USDA Natural Resources
Conservation Service

Ecological site R046XS619MT
Shallow Clay (SwC) RRU 46-S 13-16 PZ

Last updated: 7/19/2023
Accessed: 09/27/2024

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.

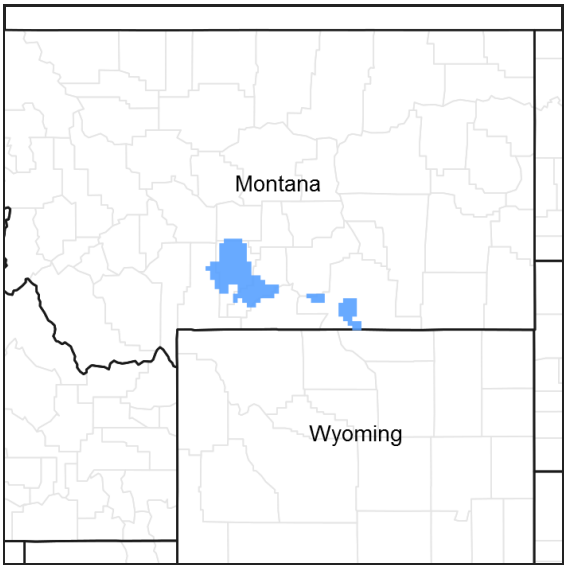


Figure 1. Mapped extent

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

R046XS105MT	**Clayey (Cy) RRU 46-S 13-19 PZ**
R046XS114MT	**Shallow (Sw) RRU 46-S 13-19 PZ**

Similar sites

R046XS105MT	**Clayey (Cy) RRU 46-S 13-19 PZ** Clayey sites have similar textures, but differ mainly by being over 20 inches to rock (shale), and having significantly more production. The plant community can be similar because of the clayey textures.
R046XS114MT	**Shallow (Sw) RRU 46-S 13-19 PZ** The Shallow site differs by having a different texture, and generally being over different parent materials/bedrock.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified

Herbaceous	(1) *Pseudoroegneria spicata* (2) *Festuca idahoensis*

Physiographic features

This ecological site can occur on nearly level to very steep uplands. It often occurs in complex with other ecological sites, particularly in rougher terrain. This site occurs on all slopes and exposures and aspect sometimes becomes significant. Variations in plant community composition and production can result due to aspect. The amount of exposed rock outcrop tends to increase as slopes increase. Runoff and the potential for water erosion can be important features of this site.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Plain (3) Escarpment
Flooding frequency	None
Ponding frequency	None
Slope	0–70%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

See Climatic Data Sheet for more details (Section II of the Field Office Technical Guide) or reference the following climatic web site: http://www.wrcc.sage.dri.edu/ .

Table 3. Representative climatic features

Frost-free period (characteristic range)	49-96 days
Freeze-free period (characteristic range)	105-122 days
Precipitation total (characteristic range)	356-457 mm
Frost-free period (actual range)	47-99 days
Freeze-free period (actual range)	104-125 days
Precipitation total (actual range)	330-457 mm
Frost-free period (average)	76 days
Freeze-free period (average)	114 days
Precipitation total (average)	406 mm

Climate stations used

- (1) JOLIET [USC00244506], Joliet, MT
- (2) COLUMBUS [USC00241938], Columbus, MT
- (3) BIG TIMBER [USC00240780], Big Timber, MT
- (4) MELVILLE 4 W [USC00245603], Big Timber, MT
- (5) MARTINSDALE 3 NNW [USC00245387], Martinsdale, MT
- (6) NYE 2 [USC00246190], Fishtail, MT

Influencing water features

No influencing water features.

Soil features

These soils develop on alluvium, colluvium, or residuum of semiconsolidated or consolidated shale. These are clayey soils that are 10 to 20 inches deep to underlying shale or nearly impervious clays. Texture ranges from granular clay loam, silt clay loam, silt clay, sandy clay, or clay. Few roots penetrate deeper than 20 inches.

