USDA Natural Resources
Conservation Service

Ecological site DX032X01B122
Loamy (Ly) Big Horn Basin Rim

Last updated: 2/22/2019
Accessed: 05/09/2024

General information

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

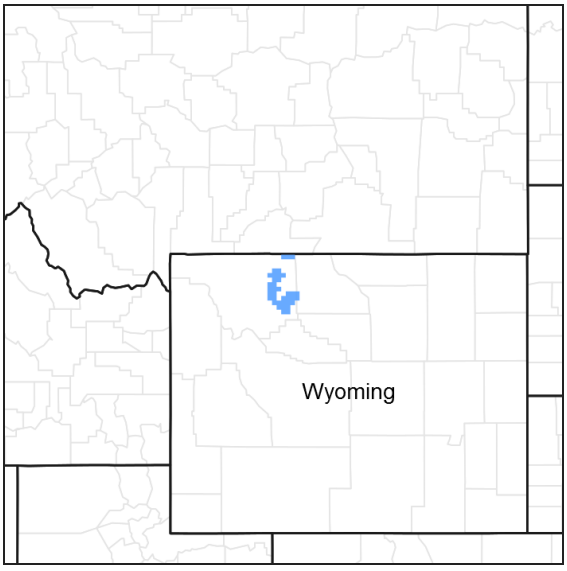


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 032X–Northern Intermountain Desertic Basins

Major Land Resource Area: 032X – Northern Intermountain Desertic Basins
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):

32X02B (WY): This LRU is the Big Horn Basin within MLRA 32. This LRU is lower in elevation, slightly warmer and receives slightly less overall precipitation than the Wind River Basin (LRU 02). This LRU was originally divided into two LRU's - LRU A which was the core and LRU B which was the rim. With the most current standards, this LRU is divided into two Subsets. This subset is Subset B, referred to as the Rim, is a transitional band between the basin floor and the lower foothills. The subset encircles Subset A which was originally LRU A. As the LRU shifts towards the south and tracks east, changes in geology and relation to the mountain position, creates a minor shift in soil

chemistry influencing the variety of ecological sites and plant interactions. 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: Ustic Aridic – Prior to 2012, many of the soils within this group were correlated as Frigid Ustic Aridic or as Mesic Typic Aridic, with few mapped within this cross over zone. As progressive soil survey mapping continues, these "crossover" or transitional areas are being identified and corrected.

Temperature Regime: Mesic
Dominant Cover: Rangeland, with Saltbush flats the dominant vegetative cover for this LRU/ESD.
Representative Value (RV) Effective Precipitation: 10-14 inches (254 – 355 mm)
RV Frost-Free Days: 105-125 days

Classification relationships

Relationship to Other Established Classification Systems:

National Vegetation Classification System (NVC):
3 Xeromorphic Woodland, Scrub & Herb Vegetation Class
3.B Cool Semi-Desert Scrub & Grassland Subclass
3.B.1 Cool Semi-Desert Scrub & Grassland formation
3.B.1.NE Western North American Cool Semi-Desert Scrub & Grassland Division
M169 Great Basin & Intermountain Tall Sagebrush Shrubland & Steppe Macrogroup
G302 Artemisia Tridentata - Artemisia tripartita - Purshia tridentata Big Sagebrush Steppe Group
CEGL001535 - Artemisia tridentata ssp. wyomingensis/Pseudoroegneria spicata Herbaceous Vegetation or
CEGL001009 - Artemisia tridentata ssp. wyomingensis/Pseudoroegneria spicata Shrubland

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.g Big Horn Salt Desert Shrub Basin

Ecological site concept

• Site receives no additional water.
• Soils are:
o Not saline or saline-sodic.
o Moderately deep to very deep
o <3% stone and boulder cover and <20% cobble and gravel cover.
o Not skeletal (<35% rock fragments) within 20" (51 cm) of mineral soil surface.
o None to Slight(moderate) effervescence throughout top 20" (51 cm) of mineral soil surface.
o Textures range from very fine sandy loam to clay loam in top 4" (10 cm) of mineral soil surface.
• Slope is <25%.
• Clay content is =32% in top 4" (10 cm) of mineral soil surface. Each following subsurface horizon has a clay content of <35%.

Review of the Loamy range site identified the need to narrow the concept; site originally included calcareous soil characteristics, and the state and transition model was tailored for carbonate influenced soils. Soils/Vegetation analysis showed a plant composition and production shift to warrant a separation into Loamy and Loamy Calcareous ecological sites. The Loamy ecological site concept is based on minimal (no to slight) influence from Salts, Carbonates, Gypsum or other chemistry within the top 20 inches (51 cm) of the profile, with 18-35% clays (sandy loam to clay loam textures). Soils may shift with management as carbonates or salts concentrate higher in the profile, shifting plant dynamics, leading to a change in ecological site; more details available in plant community narratives. Production shifts were also noted as moved from central to the fringes of the basin in transition into the foothills region. Although transitions are difficult to identify by ocular estimation, there is a trend in production and a distinct shift across the climatic gradient. Original concept included a wider range of precipitation than noted. Within

the plant community descriptions for this ecological site (Loamy 10-14” precipitation, Mesic), the accepted range of production will be similar to what was detailed for the original Loamy 5-9” Big Horn Basin production.

Associated sites

DX032X01A122	**Loamy (Ly) Big Horn Basin Core** Loamy 5-9" has a slightly lower plant diversity and a lower productivity than the 10-14" sites.
R032XY304WY	**Clayey (Cy) 10-14" East Precipitation Zone**
R032XY328WY	**Lowland (LL) 10-14" East Precipitation Zone**
R032XY350WY	**Sandy (Sy) 10-14" East Precipitation Zone**
R032XY362WY	**Shallow Loamy (SwLy) 10-14" East Precipitation Zone**

Similar sites

R032XY162WY	**Shallow Loamy (SwLy) 5-9” Big Horn Basin Precipitation Zone** Shallow Loamy site has a restrictive layer at or between 10 to 20 inches within the mineral surface of the profile.
DX032X01A122	**Loamy (Ly) Big Horn Basin Core** LRU D has slightly higher productivity and plant diversity than LRU A.
R032XY222WY	**Loamy (Ly) 5-9” Wind River Basin Precipitation Zone** This site is the Wind River Basin equivalent, still within MLRA 32, but with a slightly different weather pattern and climatic markers.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata subsp. wyomingensis*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Hesperostipa comata*

Legacy ID

R032XB122WY

Physiographic features

This site occurs on near level to gently undulating rolling land and on slope generally less than 25%. Generally the site is interlaced with other chemistry or rock controlled sites.

