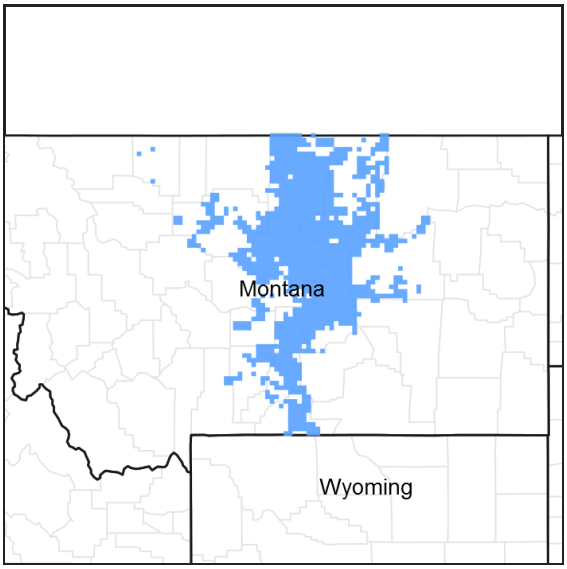


Figure 1. Mapped extent

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.

Associated sites

R058AC041MT	**Clayey (Cy) RRU 58A-C 11-14" p.z.**
R058AC050MT	**Saline Upland (SU) RRU 58A-C 11-14" p.z.**
R058AC054MT	**Claypan (Cp) RRU 58A-C 11-14" p.z.**

Similar sites

R058AC052MT	**Shale (Sh) RRU 58A-C 11-14" p.z.** The Shale site differs by having soils that are usually shallow with very little soil profile evident.
R058AC054MT	**Claypan (Cp) RRU 58A-C 11-14" p.z.** The ClayPan site differs by generally having 2 to 8 inches of soil over the hard, argillic layer, less bare ground, and higher production.
R058AC050MT	**Saline Upland (SU) RRU 58A-C 11-14" p.z.** The Saline Upland site differs by not having the very hard layer near the surface and by having a plant community of mainly salt tolerant species. In addition, the electro conductivities significantly limit, if not prohibit, the potential for any form of mechanical treatment or reseeding on the Saline Upland. Soils in the Saline Upland site generally are given a Capability Class rating of 7. (Soils in the Dense Clay site are generally Capability Class 6.)

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. wyomingensis* (2) *Artemisia frigida*
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

This ecological site occurs on nearly
level to strongly sloping sedimentary plains, terraces and fans.

Table 2. Representative physiographic features

Landforms	(1) Lake plain (2) Fan (3) Terrace
Flooding frequency	None
Ponding frequency	None
Elevation	686–1,372 m
Slope	0–8%
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)	135 days
Freeze-free period (average)	155 days
Precipitation total (average)	356 mm

Influencing water features

None.

Soil features

These are moderately deep to very deep non-granular clay soils that are strongly to very strongly alkaline near the surface. These soils typically are very hard to extremely hard when dry and very sticky when wet. They typically have a thin vesicular surface crust, which restricts water permeability. The subsoil is either massive, or has a very strong columnar structure. Permeability and root development are severely limited by the surface crust, hard subsoil, and alkalinity.

Available water holding capacity to 40 inches is 5 to 7 inches. Reaction (pH) (1:1 water): moderately alkaline to very strongly alkaline (7.9–9.6).