Table 4. Representative soil features

Surface texture	(1) Clay loam (2) Silty clay loam (3) Silty clay
Drainage class	Well drained to somewhat excessively drained
Permeability class	Slow to very slow
Soil depth	25–51 cm
Available water capacity (0-101.6cm)	5.08–10.16 cm
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

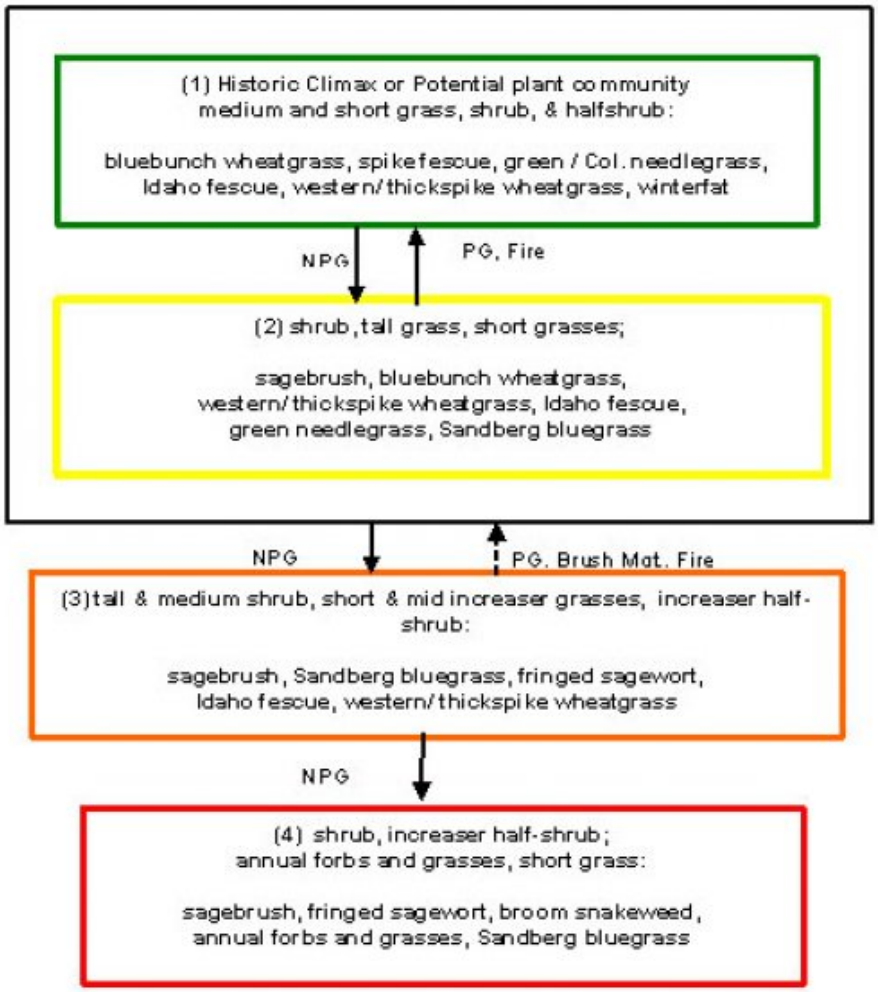
This site developed under Northern Rocky Mountain foothills climatic conditions, which included the natural influence of large herbivores and occasional fire. The plant community upon which interpretations are primarily based is the Historic Climax Plant Community (HCPC). The Historic Climax Plant Community is described as a reference to understand the original potential of this site, and is not considered to be the management goal for every acre of rangeland. The following descriptions should enable the landowner/ manager to better understand which plant communities occupy their land, and assist with setting goals for vegetation management. It can also be useful to understand the environmental and economic values of each plant community.

This site is considered moderately resilient to disturbance as it has only moderate soil limitations for plant growth. Changes may occur to the Historic Climax Plant Community due to management actions and/or climatic conditions. Under continued adverse impacts, a moderate decline in vegetative vigor and composition will occur. Under favorable vegetative management treatments, this site can more readily return to the Historic Climax Plant Community (HCPC).

Continual adverse impacts to the site over a period of years results in a departure from the HCPC, with a decrease of the taller, more palatable species such as bluebunch wheatgrass, plains muhly, spike fescue, and the taller needlegrasses. These plants will be replaced by Idaho fescue, western or thickspike wheatgrass, Sandberg bluegrass, plains reedgrass, threadleaf sedge, various increaser forbs, and mountain big sagebrush. Continued deterioration results in increased amounts of fringed sagewort, threeawns, and weedy forbs. Rubber rabbitbrush may also increase at some locations.

