

Ecological site EX043B23B172

Stony Upland (StU)

Absaroka

Upper Foothills

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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.

MLRA notes

Major Land Resource Area (MLRA): 043B–Central Rocky Mountains

43B – Central Rocky Mountains – The Central Rocky Mountains extends from northern Montana to southern extent of Wyoming and from Idaho to central Wyoming. The southern extent of 43B is comprised of a combination of metamorphic, igneous, and sedimentary mountains and foothills. Climatic changes across this extent are broad and create several unique breaks in the landscape. Further information regarding MLRAs, refer to: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. Available electronically at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook.

LRU notes

Land Resource Unit (LRU) 43B23B: Absaroka Upper Foothills Based on the shifts in geology, precipitation patterns and other climatic factors, as well as elevations and vegetation, the Absaroka Range was divided into LRU 23. Further division of this LRU is necessary due to the gradient moving from the foothills to the summit, as well as aspect shifts (north/east face versus south/west face). Subset B is set for the higher elevations within the foothills, with 15 to 19 inches of precipitation. To verify or identify Subset B (the referenced subset for this ecological site), refer to the Wyoming LRU matrix key contained within the Ecological Site Key. This particular LRU/Subset occurs along the eastern foothills of the Absaroka Range. This LRU starts north of Clark, WY and runs to the Thermopolis, WY area. Once the foothills cross into the Northern Beartooth Range, the climatic patterns and elevational changes shifts the plant community and allows for a break in LRU's near the Montana state line. As the LRU follows to the south and then tracks east to the intersection of the Absaroka Range and the Owl Creek Range, the face changes aspect and geology creating a shift in plant dynamics and a break in the LRU. The extent of soils currently correlated to this ecological site does not fit within the digitized boundary. Many of the noted soils are provisional and will be reviewed and corrected in mapping update projects. Other map units are correlated as small inclusions within other MLRA's/LRU's based on elevation, landform, and biological references. Moisture Regime: Typic Ustic Temperature Regime: Frigid Dominant Cover: Rangeland – Sagebrush Steppe (major species is Mountain Big Sagebrush) Representative Value (RV) Effective Precipitation: 15-19 inches (381 – 483 mm) RV Frost-Free Days: 37 - 80 days

Classification relationships

Relationship to Other Established Classification Systems: National Vegetation Classification System (NVC): 2 Shrub & Herb Vegetation Class 2.B Temperate & Boreal Grassland & Shrubland Subclass 2.B.2 Temperate Grassland & Shrubland Formation 2.B.2.Na Western North American Grassland & Shrubland Division Division M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland Macrogroup G273 Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group Ecoregions (EPA): Level I: 10 North American Deserts Level II: 10.1 Cold Deserts Level III: 10.1.18 Wyoming Basin Level IV: 10.1.18.d Foothills and Low Mountains

Ecological site concept

- Site receives no additional water.
- Slope is 20%
- Soils are:
 - o Non-saline, sodic, or saline-sodic
 - o Moderately deep to very deep (20-80+ in. (50-200+ cm)
 - o > 5% stone and boulder cover and >35% cobble and gravel cover
 - o Skeletal (?35% rock fragments) starting within 8-20" (20-50 cm) of mineral soil surface (may have up to but not exceeding 35% rock fragments above 8")
 - o Textures range from fine sandy loam to clay loam in top 4" (10 cm) of mineral soil surface
 - o Clay content is ?18% in top 4" (10 cm) of mineral soil surface
 - o All subsurface horizons in the particle size control section have a weighted average of ?18% but 35% clay. (The particle size control section is the segment of the profile from either the start of an argillic horizon for 50 cm's or from 25-100 cm's).

Associated sites

EX043B23B122	Loamy (Ly) Absaroka Upper Foothills Loamy soils will be found in similar areas as the Stony Upland (depositional areas) with a deeper fine-loamy cap lacking the skeletal structure higher in the profile. Will occur intermixed with Stony Upland.
R043BY362WY	Shallow Loamy (SwLy) 15-19" Foothills and Mountains East Precipitation Zone Shallow Loamy will be found along outcroppings either above or within the slides. Stony Upland will have incidental or scattered pockets of Shallow loamy intermixed.
EX043B23B175	Skeletal (Sk) Absaroka Upper Foothills The skeletal profile is found in erosional positions or convex portions of a landform where the Stony upland will be found in depositional zones on the landform.