Table 4. Representative soil features

Surface texture	(1) Clay
Drainage class	Moderately well drained to well drained
Permeability class	Very slow to slow
Soil depth	51–183 cm
Surface fragment cover <=3"	0–5%
Available water capacity (0-101.6cm)	12.7–17.78 cm
Soil reaction (1:1 water) (0-101.6cm)	7.9–9.6

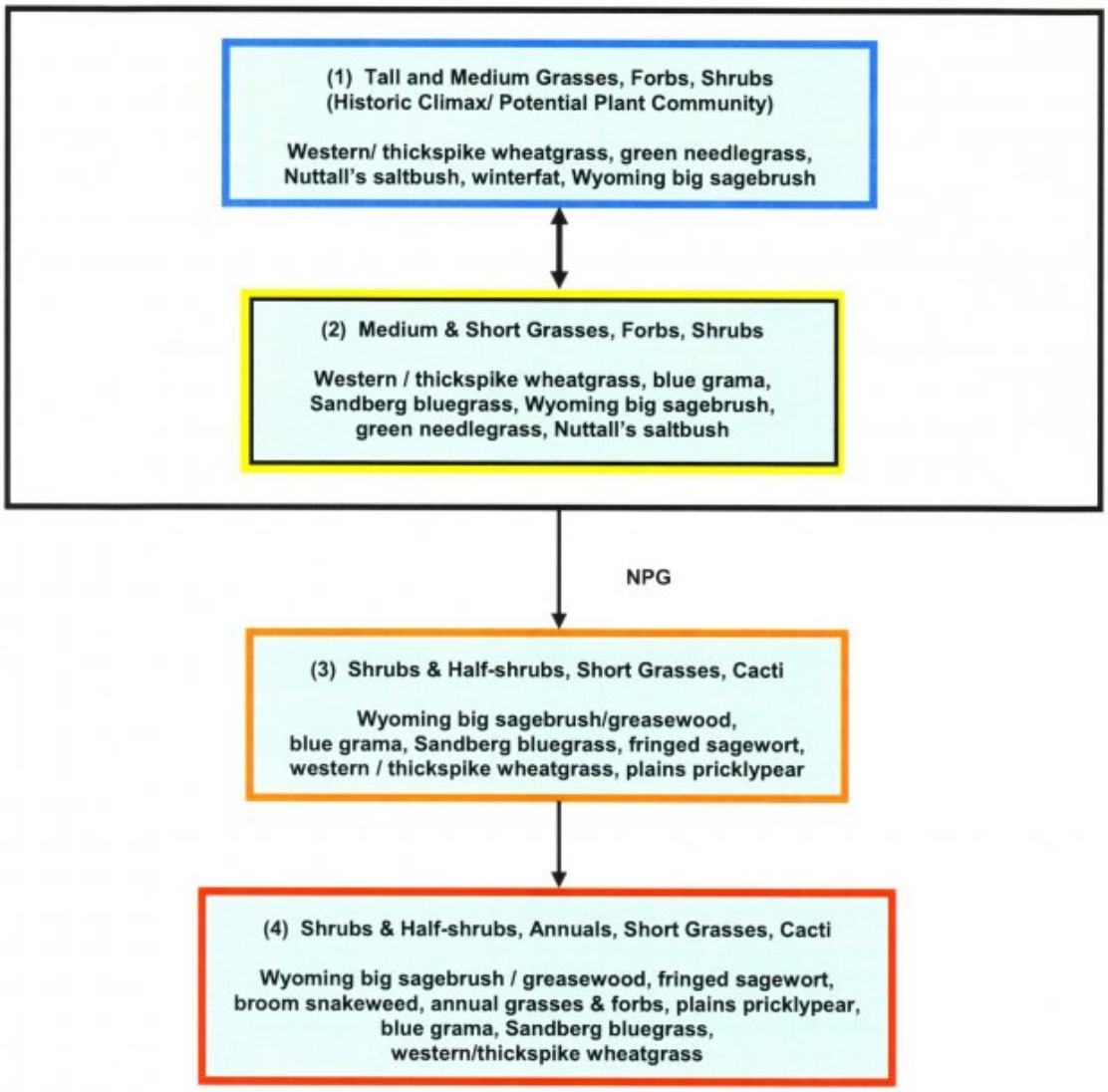
Ecological dynamics

The following are descriptions of several plant communities that may occupy this site:

State and transition model

MLRA: 58AC – Sedimentary Plains, Central
R058AC053MT

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)