Plants that are not a part of the reference community that are most likely to invade are annuals, broom snakeweed, and thistles. There are several noxious weeds that are also likely to invade this site including spotted knapweed, leafy spurge, dalmation toadflax, and sulphur cinquefoil.

State and transition model



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 more than the available forage supply.

Fire: Prescribed fire or non-prescribed wildfire.

Figure 8. State and Transition Model

State 1
Tall and Medium Grasses, Forbs, Half-Shrub

Community 1.1
Tall and Medium Grasses, Forbs, Half-Shrub

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 high diversity of tall and medium height, cool and warm season grasses (bluebunch wheatgrass, green or Columbia needlegrasses, thickspike or western wheatgrass, spike fescue, and plains muhly), and short grasses and sedges (Idaho fescue, Cusick bluegrass, Sandberg bluegrass, plains

reedgrass, threadleaf and needleleaf sedge). There are abundant forbs (prairie clovers, dotted gayfeather) which occur in smaller percentages. Half shrubs such as winterfat should also be common. Shrubs such as mountain big sagebrush can also be present. This plant community is well adapted to the Northern Rocky Mountain foothills climatic conditions. The diversity in plant species allows for drought tolerance. Individual species can vary greatly in production depending on growing conditions (timing and amount of precipitation, and temperature). This plant community is well suited to managed livestock grazing and provides diverse habitat for many wildlife species. Plants on this site have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. This plant community provides for soil stability and a properly functioning hydrologic cycle. 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. The soils associated with this site provide a limited soil-water-plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1048	1191	1334
Forb	123	140	157
Shrub/Vine	28	35	78
Total	**1199**	**1366**	**1569**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	5-10%
Grass/grasslike foliar cover	20-40%
Forb foliar cover	1-5%
Non-vascular plants	0-1%
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	0-2%
Grass/grasslike basal cover	14-21%
Forb basal cover	1-2%
Non-vascular plants	0-1%
Biological crusts	0%
Litter	50-60%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	5-15%
Bedrock	0%
Water	0%

Bare ground	10-20%

State 2
Medium and Short Grasses, Sedge, and Increaser Forbs

Community 2.1
Medium and Short Grasses, Sedge, and Increaser Forbs

Early stages of degradation, including non-prescribed grazing, will tend to change the HCPC to a community dominated by medium and short grasses and sedges such as Idaho fescue, thickspike/western wheatgrass, Sandberg bluegrass, threadleaf sedge, Cusick bluegrass, and prairie junegrass. Bluebunch wheatgrass can still be relatively abundant. Most of the othe taller and more palatable plants (spike fescue, tall needlegrasses, winterfat) will still be present but in smaller amounts. There may be an increase in the amount of some shrubs, particularly mountain big sagebrush. Palatable and nutritious forbs will be replaced by less desirable and more aggressive species such as fringed sagewort. This plant community will readily respond to improved grazing management, but a significant amount of time can be necessary to move it toward a higher successional stage and a more productive plant community similar to community 1. Biomass production and litter become slightly reduced on the site with Community 2 as the taller grasses become replaced by shorter ones. Evapotranspiration tends to increase, moisture retention is reduced, and soil surface temperatures increase. Some natural ecological processes will be altered. These plant communities provide for moderate soil stability. Increased amounts of bare ground can result in undesirable species invading. Common invaders can include spotted knapweed, leafy spurge, dalmation toadflax, and sulphur cinquefoil.

State 3
Shrub, Short and Mid Increaser Grasses, Fringed Sagewort, Increaser Forbs, Cactus

Community 3.1
Shrub, Short and Mid Increaser Grasses, Fringed Sagewort, Increaser Forbs, Cactus