Similar sites

EX043B23B109	Cobbly Upland (CoU) Absaroka Upper Foothills Cobbly Upland is lacking the stones and boulders on the surface and is generally cobbles and gravels. The deposits include more to the alluvial deposits rather than slide and glacial deposits, although it occurs in all.
R043BY108WY	Coarse Upland High Mountains Course Upland was developed to describe any moderately textured soils that had a skeletal or near skeletal profile with intermixed pockets of deeper soils. The Cobbly Upland and Stony Upland ecological sites were derived from this one ESD.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Artemisia tridentata ssp. vaseyana</i> (2) <i>Artemisia frigida</i>
Herbaceous	(1) <i>Achnatherum nelsonii</i> (2) <i>Festuca idahoensis</i>

Legacy ID

R043BX672WY

Physiographic features

This site occurs in most positions and is focused on nearly flat to slopes less than 20 percent. This site is commonly associated with glacial deposits, escarpments, or landslides with stones and boulders,.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Landslide (2) Foothills > Outwash fan (3) Foothills > Ridge
Runoff class	Negligible to high
Elevation	2,070 – 2,740 m
Slope	0 – 20 %
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation and modeled relative effective annual precipitation ranges from 15 to 19 inches (381 – 483 mm). The normal precipitation pattern shows peaks in June tapering into September. This amounts to about 50 percent of the mean annual precipitation. Average snowfall is about 150 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation.

Because of the varied topography, the wind will vary considerably for different parts of the area. The wind is usually much lighter at the lower elevations and in the valleys as compared with the higher terrain. The average winter wind velocity is 8.5 mph while the summer wind velocity averages 7.5 mph. Winds during storms and on ridges may exceed 45 mph.

Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. High winds are generally blocked by high mountains but occur in conjunction with thunderstorms, which are common in late summer. Growth of native cool-season plants begins about May 1 to May 15 and continues until about October 15.

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at <http://www.wcc.nrcs.usda.gov/>. Historically, Crandall Creek was the representative weather stations within this subset. However, Sunshine 3NE, Yellowstone Park Mammoth, and Tower Falls are the only available weather stations within a close proximity in location and characteristics for this subset. The following graphs and charts are a collective sample representing the averaged normals and 30-year annual rainfall data for the selected weather stations from 1981 to 2010.

Table 3 Representative climatic features

Frost-free period (characteristic range)	20-60 days
Freeze-free period (characteristic range)	40-100 days
Precipitation total (characteristic range)	360-410 mm
Frost-free period (actual range)	10-70 days
Freeze-free period (actual range)	20-110 days

Precipitation total (actual range)	360-410 mm
Frost-free period (average)	40 days
Freeze-free period (average)	70 days
Precipitation total (average)	380 mm

- (1) SUNSHINE 3NE [USC00488758], Meeteetse, WY
- (2) TOWER FALLS [USC00489025], Yellowstone National Park, WY
- (3) YELLOWSTONE PK MAMMOTH [USC00489905], Yellowstone National Park, WY

Influencing water features

The characteristics of these upland soils have no influence from ground water (water table below 60 inches or 150 cm) and have minimal influence from surface water and overland flow. There may be isolated features that are affected by snowpack that persists longer than surrounding areas due to position on the landform (shaded or protected pockets), but overflow is not a suitable fit. No streams are classified within this ecological site.

Soil features

The soils of this site are deep to moderately deep (greater than 20 inches to bedrock), moderately well to somewhat excessively well-drained, and moderately slow to moderately rapidly permeable. This site consists of bouldery to cobbly coarse fragment soils. The soil surface can be covered extensively with coarse fragments, with stones and boulders common. The high fragment cover limits and causes plant density to be reduced. The soil characteristics most influential to the plant community are volume of coarse fragments in the profile that reduces the available moisture and vegetative cover.

Figure 7. Soils pit, dug by hand, showing the deeper stony skeletal segment of a fine-loamy profile (upper soil layers 0-10 inches).

