

Ecological site R058AC055MT

Gravel (Gr) 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.

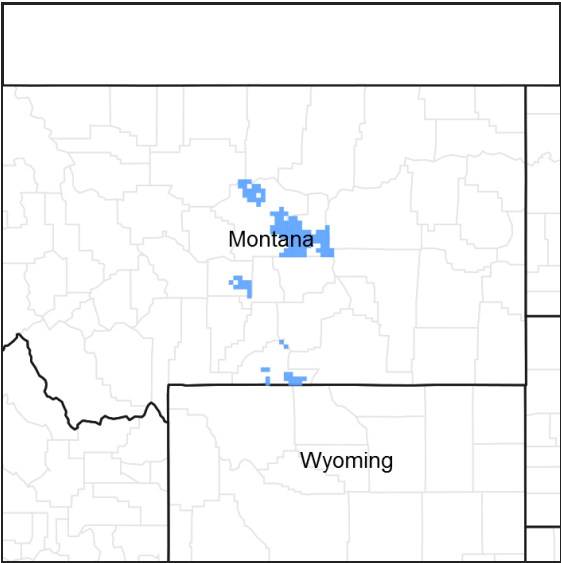


Figure 1. Mapped extent

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

R058AC040MT	Silty (Si) RRU 58A-C 11-14" p.z.
R058AC057MT	Shallow (Sw) RRU 58A-C 11-14" p.z.

Similar sites

R058AC058MT	Very Shallow (VSw) RRU 58A-C 11-14" p.z. Very Shallow sites typically have a restrictive layer at less than 10 inches.
R058AC194MT	Shallow to Gravel (SwGr) RRU 58A-C 11-14" p.z. Shallow to Gravel sites are typically silt loams, loams, and sandy loams less than 20 inches deep over gravels or a layer with 35% or more gravels.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Ericameria nauseosa</i> ssp. <i>nauseosa</i> (2) <i>Rhus trilobata</i>

Herbaceous	(1) <i>Carex filifolia</i> (2) <i>Bouteloua gracilis</i>
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Physiographic features

This ecological site can occur on outwash fans, hilltops, hills, plains, and terrace escarpments. It often occurs in a complex with other ecological sites. This site occurs on all exposures and aspect can sometimes be significant. Variations in plant composition and production can occur due to aspect.

Table 2. Representative physiographic features

Landforms	(1) Outwash fan (2) Hill (3) Plain
Flooding frequency	None
Ponding frequency	None
Elevation	686–1,372 m
Slope	0–70%
Ponding depth	0 cm
Water table depth	152 cm
Aspect	N, E, S

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 80°s F for July and August. Summertime temperatures will typically reach in the 100°s F at some point during the summer, and can reach 90° F any month between May and September. Conversely, winter temperatures can be cold, averaging in the mid teens to mid 20°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 30–40° 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 (32° 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

Soil features

These are moderately deep to very deep, droughty soils formed in sand and gravel deposits. They typically have greater than 15% pebbles and gravels in the upper part of the soil, and 50% or more pebbles, gravels, and cobbles in the lower part, often within 12 inches of the surface. Available Water Holding Capacity to 40 inches is less than 2 inches.