With continued heavy disturbance, the site will become dominated by species such as mountain big sagebrush, short and medium increaser grasses such as Sandberg bluegrass, plains reedgrass, prairie junegrass, western or thickspike wheatgrass, and Idaho fescue, fringed sagewort, and increaser forbs such as scarlet globemallow and Hood’s phlox. There may still be remnant amounts of some of the late-seral species such as bluebunch wheatgrass, spike fescue, and green/Columbia needlegrass present. The taller grasses will occur only occasionally, often under sagebrush plants. Palatable forbs will be mostly absent. Plains pricklypear cactus and rubber rabbitbrush may become common. Plant community 3 is often less productive than 1 or 2. The lack of litter and short plant heights result in higher soil temperatures, poor water infiltration rates, and higher evapotranspiration rates, thus eventually favoring species that are more adapted to drier conditions. This community has lost many of the attributes of a healthy rangeland, including good infiltration, minimal erosion and runoff, nutrient cycling and energy flow. This plant community is the result of long-term, heavy, continuous grazing and/or annual, early spring seasonal grazing. Repeated spring grazing depletes stored carbohydrates, resulting in weakening and eventual death of the cool season tall and medium grasses. This plant community can occur throughout the pasture, on spot grazed areas, and around water sources where season-long grazing patterns occur. This community will respond positively to improved grazing management, but significant economic inputs along with a significant amount of time are usually required to move it toward a higher successional stage and a more productive plant community. Practices such as prescribed burning and brush management are generally needed, along with extended rest and prescribed grazing once the community has degraded to this point. There are limitations to using mechanical treatment on this site due to the shallow soils. Periodic wild fire will result in a community similar to number 3, but with a smaller component of big sagebrush for a few years. There may also be a slight decrease in the amount of fringed sagewort, depending on frequency, timing, and severity of the fire. However, these will soon return if there’s no change in grazing management.

State 4
Shrub, Half Shrubs, Weedy Forbs, Annuals, and Short Grasses

Community 4.1
Shrub, Half Shrubs, Weedy Forbs, Annuals, and Short Grasses

Further deterioration of community 3 results in a plant community dominated by mountain big sagebrush and undesirable plants such as fringed sagewort, broom snakeweed, plains pricklypear, weedy forbs (e.g., pussytoes and thistles), annuals such as cheatgrass and Japanese bromes and sixweeks fescue. Many increaser short grasses such as Sandberg bluegrass and plains reedgrass will be abundant. Frequently, a remnant population of climax species such as bluebunch wheatgrass will occur under sagebrush plants. Rubber rabbitbrush can be abundant in some locations. Plant community 4 produces less usable forage than the others described. The continuation of the downward trend and degradation of this site has resulted in higher soil surface temperatures, reduced water infiltration, and higher evapotranspiration. This has resulted in plant species that are more adapted to drier conditions, such as cactus. A thick canopy cover (e.g., 20% or more) of big sagebrush often results in precipitation being intercepted, thus not reaching the soil. Most of the attributes of a healthy rangeland, including good infiltration, minimal erosion and runoff, nutrient cycling and energy flow, have been lost. This community can respond positively to improved grazing management but it will take additional inputs to move it towards communities similar in production and composition to others that have been described. Once plants such as mountain big sagebrush become established, they are very difficult to remove and replace by grazing management alone. Additionally, the chances for success are significantly reduced. Practices such as prescribed burning or brush management can reduce the amount of sagebrush, as well as some of the other susceptible plant species. The potential for success depends on the composiiion of the rest of the plant community. Because of the shallow soils (and sometimes, steeper slopes) associated with this ecological site, other practices such as mechanical treatment or seeding are generally not feasible nor recommended.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
0	**Shrubs and Half-shrubs**			28–78	
	Shrub, broadleaf	2SB	*Shrub, broadleaf*	0–78	–
	silver sagebrush	ARCAV2	*Artemisia cana ssp. viscidula*	0–78	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–78	–
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	0–78	–
	rubber rabbitbrush	ERNAN2	*Ericameria nauseosa ssp. consimilis var. nitida*	0–78	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–78	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–1	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–1	–
Grass/Grasslike					
0	**Grasses and Sedges**			1048–1334	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	493–1098	–
	Idaho fescue	FEID	*Festuca idahoensis*	62–235	–
	spike fescue	LEKI2	*Leucopoa kingii*	0–157	–
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	62–157	–
	green needlegrass	NAVI4	*Nassella viridula*	31–78	–
	western wheatgrass	PASM	*Pascopyrum smithii*	31–78	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	0–78	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–78	–
	prairie junegrass	KOMA	*Koeleria macrantha*	0–78	–