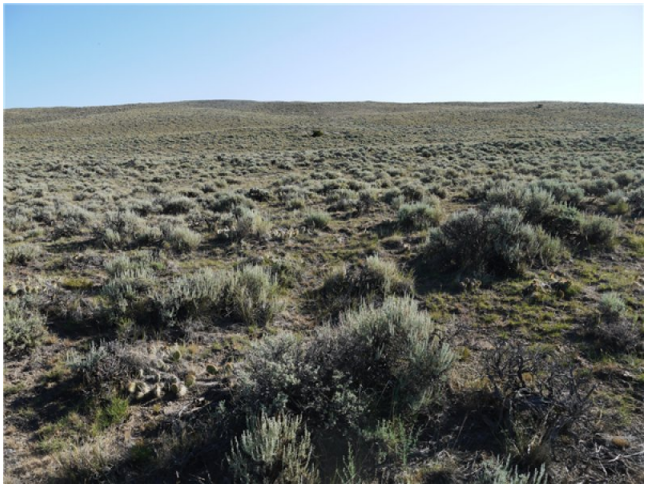


Figure 2. Example of the Landscape position for Loamy sites

Table 2. Representative physiographic features

Landforms	(1) Basin-floor remnant (2) Alluvial fan (3) Stream terrace
Elevation	1,399–1,701 m
Slope	0–25%
Ponding depth	0 cm
Water table depth	122 cm
Aspect	Aspect is not a significant factor

Climatic features

Annual Precipitation and modeled relative effective annual precipitation ranges from 10 to 14 inches (254 – 355 mm). The normal precipitation pattern shows peaks in May and June and a secondary peak in September. This amounts to about 50% of the mean annual precipitation. Much of the moisture that falls in the latter part of the summer is lost by evaporation and much of the moisture that falls during the winter is lost by sublimation. Average snowfall is about 20 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation.

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. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring. High winds are generally blocked form the basin by high mountains, but can occur in conjunction with an occasional thunderstorm.

Growth of native cool-season plants begins about April 1st and continues to about July 1st. Cool weather and moisture in September may produce some green up of cool season plants that will continue to late October.

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. “Black MTN”, "Clark 3NE", "Cody", "Cody 12SE", "Heart Mtn", Powelll Fld Stn", and “Tensleep 16SSE” are the representative weather stations within LRU D. 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 (average)	108 days
Freeze-free period (average)	130 days
Precipitation total (average)	279 mm

Climate stations used

- (1) CODY [USC00481840], Cody, WY
- (2) POWELL FLD STN [USC00487388], Powell, WY
- (3) BLACK MTN [USC00480778], Thermopolis, WY
- (4) CLARK 3NE [USC00481775], Powell, WY
- (5) HEART MTN [USC00484411], Powell, WY
- (6) CODY 12SE [USC00481850], Meeteetse, WY
- (7) TENSLEEP 16SSE [USC00488858], Ten Sleep, WY

Influencing water features

Stream Type: None

Soil features

The soils of this site are moderately deep to very deep (greater than 20” to bedrock), moderately well to well drained, and moderately slow to moderate permeability. The soil characteristic having the most influence on the plant community is available moisture and the potential to develop soluble salt near the surface.

Major Soil Series correlated to this site include: Cushman, Forelle-like, Thedalund, Shavano, Neville, Olney, Kishona, Forkwood, Hiland-Like, Colby, Stormitt. This list of soil series is subject to change upon completion and correlation of the initial soil surveys: WY629, WY603, WY 617; as well as revisions to completed soil surveys: WY043 and MT611.

Figure 7. Soil Profile for Loamy 10-14" Mesic

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone (2) Residuum–shale
Surface texture	(1) Gravelly sandy loam (2) Loam (3) Sandy clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained to well drained
Permeability class	Moderately slow to moderate
Soil depth	51–152 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	5.59–19.81 cm
Calcium carbonate equivalent (0-101.6cm)	0–14%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–13
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%

Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

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

As this site deteriorates species such as Blue grama, Sandberg bluegrass, and Wyoming big sagebrush will increase. Plains prickly pear and weedy annuals will invade. Cool-season grasses such as Bluebunch wheatgrass, rhizomatous wheatgrasses, Needleandthread, and Indian ricegrass will decrease in frequency and production.

Wyoming Big Sagebrush may become dominant on areas with an absence of fire and sufficient amounts of precipitation. Wildfires have been actively controlled in recent times and as a result old decadent stands of Wyoming big sagebrush persist. Chemical control using herbicides has replaced the historic role of fire on this site. Recently, prescribed burning has regained some popularity.

Due to the amount and pattern of the precipitation, the Wyoming big sagebrush component may not be resilient once it has been removed or severely reduced if a vigorous stand of grass exists and is maintained. On these areas, Blue grama may become dominant if the area is subjected to a combination of frequent and severe grazing, especially yearlong grazing. As a result, a dense sod cover of Blue grama and/or Threadleaf sedge will become established.

The Reference 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.

Studies showed a need to narrow the site concept to a more defined picture. By narrowing the ecological site characteristics and the reference state, soil particle size classes of fine-loamy and coarse-loamy soil texture were compared to see how the plant communities varied. Data has noted a correlation with the amount of Needleandthread and Western wheatgrass with the fine-loamy and coarse-loamy particle size classes. Finer textured soils hold a higher ratio of western wheatgrass to Needleandthread (or Indian ricegrass) and the opposite for coarser textured soils, which hold a higher ratio of Needleandthread (or Indian ricegrass) to Western wheatgrass.

The narrowing of the site characteristics to 18% to 35% clay particles within the particle control section has eliminated the coarse-loamy particle size class from this concept. Communities will have a range of variability to account for those soils that are on the margins of these breaks. The variability of the vegetative community is also related to the soil surface structure. Granular or “loose” surface structures within the same textural classes will present with characteristics of a “sandier” site than those soils with a vesicular crust or “hard” surface. Management implications will be clarified and the range of characteristics will be documented within the plant community tables.