Figure 2. 58AC Dense Clay

The physical aspect of this site is that of a very sparse grassland and shrubland that is typically dominated by cool season grasses and shrubs. Approximately 80–85% of the annual production is from grasses and sedges, 1–5% from forbs, and 5–10% is from shrubs and half-shrubs. The canopy cover of shrubs is 5-10%. 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 diversity of tall and medium height, cool season grasses (western or thickspike wheatgrass, green needlegrass, and bluebunch wheatgrass), and short grasses (blue grama, Sandberg bluegrass). There are numerous forbs that occur in smaller percentages. Shrubs and half-shrubs such as Nuttall's saltbush and winterfat are common. Wyoming big sagebrush is also often a common component of this community.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	673	757	874
Shrub/Vine	56	84	90
Forb	28	43	45
Total	**757**	**884**	**1009**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	1-4%
Grass/grasslike foliar cover	5-15%
Forb foliar cover	1-4%
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	0-10%
Shrub/vine/liana basal cover	5-10%

Grass/grasslike basal cover	30-50%
Forb basal cover	1-5%
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 Sedges/Shrubs and Half-shrubs

Community 2.1
Plant Community 2: Medium and Short Grasses and Sedges/Shrubs and Half-shrubs

This community occurs due to minor climate shifts or slight variations in soils and/or topography or disturbance, including non-prescribed grazing. Dominants include Wyoming big sagebrush and western/thickspike wheatgrass, Sandberg bluegrass and blue grama. The medium and tall grasses such as green needlegrass and bluebunch wheatgrass will still be present, sometimes in relatively large amounts. The desirable shrubs/half-shrubs such as Nuttall’s saltbush and winterfat will be somewhat less prevalent. Palatable and nutritious forbs will begin to be replaced by less desirable and more aggressive species such as scarlet globemallow. 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-shrubs/Cacti

Community 3.1
Plant Community 3: Shrubs/Short Grasses/Half-shrubs/Cacti

This is a disturbance-induced community, with dominants including Wyoming big sagebrush, or greasewood in some situations. Short grasses such as Sandberg bluegrass and blue grama become more prevalent. Mid-seral species such as western or thickspike wheatgrass will still be relatively abundant. The taller grasses (bluebunch

wheatgrass and green needlegrass) will still be present, but in much smaller amounts. Palatable forbs will be mostly absent. Fringed sagewort and plains pricklypear will tend to become more abundant.

State 4
Plant Community 4: Shrubs & Half-Shrubs/ Annuals/ Cacti/ Short Grasses

Community 4.1
Plant Community 4: Shrubs & Half-Shrubs/ Annuals/ Cacti/ Short Grasses

If heavy disturbance continues, plant community 3 can deteriorate to one primarily composed of Wyoming big sagebrush / greasewood, fringed sagewort, and broom snakeweed, short grasses (Sandberg bluegrass, blue grama), annual grasses (cheatgrass or Japanese brome, sixweeks fescue), annual forbs (pepperweed, fanweed), and plains pricklypear. There will still be some of the mid-seral species such as western or thickspike wheatgrass present. The taller grasses will occur only rarely, often underneath the shrub canopy or mixed in with the cactus. Palatable forbs will be mostly absent. Weedy forbs (e.g., kochia) are likely to invade. Plant Communities 3 and 4 are much less productive than Plant Communities 1 or 2, and have 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**			644–857	
	western wheatgrass	PASM	*Pascopyrum smithii*	151–404	–
	tufted wheatgrass	ELMA7	*Elymus macrourus*	151–404	–
	green needlegrass	NAVI4	*Nassella viridula*	113–303	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	1–101	–
	Sandberg bluegrass	POSE	*Poa secunda*	1–101	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	38–101	–
2	**Native grasses and sedges**			1–50	
	Grass, perennial	2GP	*Grass, perennial*	1–50	–
	blue grama	BOGR2	*Bouteloua gracilis*	1–50	–
	needleleaf sedge	CADU6	*Carex duriuscula*	1–50	–
	Montana wheatgrass	ELAL7	*Elymus albicans*	1–50	–
	squirreltail	ELEL5	*Elymus elymoides*	1–50	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	1–50	–
3	**Native grasses**			1–3	
	foxtail barley	HOJU	*Hordeum jubatum*	1–3	–
	tumblegrass	SCPA	*Schedonnardus paniculatus*	1–3	–
Forb					
4	**Native forbs**			1–50	
	Forb, perennial	2FP	*Forb, perennial*	1–50	–
	common yarrow	ACMI2	*Achillea millefolium*	1–50	–