Table 4. Representative soil features

Parent material	(1) Residuum – sedimentary rock (2) Slide deposits – igneous, metamorphic and sedimentary rock (3) Slope alluvium
Surface texture	(1) Cobbly, very stony, bouldery loam (2) Silt loam (3) Very fine sandy loam (4) Clay loam

Family particle size	(1) Fine-loamy (2) Loamy-skeletal (3) Fine-loamy over sandy or sandy-skeletal
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	50 cm
Surface fragment cover <=3"	0 – 40 %
Surface fragment cover >3"	10 – 20 %
Available water capacity (0-101.6cm)	4.57 – 13.72 cm
Calcium carbonate equivalent (0-101.6cm)	0 – 10 %
Electrical conductivity (0-101.6cm)	Not specified
Sodium adsorption ratio (0-101.6cm)	0 – 10
Soil reaction (1:1 water) (0-101.6cm)	6.6 – 8.4
Subsurface fragment volume <=3" (Depth not specified)	0 – 40 %
Subsurface fragment volume >3" (Depth not specified)	10 – 30 %

Ecological dynamics

Potential vegetation on this site is dominated by mid cool-season perennial grasses. Other significant vegetation includes antelope bitterbrush, big sagebrush and a variety of forbs. The expected potential composition for this site is about 75% grasses, 10% forbs and 15% woody plants. The composition and production will vary naturally due to historical use, fluctuating precipitation and fire frequency.

As this site deteriorates from improper grazing management, species such as rhizomatous wheatgrasses, Sandberg bluegrass, spike trisetum, and big sagebrush will increase. Cool season grasses such as bluebunch wheatgrass, spikefescue, Idaho fescue and Columbia needlegrass will decrease in frequency and production.

Big sagebrush and juniper may become dominant on areas with an absence of fire and sufficient amount of precipitation. Wildfires are actively controlled in recent times and as a result old decadent stands of big sagebrush persist. Chemical and mechanical controls have replaced the historic role of fire on this site. Recently, prescribed burning has regained some popularity.

The big sagebrush component may not be as resilient once it has been removed or severely reduced, if a vigorous stand of grass exists and is maintained. The exception to this is where the herbaceous component is severely degraded at the time of treatment, growing conditions are unfavorable after treatment, and/or recovery of herbaceous species are inadequate due to poor grazing management. Regeneration of big sagebrush may also be suppressed if rubber rabbitbrush is established. This situation is more likely to develop in areas where fires have occurred in a relatively short cycle. Rubber rabbitbrush is a strong resprouter and will out compete other shrubs where a site is disturbed. Any thinning project should be designed in a way to maintain the viability of the stand and to consider wildlife requirements.

The Historic Climax Plant Community (description follows the plant community diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model Diagram that illustrates the common plant communities (states) that can occur on the site and the transitions between these communities. The ecological processes will be discussed in more detail in the plant community narratives following the diagram.

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	Tall-stature, Cool-season Bunchgrasses			84-224	
	Columbia needlegrass	ACNE9	<i>Achnatherum nelsonii</i>	56-168	5-15
	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	0-56	0-5
	blue wildrye	ELGL	<i>Elymus glaucus</i>	0-56	0-5
2	Mid-stature, Cool-season Bunchgrasses			112-392	
	Idaho fescue	FEID	<i>Festuca idahoensis</i>	56-224	5-20
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	0-168	0-15
3	Rhizomatous, Cool-season Grasses			28-112	
	Montana wheatgrass	ELAL7	<i>Elymus albicans</i>	0-56	0-5
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	0-56	0-5
	slender wheatgrass	ELTR7	<i>Elymus trachycaulus</i>	0-56	0-5
4	Short-stature, Cool-season Bunchgrasses			0-84	
	Cusick's bluegrass	POCU3	<i>Poa cusickii</i>	0-56	0-5
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0-56	0-5
	spike trisetum	TRSP2	<i>Trisetum spicatum</i>	0-56	0-5
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	0-56	0-5
5	Miscellaneous Grasses/Grass-like			0-56	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0-56	0-5
	threadleaf sedge	CAFI	<i>Carex filifolia</i>	0-28	0-5