The following is a State and Transition Model (STM) Diagram for this ecological site. An STM has five fundamental components: states, transitions, restoration pathways, community phases and community pathways. The state, designated by the bold box, is a single community phase or suite of community phases. The reference state is recognized as State 1. It describes the ecological potential and natural range of variability resulting from the natural disturbance regime of the site. The designation of alternative states (State 2, etc) in STMs denotes changes in ecosystem properties that cross a certain threshold.

Transitions are represented by the arrows between states moving from a higher state to a lower state (State 1 -> State 2) and are denoted in the legend as a “T” (T1-2). They describe the variables or events that contribute directly to loss of state resilience and result in shifts between states. Restoration pathways are represented by the arrows between states returning back from a lower state to a higher state (State 2 -> State1 or better illustrated by State 1 <- State 2) and are denoted in the Legend as an “R” (R2-1). They describe the management actions required to recover the state. Remediation is included.

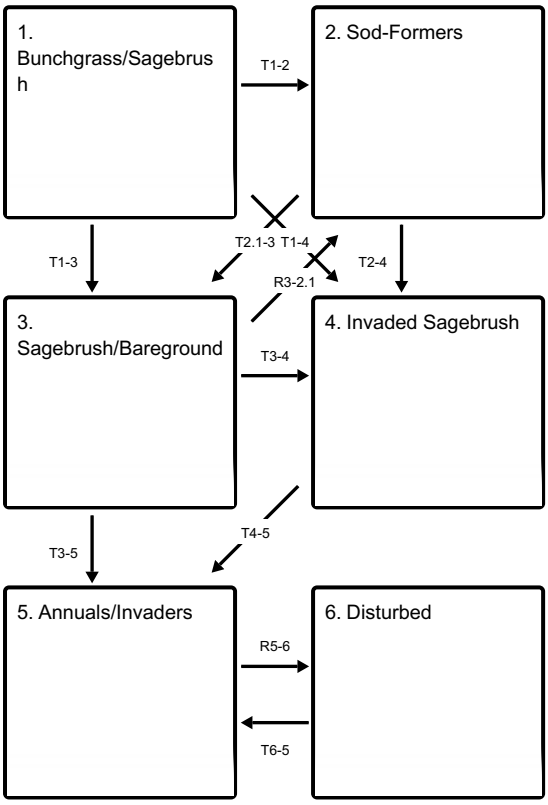
Community phases, small boxes within the bold state boxes, are generally have important management or ecological significance. Collectively, the community phases represent the range of variation within a state, including conditions that place the state at risk for transition. Community pathways are represented by the lighter arrows moving between community phases and are labeled with “CP” (CP1.1-1.2). They describe the causes of shifts between community phases. The community phases captured in this STM may not represent every possibility, but are the most prevalent and repeatable plant communities.

The specific ecological processes and community variability will be discussed in more detail in the plant community narratives following the diagram. The plant composition tables, shown within each community phase narrative, have been developed from the best available knowledge at the time of this revision. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added.

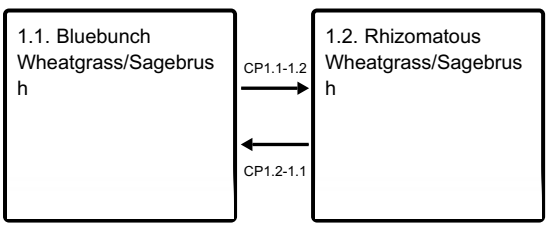
No plant communities should necessarily be thought of as “Desired Plant Communities”. According to the USDA NRCS National Range and Pasture Handbook, Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose for including any description of a plant community here is to capture the current knowledge and experience at the time of this revision.

State and transition model

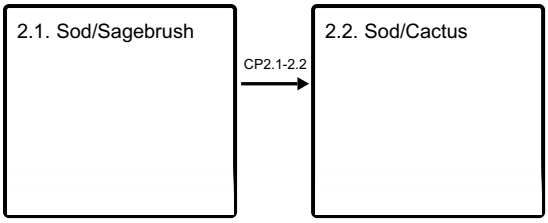
Ecosystem states



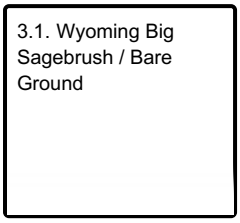
State 1 submodel, plant communities



State 2 submodel, plant communities

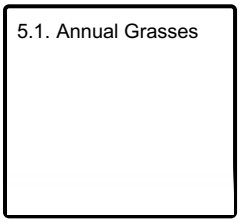


State 3 submodel, plant communities

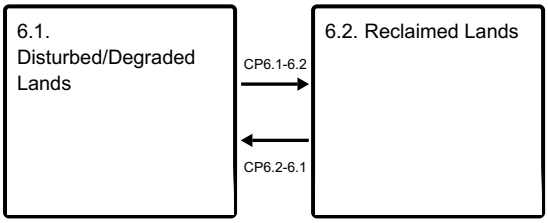


State 4 submodel, plant communities

State 5 submodel, plant communities



State 6 submodel, plant communities



State 1
Bunchgrass/Sagebrush

The reference state is characterized by the dominance of Wyoming big sagebrush, at 15% or less composition by weight, with a healthy, diverse mixture of Bluebunch wheatgrass, at 20% or less composition by weight with rhizomatous wheatgrasses, Western and Thickspike, as well as Indian ricegrass, Needleandthread, bottlebrush squirreltail, and to a minor extent sod-formers such as Threadleaf sedge and Blue grama.

Community 1.1
Bluebunch Wheatgrass/Sagebrush

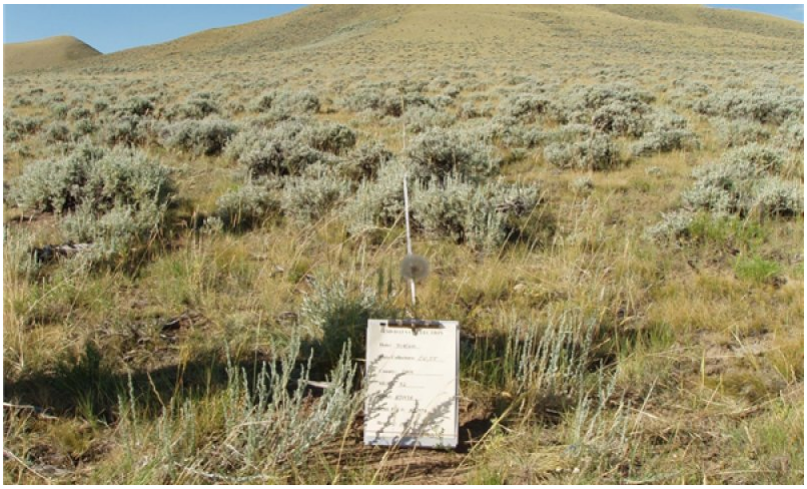


Figure 8. Reference site on upper boundary of Mesic 10-14"