Table 4. Representative soil features

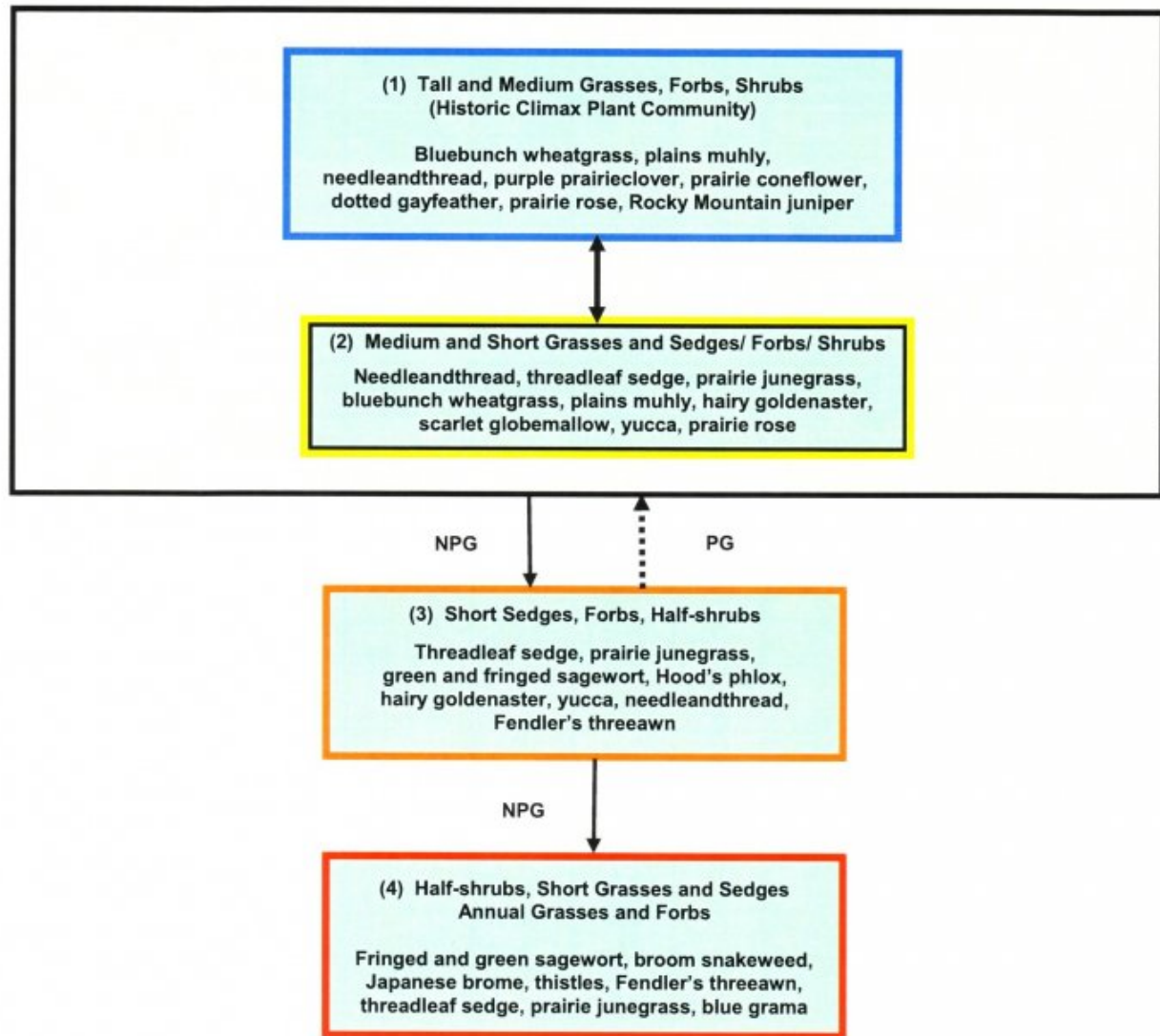
Surface texture	(1) Clay
Soil depth	51–152 cm
Surface fragment cover <=3"	15–35%
Available water capacity (0-101.6cm)	0–5.08 cm
Subsurface fragment volume <=3" (Depth not specified)	50%

Ecological dynamics

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

State and transition model

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.

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 Gravel 11-14" MAP Plant Community 1

The physical aspect of this site in the Historical Climax (HCPC) is that of a sparse grassland that is dominated by grasses and sedges with scattered shrub cover. Approximately 80–90% of the annual production is from grasses and sedges, 1–5% from forbs, and 5–15% is from shrubs and half-shrubs. The canopy cover of shrubs is 1–10%. Dominant species include bluebunch wheatgrass, plains muhly, and needleandthread. Short grasses and sedges such as prairie junegrass and threadleaf sedge are also present. There are abundant forbs (purple and white prairie clover, prairie coneflower, dotted gayfeather) which occur in smaller percentages. Shrubs such as yucca, prairie rose, and Rocky Mountain juniper can be common on some sites. 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	600	757	942
Shrub/Vine	78	120	135
Forb	22	35	45
Total	700	912	1122

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	1-10%
Grass/grasslike foliar cover	20-30%
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%
Shrub/vine/liana basal cover	1-5%
Grass/grasslike basal cover	3-10%
Forb basal cover	1-4%
Non-vascular plants	0%
Biological crusts	0-5%
Litter	30-50%
Surface fragments >0.25" and <=3"	15-35%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	25-50%