	needleleaf sedge	CADU6	<i>Carex duriuscula</i>	0-28	0-5
Forb					
6	Perennial Forbs			28-112	
	arrowleaf balsamroot	BASA3	<i>Balsamorhiza sagittata</i>	0-112	0-10
	lupine	LUPIN	<i>Lupinus</i>	0-56	0-5
	sulphur-flower buckwheat	ERUM	<i>Eriogonum umbellatum</i>	0-56	0-5
	phlox	PHLOX	<i>Phlox</i>	0-56	0-5
	beardtongue	PENST	<i>Penstemon</i>	0-56	0-5
	Indian paintbrush	CASTI2	<i>Castilleja</i>	0-56	0-5
	American vetch	VIAM	<i>Vicia americana</i>	0-56	0-5
	milkvetch	ASTRA	<i>Astragalus</i>	0-56	0-5
	Forb, perennial	2FP	<i>Forb, perennial</i>	0-56	0-5
Shrub/Vine					
7	Dominant Shrubs			56-224	
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	56-224	5-20
8	Miscellaneous Shrubs			0-84	
	rubber rabbitbrush	ERNA10	<i>Ericameria nauseosa</i>	0-56	0-5
	snowberry	SYMPH	<i>Symphoricarpos</i>	0-56	0-5
	Woods' rose	ROWO	<i>Rosa woodsii</i>	0-56	0-5
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	0-56	0-5
	Shrub, other	2S	<i>Shrub, other</i>	0-56	0-5

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 7. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 2.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 2.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 10. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 11. Community 3.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 12. Community 4.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Animal community

Animal Community – Wildlife Interpretations Columbia Needlegrass/Spikefescue Plant Community (Reference): The predominance of grasses in this plant community favors grazers and mixed-feeders, such as deer, bison, elk, and antelope. Suitable thermal and escape cover for deer may be limited due to the low quantities of woody plants. However, topographical variations could provide some escape cover. Due to the location of these sites on the foot slopes of mountains, they are valuable for elk and deer winter ranges. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging areas for sage grouse, as well as lek

sites. Other birds that would frequent this plant community include western meadowlark, lark bunting, sage thrasher, horned larks, red-tail and ferruginous hawks, and golden eagles. Many grassland obligate small mammals would occur here.

Idaho Fescue/Mixed Shrub Plant Community: The combination of an overstory of antelope bitterbrush and big sagebrush and an understory of grasses and forbs provides a very diverse plant community for wildlife. The crowns of sagebrush tend to break up hard crusted snow on winter ranges, so mule deer, elk, and antelope may use this state for foraging and cover year-round, as would cottontail and jack rabbits. It provides important winter, nesting, brood-rearing, and foraging habitat for sage grouse. Brewer's sparrows' nest in big sagebrush plants and hosts of other nesting birds utilize stands in the 20-30% cover range. Other birds that would frequent this plant community include western meadowlark, lark bunting, sage thrasher, horned larks, red-tail and ferruginous Hawks, and golden eagles.

Rhizomatous Wheatgrass/Big Sagebrush Plant Community: The combination of an overstory of big sagebrush and an understory of grasses and forbs provides a very diverse plant community for wildlife. The crowns of sagebrush tend to break up hard crusted snow on winter ranges, so mule deer, elk, and antelope may use this state for foraging and cover year-round, as would cottontail and jack rabbits. It provides important winter, nesting, brood-rearing, and foraging habitat for sage grouse. Brewer's sparrows' nest in big sagebrush plants and hosts of other nesting birds utilize stands in the 20-30% cover range. Other birds that would frequent this plant community include western meadowlark, lark bunting, sage thrasher, horned larks, red-tail and ferruginous Hawks, and golden eagles.

Montana Wheatgrass/Rubber Rabbitbrush Plant Community: The production of herbaceous species provided for good foraging to grazers. However, the lack of tall or mid growing shrubs does not benefit browsers nor provides cover for many wildlife species. As these site greens-up sooner in the spring, this site tends to provide early new growth for foraging large and small mammals. If located adjacent to shrub dominated sites, It provides good foraging habitat for sage grouse.

Rhizomatous Wheatgrass/Prairie Junegrass Plant Community: The production of herbaceous species provided for good foraging for grazers. However, the lack of tall or mid growing shrubs does not benefit browsers nor provides cover for many wildlife species. As these site greens-up sooner in the spring, this site tends to provide early new growth for foraging large and small mammals. If located adjacent to shrub dominated sites, It provides good foraging habitat for sage grouse.

Big Sagebrush/Bluegrass Plant Community: This plant community can provide important winter foraging for elk, mule deer and antelope, as sagebrush can approach 15% protein and 40-60% digestibility during that time. This community provides escape and thermal cover for large ungulates, as well as nesting and brood rearing habitat for sage grouse. Due to the lack of herbaceous production and diversity of mid cool season grasses on this site, it is not as beneficial to grazers. Other birds that would frequent this plant community include western meadowlark, lark bunting, sage thrasher, horned larks, red-tail and ferruginous Hawks, and golden eagles.