	prairie junegrass	KOMA	*Koeleria macrantha*	0–78	–
	Grass, perennial	2GP	*Grass, perennial*	0–78	–
	Columbia needlegrass	ACNEN2	*Achnatherum nelsonii ssp. nelsonii*	31–78	–
	needleleaf sedge	CADU6	*Carex duriuscula*	0–78	–
	threadleaf sedge	CAFI	*Carex filifolia*	0–78	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	0–78	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	31–78	–
	purple threeawn	ARPU9	*Aristida purpurea*	0–1	–
	Fendler's threeawn	ARPUF	*Aristida purpurea var. fendleriana*	0–1	–
Forb					
0	**Forbs**			123–157	
	Forb, perennial	2FP	*Forb, perennial*	0–78	–
	larkspur	DELPH	*Delphinium*	0–78	–
	common starlily	LEMO4	*Leucocrinum montanum*	0–78	–
	desertparsley	LOMAT	*Lomatium*	0–78	–
	lupine	LUPIN	*Lupinus*	0–78	–
	spiny phlox	PHHO	*Phlox hoodii*	0–78	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–78	–
	American vetch	VIAM	*Vicia americana*	0–78	–
	deathcamas	ZIGAD	*Zigadenus*	0–78	–

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. Grazing must be managed carefully on this site to be sure livestock drift onto the better, more productive sites is not excessive. Management objectives should include maintenance or improvement of the plant community.

Using shorter grazing periods and providing for adequate re-growth after grazing are recommended for plant maintenance, health, and recovery. Continual over stocking and season-long use of this site can be detrimental and will alter the plant composition and production over time. The result will be plant communities that resemble numbers 3 and 4, depending on how long this grazing management is used as well as other circumstances such as weather conditions and fire frequency.

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

Plant community 3 is the result of long-term, heavy, continuous grazing and/or annual, early spring seasonal grazing. Repeated heavy early spring grazing, especially during stem elongation (generally mid May through mid June), can also have detrimental affects on the taller, key forage species. Repeated spring grazing depletes stored carbohydrates, resulting in weakening and eventual death of the cool season tall and medium grasses. This plant community can occur throughout the pasture, on spot grazed areas, and around water sources where season-long grazing patterns occur.

Plant Communities 3 and 4 have a high percentage of aggressive, less-desirable species. Once these have become established, it is significantly more difficult using grazing management alone to restore the site to one that resembles the HCPC/PPC. The management objective at this point to implement a grazing strategy that will restore

the stability and health of the site. Additional rest, sometimes for the growing season, or more probable for a full year or more, is often necessary for re-establishment of the desired species. There are limitations to using mechanical treatment on this site due to the shallow soils.

Calculating Safe Stocking Rates: Proper stocking rates should be incorporated into a grazing management strategy that protects the resource, maintains or improves rangeland health, and is consistent with management objectives. Safe stocking rates will be based on useable forage production, and should consider ecological condition and trend of the site, and past grazing use history.

Calculations used to determine a safe stocking rate are based on the amount of useable forage available, taking into account the harvest efficiency of the animal and the grazing strategy to be implemented. Average annual production must be measured or estimated to properly assess useable forage production and stocking rates.

Stocking rates are calculated from average forage production values using a 25% Harvest Efficiency factor for preferred and desirable plants, and 10% Harvest Efficiency for less desirable species. AUM calculations are based on 915 pounds (air-dry) per animal unit month (AUM) for a 1,000-pound cow with calf up to 4 months. No adjustments have been made for site grazability factors, such as steep slopes, site inaccessibility, or distance to drinking water.

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 AU! M/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).

Hydrological functions

The soils associated with this ecological site are generally in Hydrologic Soil Group D. The infiltration rates for these soils will normally be slow to very slow. The runoff potential for this site is moderate to high, depending on slope and ground cover/health. Runoff curve numbers generally range from 79 to 94.

Good hydrologic conditions exist on rangelands if plant cover (grass, litter, and brush canopy) is greater than 70%. Fair conditions exist when cover is between 30 and 70%, and poor conditions exist when cover is less than 30%. Sites in high similarity to HCPC (Plant Communities 1 and 2) generally have enough plant cover and litter to

optimize infiltration, minimize runoff and erosion, and have a good hydrologic condition. The deep root systems of the potential vegetation help maintain or increase infiltration rates and reduce runoff.