	onion	ALLIU	*Allium*	1–50	–
	tiny trumpet	COLI2	*Collomia linearis*	1–50	–
	bastard toadflax	COUM	*Comandra umbellata*	1–50	–
	buckwheat	ERIOG	*Eriogonum*	1–50	–
	desertparsley	LOMAT	*Lomatium*	1–50	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	1–50	–
	spiny phlox	PHHO	*Phlox hoodii*	1–50	–
	Douglas' knotweed	PODO4	*Polygonum douglasii*	1–50	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	1–50	–
	stemless four-nerve daisy	TEACA2	*Tetraneuris acaulis var. acaulis*	1–50	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	1–50	–
Shrub/Vine					
5	**Native shrubs and half-shrubs**			38–101	
	Shrub, broadleaf	2SB	*Shrub, broadleaf*	38–50	–
	prairie sagewort	ARFR4	*Artemisia frigida*	38–50	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	38–50	–
	Nuttall's saltbush	ATNU2	*Atriplex nuttallii*	1–50	–
	rubber rabbitbrush	ERNAN5	*Ericameria nauseosa ssp. nauseosa var. nauseosa*	38–50	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	1–50	–
	greasewood	SAVE4	*Sarcobatus vermiculatus*	38–50	–
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 Dense Clay ecological site often occupies large acreages of relatively level ground, which provide uninterrupted expanses of habitat for area sensitive species such as sage grouse and other ground-nesting birds. With the exception of the bison, modern day wildlife populations are probably similar to the historical species composition. A diverse shrub and half-shrub component provides nutritious browse for pronghorns and mule deer, especially if thermal cover is available nearby in stream bottoms and/or rough topography. Concave depressions can hold temporary water, which may supply breeding sites for a variety of amphibians. Although this site is less, productive compared to sites having more favorable soil conditions, habitat structure is relatively complex as a result of the diversity of plant life forms.

Plant Community 1: Tall Grasses/ Forbs/ Shrubs (HCPC):
The diversity of forbs, half-shrubs and shrubs provides feeding substrate for a variety of pollinating insects, which are prey for many birds, reptiles and small mammals. Woodhouse's toad, the prairie rattlesnake, and the short-horned lizard are representative amphibians and reptiles. The relatively open ground provides lek sites for sage grouse; a diverse forb community produces insects and succulent vegetation for grouse broods and adults. Small mammal communities are dominated by seed-eaters such as the deer mouse and the largely carnivorous northern grasshopper mouse. The predominance of grasses plus a diversity of forbs, shrubs and half-shrubs in this community favors grazers and mixed feeders such as bison, pronghorn, and elk.

Plant Community 2: Medium and Short Grasses and Sedges/ Shrubs and Half-shrubs: Pollinator insect species diversity may decline with the loss of some succulent, palatable forbs. A reduction in litter cover and residual plant material during early spring decreases nesting habitat value for sage grouse and other ground-nesting birds. The potential increase in big sagebrush cover may benefit sage grouse nesting and winter habitat to some extent. Pronghorn and mule deer still find winter browse but overall nutrition value declines with the reduction in winterfat and Nuttall's saltbush cover. Herbivorous small mammals, such as voles, may decline with the reduction in litter cover.