Table 8. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	—	—	—	—
>0.15 <= 0.3	—	—	—	1-5%
>0.3 <= 0.6	—	1-10%	20-30%	—
>0.6 <= 1.4	—	—	—	—
>1.4 <= 4	—	—	—	—
>4 <= 12	—	—	—	—
>12 <= 24	—	—	—	—
>24 <= 37	—	—	—	—
>37	—	—	—	—

State 2

Plant Community 2: Medium and Short Grasses and Sedges/ Forbs/ Shrubs

Community 2.1

Plant Community 2: Medium and Short Grasses and Sedges/ Forbs/ Shrubs

This community occurs from shifts in climate or other disturbances. Dominants include needleandthread, threadleaf sedge, and prairie junegrass. Bluebunch wheatgrass and plains muhly will still be present but in smaller amounts. Palatable and nutritious forbs will be replaced by less desirable and more aggressive species, such as green sagewort, hairy goldenaster, silverleaf scurfpea, and scarlet globemallow. Yucca and prairie rose may increase on the site. 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. This plant community provides for moderate soil stability.

State 3

Plant Community 3: Short Sedges/ Forbs/ Half-shrubs

Community 3.1

Plant Community 3: Short Sedges/ Forbs/ Half-shrubs

This is a disturbance induced community, with dominants including prairie junegrass, threadleaf sedge, perennial

forbs and half-shrubs (Hood's phlox, green and fringed sagewort). Remnant amounts of needleandthread may be present. Tall grasses and palatable forbs will be mostly absent. Red or Fendler's threeawn may invade the site.

State 4

Plant Community 4: Half-Shrubs/ Short Grasses and Sedges/ Annual Grasses and Forbs

Community 4.1

Plant Community 4: Half-Shrubs/ Short Grasses and Sedges/ Annual Grasses and Forbs

This community is the result of continual adverse disturbances. Dominants include broom snakeweed, fringed and green sagewort, cheatgrass or Japanese brome, six-weeks fescue, Fendler's threeawn, and weedy forbs (thistles). Remnant amounts of prairie junegrass, blue grama, and threadleaf sedge may be present. Tall and medium grasses (needleandthread) and palatable forbs will be mostly absent. Spotted knapweed is a common invader onto this site. 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. These communities can respond positively to improved grazing management but it will take additional inputs to move them towards a community similar in production and composition to that of Plant Community 1 or 2. Plant community 4 has extremely reduced production of native plants (< 400 lbs. / acre). The lack of litter and short plant heights result in higher soil temperatures, poor water infiltration rates, and increased evaporation, which gives short sod grasses and sedges, and annual invaders a competitive advantage over the tall and medium grasses. This community has lost many of the attributes of a healthy rangeland, including good infiltration, minimal erosion and runoff, nutrient cycling and energy flow. Significant economic inputs and time would be required to move this plant community toward a higher successional stage and a more productive plant community. Seeding and mechanical treatment are typically not recommended on shallow, droughty soils, such as those

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			560–953	
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	280–785	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	1–224	–
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	69–224	–
	plains muhly	MUCU3	<i>Muhlenbergia cuspidata</i>	1–56	–
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	1–56	–
	tufted wheatgrass	ELMA7	<i>Elymus macrourus</i>	1–56	–
2	Native grasses			1–56	
	Grass, perennial	2GP	<i>Grass, perennial</i>	1–56	–
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	1–56	–
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	1–56	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	1–56	–
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	1–56	–
3	Native grasses			1–3	
	Fendler's threeawn	ARPUF	<i>Aristida purpurea var. fendleriana</i>	1–3	–
Forb					
4	Native forbs			7–56	
	Forb. perennial	2FP	<i>Forb. perennial</i>	1–56	–