Invaded Plant Communities: This community provides limited foraging for elk and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover. Generally, these are not target plant communities for wildlife habitat management.

Animal Community – Grazing Interpretations The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity* (lb./ac) (AUM/ac)

Plant Community	Production (lb./ac)	Carrying Capacity (AUM/ac)
Columbia Needlegrass/Spikefescue	600-1000	.5
Idaho Fescue/Mixed Sagebrush	500-1000	.4
Rhizomatous WG/Big Sagebrush	** **	** **
Montana WG/R. Rabbitbrush	** **	** **
Rhizomatous WG/Prairie Junegrass	** **	** **
Big Sagebrush/Bluegrass	** **	** **
Invaded	** **	** **

- Carry Capacity is figured for continuous, season-long grazing by cattle under average growing conditions. ** - Sufficient data for invaded and reclaimed communities has not be collected or evaluated, at this time, so no projection of a stocking rate recommendation or production range will be established at this time. Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements. Distance to water, shrub density, and slope can affect carrying capacity (grazing capacity) within a management unit. Adjustments should be made for the area that is considered necessary for reduction of animal numbers. For example, 30% of a management unit may have 25% slopes and distances of greater than one mile from water; therefore, the adjustment is only calculated for 30% of the unit (i.e. 50% reduction on 30% of the management unit). Fencing, slope length, management, access, terrain, kind and class of livestock, and breeds are all factors that can increase or decrease the percent of graze-able acres within a management unit. Adjustments should be made that incorporate these factors when calculating stocking rates.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B and C, with localized areas in hydrologic group D. Infiltration ranges from moderate to moderately rapid. Runoff potential for this site varies from moderate to high depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where; short-grasses form a strong sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information). Rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses such as bluebunch wheatgrass. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides hunting opportunities for upland game species. The wide varieties of plants that bloom from spring until fall have an esthetic value that appeals to visitors. Other recreational uses may include hiking, camping, mountain biking, and in the winter snowshoeing and cross-country skiing.

Wood products

No appreciable wood products are present on the site.

Other products

None noted.

Other information

Herbs: Several of the forb species within the communities of the Stony Upland ecological site have medicinal characteristics and have been used by the Native Americans in this area and more recently by the naturopathic profession. Ornamental Species: The forbs commonly found as well as the shrub component of these communities have been used in landscaping and xeriscaping.

Inventory data references

Information presented here has been derived from NRCS inventory data, Field observations from range trained personnel, and the existing range site descriptions. Those involved in the development of the new concept for the Stony Upland ecological site include: Blaise Allen, Area Range Management Specialist, NRCS; Jim Wolf, Resource Manager, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, USDI and USDA Interpreting Indicators of Rangeland Health Version IV, and USDA NRCS Soil Surveys from various counties. Inventory Data References: Ocular field estimations observed by trained personnel were completed at each site. Then sites were selected where a 100 foot tape was stretched and the following sample procedures were completed by inventory staff. For full sampling protocol and guidelines with forms please refer to the Wyoming ESI Operating Procedures, compiled in 2012 for the Powell and Rock Springs Soil Survey Office, USDA-NRCS. • Double Sampling Production Data (9.6 hoop used to estimate 10 points, clipped a minimum of 3 of these estimated points, with two 21 foot X 21 foot square extended shrub plots). • Line Point Intercept (over story and understory captured with soil cover). Height of herbaceous and woody cover is collected every three feet along established transect.) • Continuous Line Intercept (Woody Canopy Cover, with minimum gap of 0.2 of a foot for all woody species and succulents. Intercept height collected at each measurement.), • Gap Intercept (Basal Gap measured with a minimum gap requirement of 0.7 foot.), • Sample Point (10 – 1 meter square point photographs taken at set distances on transect. Red using the sample point computer program established by the High Plains Agricultural Research Center, WY). • Soil Stability (Slake Test – surface and subsurface samples collected and processed according to the soil stability guidelines provided by the Jornada Research Center, NM.)