This site, as the Reference community (1.1) for the ecological site, holds an interpretive value. The community can be found on areas that are still within the original scope of disturbance regimes (grazing by large herbivores and periodic fires, that by which the state evolved), or under properly managed locations with grazing and/or prescribed burning, with periodic short intervals of rest. The potential vegetation is about 75% grasses or grass-like plants, 10% forbs, and 15% woody plants. This state is dominated by cool season mid-stature grasses. The major grasses include Bluebunch wheatgrass, Western wheatgrass, Needleandthread, and Indian ricegrass. Other grasses occurring in this state include Thickspike wheatgrass, Sandberg bluegrass, and Bottlebrush squirreltail. A variety of forbs and half-shrubs also occur, as shown in the following table. Wyoming Big sagebrush is a conspicuous element of this state, occurring in a mosaic pattern, and making up 5 to 15% of the annual production. The total annual production (air-dry weight) of this state is about 500 lbs/acre, but it can range from about 275 lbs./acre in unfavorable years to about 650 lbs./acre in above average years. Diversity of the plant species found on this site allows for a high drought tolerance, lending this plant community to be well adapted for the limiting climatic conditions of the Big Horn Basin. The sustainability of this community is supported by the site/soil stability, watershed function, and biologic integrity. Without any major disturbance this site will remain extremely stable.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	263	420	488
Shrub/Vine	17	84	135
Forb	28	56	106
Total	**308**	**560**	**729**

Table 6. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-10%
Litter	26-65%
Surface fragments >0.25" and <=3"	0-9%
Surface fragments >3"	0-1%
Bedrock	0%
Water	0%
Bare ground	15-25%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-9%	–	0-5%
>0.15 <= 0.3	–	3-10%	–	–
>0.3 <= 0.6	–	–	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 10. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

Community 1.2
Rhizomatous Wheatgrass/Sagebrush

Figure 11. Rhizomatous Wheatgrass increases with high use

Figure 12. Loss of Sagebrush after fire, at-risk community

This community is found under moderate, season-long grazing by livestock or under areas affected by extended periods of drought. Historically, this community evolved under a low fire frequency and with grazing pressure. The fire regime for this site, currently, has been modified with extended periods of no fire. This disturbance change has allowed Wyoming big sagebrush to increase on the community, and although the community is still dominated by cool-season perennial grasses, the canopy has been opened to allow a stronger presence of short warm-season grasses and miscellaneous forbs to begin to hold a higher composition of the understory. Dominant grasses include Needleandthread and Western wheatgrass. Grasses and grass-like species of secondary importance include Blue grama, Sandberg bluegrass and Threadleaf sedge. Forbs commonly found in this plant community include Scarlet globemallow, Desert parsley, fleabanes, and phlox. Sagebrush can make up to 25% of the annual production. The overstory of sagebrush and understory of grass and forbs provide a diverse plant community. When compared to the Reference plant community 1.1, Wyoming big sagebrush and Blue grama have increased. Plains prickly pear cactus will also have increased, but occurs only in small patches. Indian ricegrass and Bluebunch wheatgrass have decreased and may occur in only trace amounts under the sagebrush canopy or within the patches of prickly pear. Wyoming big sagebrush is a noticeable part of the overall production and accounts for the majority of the overstory. In some instances, the sagebrush canopy has not increased in the number of plants, but as the understory production is reduced with the shift in species of dominance, the percent composition by production is skewed by the constant of sagebrush giving the appearance that sagebrush has increased when it has remained similar across the community transition. Soil/Site correlation data has shown that there is a small fraction of locations that have maintained the herbaceous canopy of the grasses and forbs found predominately on a 1.1 or a 1.2 plant community, but due to wildfire, brush management, or other unforeseen instances, such as insect damage, large expanses of sagebrush are no longer on sections of the landscape causing concern for land managers. These locations have the herbaceous cover, generally, that is required in order to ranked within the reference community; however, the shrub component, namely Wyoming big sagebrush, has been greatly reduced or removed from the landscape. Production exists to maintain the lower limits of what is described for this plant community, but are lower in general due to the lack of woody vegetative production. The locations sampled to document this community are on the margins of the soil temperature regime breaks and are unclear on the accuracy of which they are assigned soils. Until further documentation can be gathered, these sites will be included in narrative only. The total annual production (air-dry weight) of this state is about 450 pounds per acre, but it can range from about 250 lbs./acre in unfavorable years to about 550 lbs./acre in above average years. Rangeland Health Implications/Indicators: This plant community is resistant to change, but is the at-risk community for this state. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing, or by drought. The herbaceous component is mostly intact and plant vigor and replacement capabilities are sufficient. Water flow patterns and litter movement may be occurring but only on steeper slopes. Incidence of pedestalling is minimal. Soils are mostly stable and the surface shows minimum soil loss. The watershed is functioning and the biotic community is intact.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	207	370	392
Shrub/Vine	45	84	157
Forb	28	50	67
Total	**280**	**504**	**616**

Table 9. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	0%
Grass/grasslike basal cover	0%
Forb basal cover	0%
Non-vascular plants	0%
Biological crusts	0-4%
Litter	19-71%

Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	20-36%

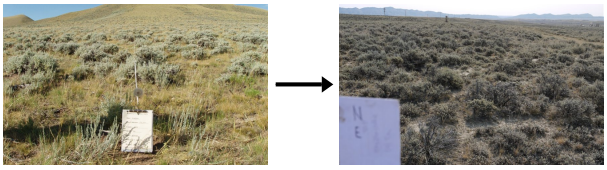
Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-2%	–	0-6%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	0-40%	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 14. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

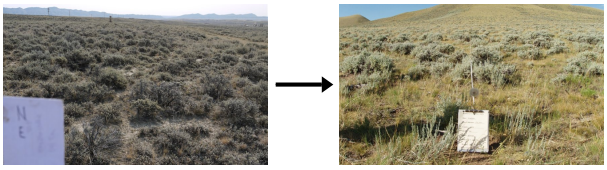
Pathway CP1.1-1.2
Community 1.1 to 1.2



Bluebunch Wheatgrass/Sagebrush **Rhizomatous Wheatgrass/Sagebrush**

Drought, Moderate Continuous Season Long Grazing – When this system is exposed to season long grazing with no rest, especially with the drought cycles that have occurred through the last twenty years, the community will transition to fewer bunchgrasses and will see the rhizomatous wheatgrasses and other perennial grasses such as the sod formers (Blue grama and Threadleaf sedge) as well as Sandberg bluegrass increase.