Plant Community 3: Shrubs/ Short Grasses/ Half-shrubs/ Cacti:
Insect species diversity further declines with the simplification of the plant community, although some species, such as grasshoppers, may be very abundant during population highs. Sparse vegetation and increased bare ground may provide suitable habitat for a few nesting bird species (i.e., horned larks) but the lack of complex vegetative structure and residual cover makes this community poor habitat in general for most ground-nesting birds and relatively poor big game habitat. Pronghorn and mule deer may forage in this type throughout the year. However, nutritional levels for big game are greatly reduced and are available for a much shorter period as compared to the HCPC. Small species diversity is quite low; populations are dominated by the adaptable deer mouse.

Plant Community 4: Shrubs & Half-Shrubs/ Annuals/ Cacti/ Short Grasses:
Insects may be very abundant during population highs (i.e. grasshoppers) but diversity is low, especially of pollinators. Amphibian habitat is very degraded; ephemeral pools evaporate rapidly and the soil surface is very dry and hot during summer. Ground nesting bird habitat value is poor because of the lack of litter cover and residual plant cover in early spring. Sage grouse and Brewer's sparrows may be fairly abundant in the heavier sagebrush cover but probably suffer heavy losses while nesting on the poorly protected ground surface. Mountain plovers prefer to nest in this community type if a somewhat pebbly surface is present. Mule deer and pronghorn may utilize sagebrush and fringed sagewort during winter in this community.

Hydrological functions

The runoff potential for this site is very high depending on slope and ground cover/health. Runoff curve numbers generally range from 84 to 93. The soils associated with this ecological site are generally in Hydrologic Soil Group D. The infiltration rates for these soils will normally be very slow.

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	04/06/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills should not be evident in the reference state.

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2. **Presence of water flow patterns:** Water flow patterns are generally not evident in the reference state.

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3. **Number and height of erosional pedestals or terracettes:** Wind and water erosion should not be evident in the reference state.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is less than 80% in the reference state. In HCPC, bare ground should not exceed 65%.

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5. **Number of gullies and erosion associated with gullies:** Gully erosion is not evident in the reference state.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Under normal climatic conditions, these should not be

evident.

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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 perennial grass leaves, anywhere from 1.5 inches up to 4 inches in length, plus small shrub leaves and minimal forb litter. Litter will not move more than a couple of inches from where it originated.

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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):** Stability values of 3-4 in plant interspaces. Stability values of 4-5 under plant canopies and at plant bases.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Non-granular surface structure of <2 inch depth; strongly columnar structure from approximately 2-8 inches in depth; brown to dark brown color. Organic matter approximately 1-2%. Sodium absorption ratios are from 5-25; Electrical conductivity ranges from 4-16 mmhos/cm.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Deep-rooted native perennial grasses optimize infiltration and runoff. Perennial plants (grasses, forbs and shrubs) should be spaced approximately 3 to 5 feet apart in the reference state.

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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):** No compaction layer present in reference state. Do not mistake the naturally occurring clay increase in the soil profile for a compaction layer.

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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: cool season, mid-height, native perennial bunchgrasses >> native shrubs > native perennial and annual forbs >= warm season, short-height, native perennial grasses.

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Plant mortality of deep-rooted perennial bunchgrases is very low; mortality of more shallow-rooted perennial grasses (eg, blue grama) may be rather high due to root shear when these soils shrink/swell. Decadence is minimal except in prolonged periods of drought.

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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):** 675 – 900 #/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:** plains pricklypear, broom snakeweed, cheatgrass, Japanese brome, curlycup gumweed, Wyoming big sagebrush, greasewood, pepperweed, fanweed, blue grama (in amounts greater than 250 pounds/acre, or canopy cover values greater than 25%), fringed sagewort, cudweed sagewort.

17. **Perennial plant reproductive capability:** This is not impaired in the reference state.