	common yarrow	ACMI2	<i>Achillea millefolium</i>	1–56	–
	pussytoes	ANTEN	<i>Antennaria</i>	1–56	–
	tarragon	ARDR4	<i>Artemisia dracunculus</i>	1–56	–
	aster	ASTER	<i>Aster</i>	1–56	–
	Douglas' dustymaiden	CHDO	<i>Chaenactis douglasii</i>	1–56	–
	miner's candle	CRVI4	<i>Cryptantha virgata</i>	1–56	–
	white prairie clover	DACA7	<i>Dalea candida</i>	1–56	–
	purple prairie clover	DAPU5	<i>Dalea purpurea</i>	1–56	–
	buckwheat	ERIOG	<i>Eriogonum</i>	1–56	–
	hairy false goldenaster	HEVI4	<i>Heterotheca villosa</i>	1–56	–
	dotted blazing star	LIPU	<i>Liatris punctata</i>	1–56	–
	western stoneseed	LIRU4	<i>Lithospermum ruderale</i>	1–56	–
	desertparsley	LOMAT	<i>Lomatium</i>	1–56	–
	rush skeletonplant	LYJU	<i>Lygodesmia juncea</i>	1–56	–
	lacy tansyaster	MAPIP4	<i>Machaeranthera pinnatifida</i> ssp. <i>pinnatifida</i> var. <i>pinnatifida</i>	1–56	–
	branched false goldenweed	OOMU	<i>Oonopsis multicaulis</i>	1–56	–
	beardtongue	PENST	<i>Penstemon</i>	1–56	–
	spiny phlox	PHHO	<i>Phlox hoodii</i>	1–56	–
	scurfpea	PSORA2	<i>Psoralidium</i>	1–56	–
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	1–56	–
	goldenrod	SOLID	<i>Solidago</i>	1–56	–
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	1–56	–
	stemless four-nerve daisy	TEACA2	<i>Tetraneuris acaulis</i> var. <i>acaulis</i>	1–56	–
5	Native forbs (toxic properties)			1–3	
	twogrooved milkvetch	ASBI2	<i>Astragalus bisulcatus</i>	1–3	–
	larkspur	DELPH	<i>Delphinium</i>	1–3	–
	white locoweed	OXSE	<i>Oxytropis sericea</i>	1–3	–
	deathcamas	ZIGAD	<i>Zigadenus</i>	1–3	–
Shrub/Vine					
6	Native shrubs and half-shrubs			34–168	
	Shrub, broadleaf	2SB	<i>Shrub, broadleaf</i>	1–56	–
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	1–56	–
	rubber rabbitbrush	ERNAN5	<i>Ericameria nauseosa</i> ssp. <i>nauseosa</i> var. <i>nauseosa</i>	1–56	–
	creeping juniper	JUHO2	<i>Juniperus horizontalis</i>	1–56	–
	Rocky Mountain juniper	JUSC2	<i>Juniperus scopulorum</i>	1–56	–
	skunkbush sumac	RHTR	<i>Rhus trilobata</i>	1–56	–
	prairie rose	ROAR3	<i>Rosa arkansana</i>	1–56	–
	soapweed yucca	YUGL	<i>Yucca elata</i>	1–56	–

7	Native shrubs and half-shrubs			1–3	
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	1–3	–
	plains pricklypear	OPPO	<i>Opuntia polyacantha</i>	1–3	–

Animal community

Livestock Grazing Interpretations:

Managed livestock grazing is suitable on this site as it has the potential to produce a limited amount of high quality forage. Forage production is somewhat limited by steep slopes and shallow, droughty soils, and the potential for runoff, which reduces the effectiveness of the precipitation received for plant growth. The steeper slopes may also limit livestock travel and result in poor grazing distribution, especially in areas away from water. 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. Plant Community 4 has extremely limited forage production (< 150 lbs./acre), and a high percentage of non-preferred species for cattle and sheep.

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.

Wildlife Interpretations:

Because the Gravel site often occurs as a minor component in a complex with large expanses of the relatively uniform Silty Ecological Site, it adds wildlife habitat diversity to the landscape. On southern and western exposures, rubber rabbitbrush, creeping and Rocky Mountain juniper and skunkbush sumac provide winter browse for mule deer and pronghorn. Skunkbush sumac and other shrubs provide breeding habitat for some song birds, such as the spotted towhee and loggerhead shrike. Mountain plovers may nest on the relatively open, pebbly ground surface and rock wrens often inhabit the rocky face of escarpments. When the site is found on terrace escarpments, golden eagles take advantage of a hunting opportunity as they cruise low to the ground along the face of the slope to surprise cottontails and other small mammals.