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Approval

Kirt Walstad, 3/06/2025

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)	Blaise Allen
Contact for lead author	blaise.allen@usda.gov 307-347-2456
Date	04/18/2020
Approved by	
Approval date	

Composition (Indicators 10 and 12) based on	Annual Production
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Indicators

- 1. Number and extent of rills:** Rare to nonexistent. Some increase in rill development may occur on steeper slopes or on areas located below exposed bedrock or other water shedding areas where increased runoff may occur. Where rills are present, they should be fairly short (2-5 feet), <1 inch deep and somewhat widely spaced (4-8 feet). Rills may increase in length (3-6 feet) and decrease in spacing (3-6 feet) on slopes greater than 40 percent. A minor increase in rill development may be observed on all slopes following major thunderstorm or spring runoff events but should heal during the next growing season.

- 2. Presence of water flow patterns:** Barely observable. Some very minor evidence of water flow patterns may be found around perennial plant bases. They show little evidence of current erosion. They are expected to be short (3-6 feet), stable, sinuous, and not connected. There may be very minor evidence of deposition. Evidence of water flow may increase somewhat with slope.

- 3. Number and height of erosional pedestals or terracettes:** Perennial vegetation shows little evidence of erosional pedestalling (1 to 2% of individual plants). Plant roots are covered and litter remains in place around plant crowns. Terracettes should be absent or, if present, stable. A slight increase in both pedestal and terracette development may occur with increasing slope.

- 4. Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground can range from 0-20%. Bare ground spaces should not be greater than 2 foot in diameter.

- 5. Number of gullies and erosion associated with gullies:** Active gullies should not be present.

- 6. Extent of wind scoured, blowouts and/or depositional areas:** Rare to nonexistent. No evidence of wind generated soil movement is present. Wind caused blowouts and deposition are not present.

- 7. Amount of litter movement (describe size and distance expected to travel):** Herbaceous and large woody litter not expected to move. Most litter resides in place with some redistribution downslope caused by water movement. The majority of litter accumulates at the base of plants. Some grass leaves and stems may accumulate in soil depressions adjacent to plants. Woody stems are not likely to move. However, some litter movement is expected (up to 6 feet) with increases in slopes >25% and/or increased runoff resulting from heavy thunderstorms.

- 8. Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Stability Index ratings range from 3 (interspaces) to 6 (under plant canopy), but average values should be 4.0 or greater.

- 9. Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. Soil OM of 2 to 5% is expected.

10. Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff: Plant community consists of 50-80% grasses, 15% forbs, and 5-35% shrubs. Evenly distributed plant canopy (60-95%) and litter plus moderate infiltration rates result in minimal runoff. Basal cover is typically 5-15% for this site and does affect runoff on this site. Surface rock fragments of 5-20% provide stability to the site, but reduce infiltration.

11. Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site): None.

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-size, cool season bunchgrasses

Sub-dominant: perennial shrubs

Other: perennial forbs>>tall, cool season bunchgrasses=cool season rhizomatous grasses=short cool season bunchgrasses

Additional: Following a disturbance such as fire, drought, rodents or insects that remove woody vegetation, forbs and perennial grasses (herbaceous species) may dominate the community for a period of time. If a disturbance has not occurred for an extended period of time, woody species may continue to increase. These conditions would reflect a functional community phase within the reference state.

13. Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):
All age classes of perennial grasses should be present under average to above average growing conditions. There may be partial mortality on individual bunchgrasses and shrubs during drought periods, and complete mortality of individual plants during severe drought periods. Slight decadence in the principle shrubs could occur near the end of the fire cycle or during periods of extended drought, or insect infestations. In general, a mix of age classes should be expected with some dead and decadent plants present.

14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5-40% of total canopy measurement with total litter (including beneath the plant canopy) from 50-90% expected. Herbaceous litter depth typically ranges from 5-15mm. Woody litter can be up to a couple inches (4-6 cm).

15. Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):
English: 600-1000 lb/ac (850 lb/ac average); Metric 672 -1121 kg/ha (952 kg/ha average).

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: Bare ground greater than 30% is the most common indicator of a threshold being crossed. Rhizomatous wheatgrasses, Sandberg bluegrass, spike trisetum, juniper and big sagebrush are common increasers. Kentucky bluegrass, common dandelion, thistles, and annual weeds such as cheatgrass and mustards are common invasive species in disturbed sites.

17. **Perennial plant reproductive capability:** All species are capable of reproducing, except in extreme drought years.