Pathway CP1.2-1.1
Community 1.2 to 1.1



Rhizomatous Wheatgrass/Sagebrush **Bluebunch Wheatgrass/Sagebrush**

Prescribed Grazing over time will allow this community to shift back to the reference Community. This may be a long term management strategy, with several years required before any trend towards reference is noticed. The

overstory of Wyoming big sagebrush may be the one factor that could require further management techniques to manipulate if it has truly increased from 15 to 25% or greater.

Conservation practices

Brush Management
Prescribed Burning
Integrated Pest Management (IPM)
Prescribed Grazing

State 2
Sod-Formers

The two dominant sod-forming species that currently exist within this LRU are Blue grama and Threadleaf sedge. Both are species that persist as a component of the perennial vegetation naturally (in reference communities) in the ecological site. The general tendency of these species is to increase under grazing pressure, becoming dominant. The species that gains dominance is unclear. But it appears to be dependent on one or a combination of three specific factors: the specific conditions that forced the transition; underlying soil characteristics for each site; or the species that is more prevalent in the community before the grazing disturbance occurred.

Community 2.1
Sod/Sagebrush

Figure 15. Threadleaf Sege/Blue grama dominated community

This plant community is the result of frequent and severe year-long grazing, which has adversely affected the perennial grasses as well as impacted the shrub component. The nature of the sod decreases infiltration of water with a thick shallow mat of roots, and tends to channelize runoff between established clumps of vegetation. This, with the lack of structure to hold moisture, compounded by drought can reduce the shrubs significantly on this site. A dense sod of Blue grama with patches of Threadleaf sedge is the major grass component of this community with only incidental occurrences of other native species. Prickly pear cactus can provide a niche for other perennial natives to persist in this community. Wyoming big sagebrush has been reduced to small patches or in some cases removed. When compared to the Reference Plant Communities 1.1 and 1.2, Blue grama and Threadleaf sedge, have increased. Prickly pear cactus has invaded. All cool-season mid-grasses, forbs, and most shrubs have been greatly reduced. Production has been significantly decreased. The total annual production (air-dry weight) of this state is about 100 lbs./acre, but it can range from about 55 lbs./acre in unfavorable years to about 150 lbs./acre in above average years. Rangeland Health Implications/Indicators: This community is at-risk of transitioning to a completely sod-bound community as explained above, as the sod is extremely resistant to change and continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of the sod-formers, but it will eventually remove the shrub component from the plant community. The biotic integrity of this state is not functional and plant diversity is extremely low. The plant vigor is significantly weakened and replacement capabilities are limited due to the reduced number of cool-season grasses. This sod-bound plant community is very resistant to water infiltration. While this sod protects the site itself, off-site areas are affected by

excessive runoff that can cause rills and gully erosion. Water flow patterns are obvious in areas of bare ground and pedestalling is apparent along the sod edges. Rill channels are noticeable in the interspaces and down slope. The watershed may or may not be functioning, as runoff may affect adjoining sites.

Figure 16. Plant community growth curve (percent production by month). WY0504, 5-9 BH Upland Sites Warm Season Dominate. Monthly percentages of total annual growth based on a predominately C4 warm season plant community with shrubs and some C3 plants. Generally sod-forming community..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	15	25	45	10	0	5	0	0	0

Community 2.2
Sod/Cactus

Figure 17. Loss of Sagebrush Canopy with sod forming grasses

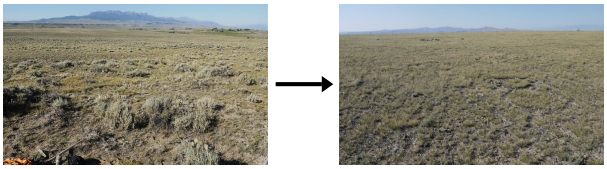
This plant community shift occurs relatively easily after the initial transition into a sod-former state through drought or continued pressure on the remaining shrubs. A dense sod of Blue grama with patches of Threadleaf sedge dominates this state. Prickly pear cactus can become dense enough in patches so that livestock cannot graze forage growing within the cactus clumps. Wyoming big sagebrush has been generally removed from the site with only isolated occurrences. Rubber rabbitbrush is significantly reduced, but is the remaining shrub on the site. When compared to the Reference Community, Blue grama and Threadleaf sedge, have increased. Prickly pear cactus has invaded. All cool-season mid-grasses, forbs, and most shrubs have been greatly reduced or removed. Production has been significantly decreased. The spring of 2014 has proven to provide information that this sight can carry significant production when conditions are optimal. The Big Horn Basin has been in an extended drought for the past 15 years. Blue grama over the last 5 years has shown the stress of this drought, through the loss of root mat, opening the canopy that has allowed other species to increase within these communities. Predominately, Sandberg bluegrass, Sixweeks fescue, and Cheatgrass are the main species increasing throughout the Big Horn Basin. The Cold, snow driven winter followed by a cool spring allowed Sandberg bluegrass to dominate within these opened Blue grama/ Threadleaf sedge sod communities increasing production by 200 to 400 lbs./acre of just Sandberg bluegrass. Other species were more prevalent as well, but the most noted variance is Sandberg bluegrass. This production value was excluded from the production data at this time until further analysis can be completed. The total annual production (air-dry weight) of this state is about 75 pounds per acre, but it can range from about 50 lbs./acre in unfavorable years to about 100 lbs./acre in above average years. Rangeland Health Implications/Indicators: This sod bound community is extremely resistant to change and continued frequent and severe grazing or the removal of grazing does not seem to affect the plant composition or structure of the plant community. The biotic integrity of this state is not functional and plant diversity is extremely low. The plant vigor is significantly weakened and replacement capabilities are limited due to the reduced number of cool-season grasses. This sod bound plant community is very resistant to water infiltration. While this sod protects the site itself, off-site areas are affected by excessive runoff that can cause rills and gully erosion. Water flow patterns are obvious in the bare ground areas and pedestalling is apparent along the sod edges. Rill channels are noticeable in the interspaces and down slope. The watershed may or may not be functioning, as runoff may affect adjoining sites.