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

Pollinator insect diversity may be high, reflecting the abundance and variety of flowering plants. Reptiles are represented by the prairie rattlesnake and bull snake and short-horned lizard. Hummingbirds are attracted to brightly colored flowering plants. Ground-nesting birds that favor light to medium ground cover, such as long-billed curlews, find adequate litter cover and residual plant material in spring to hide the nest site from predators. Sharp-tailed grouse may find lek sites where this community occurs on ridge tops and relatively level ground. A diverse forb and shrub component provides mule deer and pronghorn with nutritious forage throughout the year; shrubs during winter and both shrubs and forbs spring through fall. Small mammal diversity can be relatively high; seed eaters like the deer mouse are more common than herbivorous species such as voles.

Plant Community 2: Medium and Short Grasses and Sedges/ Forbs/ Shrubs:

Insect diversity may decline with a partial loss of forb variety. The reduction of taller grasses and some desirable shrubs degrades habitat value for many birds, small mammals and big game. Potential increases in half-shrubs and shrubs may maintain big game winter range feeding value, although thermal cover will be reduced if the larger

shrubs, such as skunkbush sumac decline. Small mammal variety declines with the loss of vegetative diversity and litter cover.

Plant Community 3: Short Sedges/ Half-shrubs and Shrubs:

Pollinating insect diversity further declines as the forb community is simplified and soils become warmer and drier. Ground nesting bird habitat value is very poor and the loss of skunkbush sumac deprives other songbirds, such as the spotted towhee, of nesting habitat. The ubiquitous deer mouse may still thrive in this community but small mammal diversity in general declines significantly. Big game animals lose nutritional value on winter ranges with the loss of browse plants and during summer and fall with the loss of desirable warm season grasses and forbs.

Plant Community 4: Half-shrubs /Short Grasses and Sedges/ Annual Grasses and Forbs: Wildlife habitat value is very poor in general. Insects (i.e. grasshoppers) may be very abundant during population highs but species diversity especially of pollinators, is very low. Amphibian habitat around seeps and springs is severely degraded. Reptiles, such as the short-horned lizard, may still occur but their formerly diverse food supply is reduced. Habitat is very poor for most ground-nesting birds. Night hawks may nest on the uncovered gravel surface. Topographic diversity still provides some thermal cover for big game animals but nutritional value is very limited because the higher value browse plants are gone. Small mammals are represented by very few species. The deer mouse, a seed eater, may be relatively abundant.

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group A. The infiltration rates for these soils will normally be rapid to very rapid. The runoff potential for this site is low, depending on slope and ground cover/health. Runoff curve numbers generally range from 49 to 79.

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: $AUM/AC = [(2200-500)(0.25)]/915 \text{ lbs/month for one AU} = 0.46 \text{ AUM/AC}$
 $AC/AUM = (1.0 \text{ AU})/(0.46 \text{ AUM/AC}) = 2.2 \text{ AC/AUM}$

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

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 and Composition Record for Native Grazing Lands (Range-417): 2

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

NRCS Range Condition Record (ECS-2): 10

NRCS Range/Soil Correlation Observations and Soil 232 notes: 15

Ecological Site Reference: NRCS 417 No.: Park 503

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
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Contact for lead author	
Date	04/11/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Minor rills may be present in the reference state when slopes are greater than 8%. Obvious rills may be present when slopes exceed 45%. Plant community 2 has more rills than Plant community 1.

2. **Presence of water flow patterns:** Water flow patterns are evident in the reference state.

3. **Number and height of erosional pedestals or terracettes:** These may be evident in the reference state.

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 50% in the reference state. In HCPC, bare ground should not exceed 30%.

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

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

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 3 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.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability values of 1-2 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):** Granular surface structure; light brown to brown color. Organic matter approximately 1-2%. Coarse fragments in upper soil profile exceed 15% by volume.

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 1 to 3 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.
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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:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Plant mortality is very low; decadence is minimal except in prolonged periods of drought.
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14. **Average percent litter cover (%) and depth (in):**
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 625 – 1000 #/acre.
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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:** broom snakeweed, fringed and green sagewort, thistles, threadleaf sedge, plains pricklypear, threeawn species, annual grasses (cheatgrass, Japanese brome, others), blue grama, etc.
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17. **Perennial plant reproductive capability:** This is not impaired in the reference state.
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