Sites in low similarity (Plant Communities 3 and 4) are generally considered to be in poor hydrologic condition as the majority of plant cover is from shallow-rooted species such as Sandberg bluegrass.

Erosion is minor for sites in high similarity. Rills and gullies should not be present. Water flow patterns, if present, will be barely observable. Plant pedestals are essentially non-existent. Plant litter remains in place and is not moved by erosion. Soil surfaces should not be compacted or crusted. Plant cover and litter helps retain soil moisture for use by the plants. Maintaining a healthy stand of perennial vegetation will optimize the amount of precipitation that is received. (Reference: Engineering Field Manual, Chapter 2 and Montana Supplement 4).

Recreational uses

This site provides some recreational opportunities for hiking,
horseback riding, big game and upland bird hunting. The forbs have flowers that appeal to photographers. This site provides valuable open space and visual aesthetics. Caution should be used during wet weather periods.

Wood products

None

Contributors

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Approval

Kirt Walstad, 7/19/2023

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.

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Date	03/01/2020
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are rarely present in the reference condition, if present will be short and inconspicuous on the steeper slopes

2. **Presence of water flow patterns:** Water flow patterns are rarely present in the reference condition but may be present on the steeper, south facing slopes when runoff exceeds infiltration. These patterns will be short and infrequent across gentle slopes and increasingly more common on steeper slopes.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are extremely rare in the reference condition, if present will be on slopes greater than 25% and associated with waterflow patterns.

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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 10-20%. It consists of small, randomly scattered patches.

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5. **Number of gullies and erosion associated with gullies:** Gullies are not present in the reference condition.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Wind scoured, or depositional areas are not evident in the reference condition.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is not evident in the reference condition.

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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):** The average soil stability rating is 4-6 under plant canopies and plant interspaces. The A horizon is 2-4 inches thick.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil Structure at the surface is typically weak fine to strong fine granular. A Horizon should be 2-4 inches thick with color, when wet, typically ranging in Value of 5 or less and Chroma of 3 or less.
Local geology may affect color, it is important to reference the Official Series Description (OSD) for characteristic range. https://soilseries.sc.egov.usda.gov/osdname.aspx

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Infiltration of the Shallow Clay ecological site is slow to very slow. This site is well drained. An even distribution of mid stature grasses (65-70%), cool season bunchgrasses (15-20%) along with rhizomatous grass (10-15%), forbs (5-10%), shrubs (5-10%), and trees/tall shrubs (0-1%)

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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 compaction layer is not present in the reference condition. Soil profile may contain an abrupt transition to an Argillic horizon which can be misinterpreted as compaction, however, the soil structure will be fine to medium subangular blocky, where a compaction layer will be platy or structureless (massive).

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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: Mid-statured, cool season, perennial bunchgrasses (Primarily bluebunch wheatgrass, spike fescue)

    Sub-dominant: shortgrass grasses/grasslikes (needleanthread, Junegrass) > rhizomatous grasses > forbs = Shrubs >> Trees/Tall shrubs

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Mortality in herbaceous species is not evident. Species with bunch growth forms may have some natural mortality in centers is 3% or less.

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14. **Average percent litter cover (%) and depth (in):** Total litter cover ranges from 50-60%. Most litter is irregularly distributed on the soil surface and is not at a measurable depth.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Average annual production is 1219. Low: 1070 High 1400. Production varies based on effective precipitation and natural variability of soil properties for this ecological site.

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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:** Potential invasive (including noxious) species (native and non-native). Invasive species on this ecological site include (but not limited to) annual brome spp., spotted knapweed, yellow toadflax, leafy spurge, crested wheatgrass, Kentucky bluegrass, and Canada bluegrass
    Native species such as Rocky Mountain juniper, limber pine, ponderosa pine, Douglas fir, lupine, broom snakeweed, Sandberg bluegrass, etc. when their populations are significant enough to affect ecological function, indicate site condition departure.

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17. **Perennial plant reproductive capability:** In the reference condition, all plants are vigorous enough for reproduction either by seed or rhizomes in order to balance natural mortality with species recruitment.