Figure 18. Plant community growth curve (percent production by month).

WY0504, 5-9 BH Upland Sites Warm Season Dominate. Monthly percentages of total annual growth based on a predominately C4 warm season plant community with shrubs and some C3 plants. Generally sod-forming community..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	15	25	45	10	0	5	0	0	0

Pathway CP2.1-2.2
Community 2.1 to 2.2



Sod/Sagebrush **Sod/Cactus**

Intensive Brush Management, Fire, Frequent or Severe Grazing, Drought – The Wyoming big sagebrush component of this community is the at risk species. Sagebrush will decrease under drought, and if grazing pressures persist through season or year-long patterns, becoming decadent and then dying. The sod dominated community reduces the ability for sagebrush to propagate, also leading to a recession of sagebrush. Although rare in occurrence, due to lack of fine fuels and canopy cover, fire will remove the shrub canopy as well. In some cases on the edge of the precipitation break, Rubber rabbitbrush will dominate a site as sagebrush diminishes. It is also noted that with periods of drought that have occurred in the past ten years, there is a noted decrease in the health and vigor of Blue grama and Threadleaf sedge. The dense root structure of the sod-former plants is reduced allowing other species to establish. The spring of 2014 has shown a flush of Sandberg bluegrass occupying Blue grama communities, and in some instances appear to be the dominant production for that community.

State 3
Sagebrush/Bareground

Continued high intensity grazing or extended drought can reduce a community to a dominant cover of Wyoming big sagebrush with only small remnant populations of herbaceous cover residing under the canopy of sagebrush. This state can be exacerbated by insects, wildlife, and other human disturbances. Many times the canopy cover does not increase with this community, but the percent production is swayed by the decrease of herbaceous vegetation and the relative stability of woody species. Risk of wildfire within this state is minimal due to the lack of fine fuels within the understory. Depending on the pattern of use, trailing and other erosional patterns are highly visible in this state. The protection from wildfire can also trend the reference state to this state as sagebrush becomes dense and decadent reducing the ability for the herbaceous component to maintain vigor. As the herbaceous cover declines and then as the sagebrush cover is impacted this state will continue to degrade. There are many stages of this state, but only one clear community.

Community 3.1
Wyoming Big Sagebrush / Bare Ground

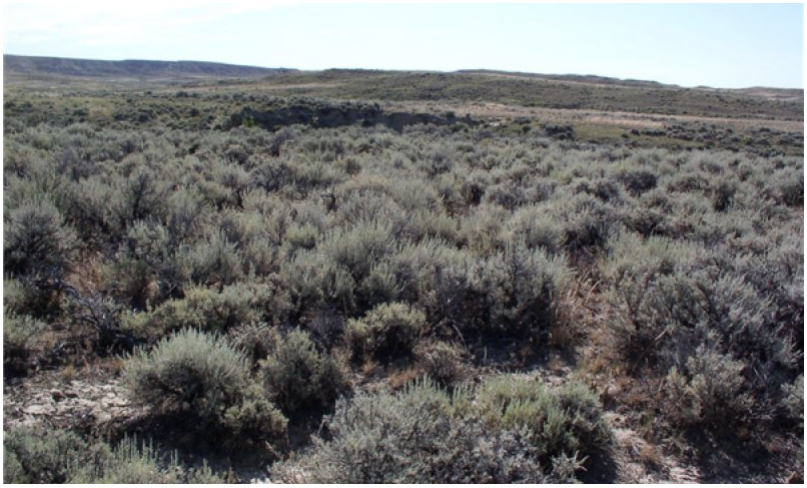


Figure 19. Sagebrush dominate after loss of understory due to drought

This plant community is the result of frequent and severe grazing and protection from fire. Sagebrush dominates this plant community, as the annual production of sagebrush exceeds 25%. Wyoming big sagebrush is a significant component of the plant community and the preferred cool season grasses have been eliminated or greatly reduced. The dominant grasses are Sandberg bluegrass and Blue grama. Prickly pear cactus often increases. The interspaces between plants have expanded leaving the amount of bare ground more prevalent. As compared with the Reference Plant community 1.1 or the state (State 1) in general, the annual production is similar, as the shrub production compensates for the decline in the herbaceous production. This community is vulnerable to invasive weeds such as Cheatgrass, Russian knapweed, leafy spurge, or Canada thistle; if a seed source is available. The total annual production (air-dry weight) of this state is about 300 pounds per acre, but it can range from about 200 lbs./acre in unfavorable years to about 400 lbs./acre in above average years. Rangeland Health Implications/Indicators: This plant community is resistant to change as the stand becomes more decadent, but is at-risk to the establishment of invasive species. These areas may actually be more resistant to fire as less fine fuels are available and the bare ground between the sagebrush plants is increased. Continued frequent and severe grazing or the removal of grazing does not seem to affect the composition or structure of the plant community. Plant diversity is moderate to poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably less when compared to the Reference Plant Community. Soil erosion is accelerated because of increased bare ground. Water flow patterns and pedestalling are obvious. Infiltration is reduced and runoff is increased. Rill channels may be noticeable in the interspaces and gullies may be establishing where rills have concentrated down slope.

Figure 20. Plant community growth curve (percent production by month). WY0501, 5-9BH Upland sites. Monthly percentages of total annual growth for all upland sites with dominantly C3 Cool season plants..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			15	50	20	5		10			

State 4
Invaded Sagebrush

Invasive plant species are a permanent concern with rangelands and rangeland management. Each year new species are discovered and will alter this section as they are identified. Currently within the Big Horn Basin there are several varieties of thistles, knapweeds, milkweeds, mustards and others that create a management issue for livestock and ecology. In areas where there has been a disturbance, natural or man-made, these species can gain a place in the landscape and are difficult to impossible to eradicate. Because of this it becomes a battle to maintain control with annual or prolonged management of the weed species, and preventing further shifts or changes to the native composition.

Community 4.1
Native Grasses/Invasives/Sagebrush

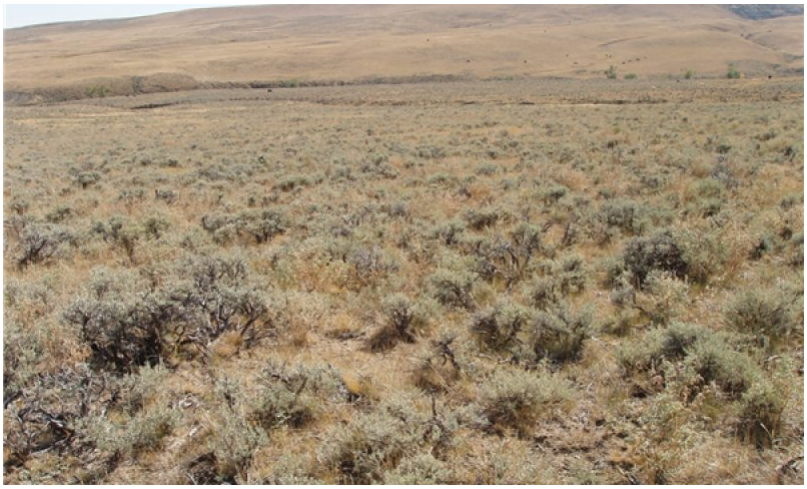


Figure 21. Native and Invasive species within the Sagebrush canopy

The Perennial Grasses/Invasive Species/Wyoming big sagebrush phase has maintained a representative sample of the perennial grasses and forbs that are typical of the site with the accompanying Wyoming big sagebrush composition. The invasive species are present and hold a significant (10% or greater) composition of the landscape, and are prominent on the site (referring to a more wide scale composition, not one isolated patch in an isolated portion of the landscape). Production of the desired perennial species of this site is generally reduced but the total production is maintained or elevated due to the production potential of many of the annual or invasive species. Rangeland Health Implications/Indicators: This plant community is resistant to change. These areas may be more prone to fire as fine fuels are more available and the bare ground between the sagebrush plants is decreased. Plant diversity is moderate to poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive species (species dependent). Soil erosion is variable depending on the species of invasion and the litter accumulation thus associated, this variability also applies to water flow patterns and pedestalling. Infiltration is reduced and runoff is increased due to loss of perennial vegetation and root density.

Figure 22. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

Community 4.2
Invasives/Sagebrush

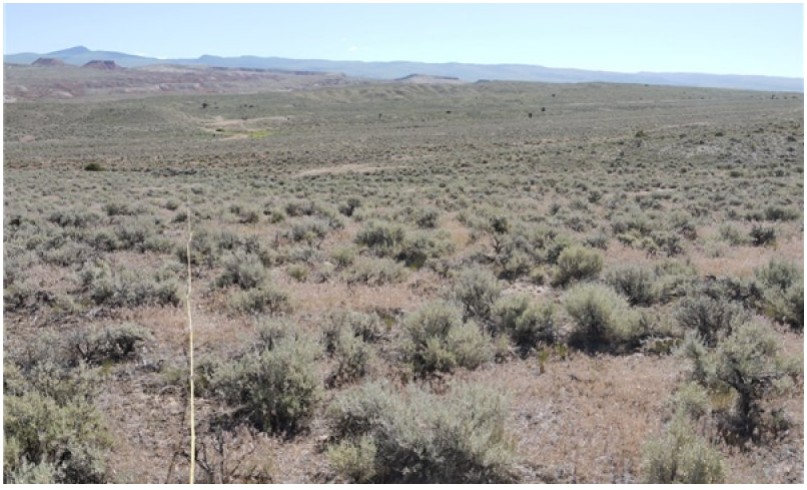


Figure 23. Cheatgrass dominates understory and interspaces of Sagebrush

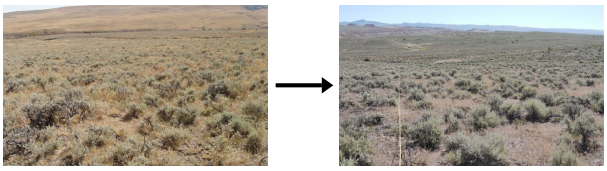
This community phase is the at-risk community. As the native populations of perennial grasses and forbs become

weakened, the site becomes invader driven, and irreversible. If environmental or management stressors or disturbances occur to remove the shrub component, the site crosses a threshold to State 5, Annual Grasses. Wyoming big sagebrush is able to compete and maintain a strong community under a heavy infestation level unless fire or disturbance of any nature weakens the plant. The canopy of the sagebrush serves as a protected niche in the system that can hold native grass species and help them to persist. But the system is low in resistance and even lower in resilience. Rangeland Health Implications/Indicators: This plant community is resistant to change as the stand becomes more decadent. These areas may be more prone to fire as fine fuels are more available and the bare ground between the sagebrush plants is decreased. Plant diversity is poor. The plant vigor is diminished and replacement capabilities are limited due to the reduced number of cool-season grasses. Plant litter is noticeably more when compared to reference communities due to the potential biomass produced by the invasive species (species dependent). Soil erosion is variable depending on the species of invasion and the litter accumulation thus associated. The variability of the water flow and pedestalling as well as infiltration and runoff is determined again by the species that establishes on this site.

Figure 24. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

Pathway CP4.1-4.2
Community 4.1 to 4.2



Native Grasses/Invasives/Sagebrush **Invasives/Sagebrush**

Frequent or Severe Grazing, Wildfire, Drought – Drought, wildfire, or other climatic stresses on the system can continue to stress the native species reducing their ability to maintain their footprint in the plant community. This continued stress or the complication with frequent or severe grazing or pressure from wildlife and livestock can reduce the natives to an unviable or unsustainable population and allow the invasive species to dominate the site. This is more typical in species such as knapweeds, Canada or Bull thistle, and specifically Cheatgrass (Downy brome).

State 5
Annuals/Invaders

Currently throughout the Big Horn Basin, Cheatgrass or Downy brome (*Bromus tectorum*) is an annual grass invader that has concerned land managers. Currently there are three other major invader species of forbs that are becoming dominant in areas of the landscape; however, Cheatgrass is the species that is taking large acres of land quickly in this region. Knapweed, namely spotted; White top or hoary cress, also became dominate in large dense stands and produces their own set of challenging management issues. As more species are found within the Big Horn Basin or as other species become more prevalent in large scale communities, this section will need to shift to meet the concerns of these species. But with the persistence of Cheatgrass and the lack of a successful control agent at this time, it is not conceivable that Cheatgrass will go away or become less of a management challenge. This state is characterized by the lack of all or most of the shrub component. Extended periods of drought alone or in combination with insect damage or wildfire has removed Wyoming big sagebrush from this community. The competitive nature of annuals, the altered fire regime created by Cheatgrass, and the effect of the loss of the shrub component itself creates an environment that does not support the propagation of new shrub species.

Community 5.1
Annual Grasses

Figure 25. Cheatgrass Invasion following Wildfire

Downy Brome, better known as Cheatgrass or *Bromus tectorum*, is able to green up and grow late into the fall taking advantage of the fall moisture. Seed lays dormant until conditions are positive, allowing growth before most native species. The plant's ability to grow quickly utilizes the minimal available resources before the native species can begin to break dormancy for the season. The ability for Cheatgrass to produce a large quantity of seeds quickly, and in poor conditions, as well as the morphology of the seed allowing easy dispersal creates a wide spread seed bank that is unmanageable. These traits create a management challenge that has not been successfully met at this time. Once this species has a niche on a landscape it is resistant and resilient to change. There may be native species that will persist in small scattered populations and under certain climatic conditions can show their resiliency and respond to the available resources, but generally found unable to out-compete the annual invader. Through the winter of 2013, and spring of 2014, Cheatgrass was seen to green up with fall moisture, and then lay dormant under a blanket of snow that lasted through most of the winter months. As the soil warmed and the soils thawed with spring melt, the Cheatgrass grew, developing a seed-head and coming to maturation as a second round of Cheatgrass was just beginning to bolt, preparing to develop a seed head. Large expanses of Cheatgrass were designated by the three colors of maturity across the landscape, with the tans of the fall crop, purples of the early spring round, and then the green of the final spring flush of Cheatgrass. Rangeland Health Implications/Indicators: This plant community is resistant to change. These areas are extremely prone to fire fueled by the high fine fuels load associated with the Cheatgrass litter. Plant diversity is poor. The plant vigor is diminished and replacement capabilities are non-existent due to the loss of cool-season grasses. Plant litter is noticeably more when compared to reference communities in response to the dense duff layer created by Cheatgrass. Soil erosion is generally reduced in response to the litter accumulation; however, the annual nature of this plant accentuates the water flow patterns and pedestalling. Infiltration is reduced and runoff is increased with the loss of perennial vegetation and root depth and density.

Figure 26. Plant community growth curve (percent production by month). WY0505, 5-9 BH Upland Sites, Annual Grasses Dominate. Monthly percentages of total annual growth, based on plant communities being affected by annual grasses (cheatgrass) or similar weedy species..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	25	45	5	0	0	10	5	5	0

State 6
Disturbed

The Disturbed or degraded state could be drafted as a stand-alone box within the state and transition model diagram. No matter what state a site originally is ranked in, once the site is mechanically disturbed, or suffers a catastrophic or significant natural disaster that alters the soil properties (erosional, depositional, hydrological or chemical), the site potential is altered. To consider this as an alternate ecological site would not be unreasonable. In some cases (site by site consideration), a re-correlation of a location may be the best solution. But in many cases, the site has not been altered out of the current site, but the potential has shifted enough that it is no longer truly comparable to the reference community. So a dynamic state was captured to detail the altered communities that exist on the landscape.

Community 6.1
Disturbed/Degraded Lands

The altered functionality of the site(erosional, depositional, hydrological or chemical), altered the site potential. Site by site consideration needs to be completed to know what the level of affect has occurred on the area. The growth curve of this plant community will vary depending on the species that are selected as the reclamation seed mix. For a more accurate portrait of the growth curve for the seeded community, the species used and the climatic tendencies of the region must be considered. Rangeland Health Implications/Indicators: The plant community is variable and depending on the age of the stand and the stage of successional tendencies that the location is in will determine how stable (resilient/resistant) the community is. Plant diversity is generally strong, but is usually lacking in the structural groups that are desired on the site. Soil erosion is variable depending on the disturbance regime that is occurring on the site and again on the specific community that has established on a specific location. The variability of the water flow and pedestalling as well as infiltration and runoff is determined again by the species that establishes on this site.

Community 6.2
Reclaimed Lands

Shifts in reclamation practices over the last several decades have altered the success and stability of reclaiming a site. Crested wheatgrass was a species used frequently for reclamation throughout Wyoming and many of these communities persist today. These stands are stable and generally persist as a monoculture until a disturbance creates a niche for native species to establish. Crested wheatgrass is crawling out into native communities as readily as native species are moving into the crested wheatgrass stands. Russian wildrye and varieties of rhizomatous and bunch-wheatgrasses are used in mixes to help increase establishment on these sites. Although the success of vegetative seedings are low in this LRU, due to the variable precipitation and timing of precipitation events, limited areas along pipeline corridors, well sites or pad sites, and along transportation corridors have succeeded. Current interpretations of reclaimed or restored refers to the establishment of native species in a composition as close to a natural (pre-disturbance) plant community as possible. This excludes the use of non-native species and allows for a more similar ecological response than what is expected with non-native species. Again, these plantings will not replicate the reference community in response to management due to the change in soil dynamics with mechanical disturbance, seedbed preparation and seeding, but they can be very similar. The growth curve of this plant community will vary depending on the species that are selected as the reclamation seed mix. For a more accurate portrait of the growth curve for the seeded community, the species used and the climatic tendencies of the region must be considered. Rangeland Health Implications/Indicators: Seeding mixtures will determine the plant community resistant to change and resilience to threat of invasive species and to erosion. Many of the stands established during seeding are diversity poor, but are better than the monocultures that were planned historically. Many seeded sites may be prone to fire because of the increased production as they mature (more biomass and possibly more litter) providing more fine fuels to carry a fire. Soil erosion is variable depending on the establishment of the seeding, how it is seeded, and mechanical procedures put in place. The variability of the water flow and pedestalling as well as infiltration and runoff is determined again by the species that establishes on this site.

Pathway CP6.1-6.2
Community 6.1 to 6.2

Seeding, Brush Management, Integrated Pest Management, Prescribed grazing management – With the proper mechanical improvements and the follow-up through establishment and then maintenance, a disturbed site can be improved and managed. However, climatic limitations and soil chemistry limit the success of seeding treatments. Depending on the site location, invasive species are a risk to most sites within the Basin and create a low success potential for this process.

Conservation practices

Brush Management
Prescribed Burning
Grazing Land Mechanical Treatment
Range Planting

Heavy Use Area Protection
Integrated Pest Management (IPM)
Early Successional Habitat Development/Management
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control

Pathway CP6.2-6.1
Community 6.2 to 6.1

No use, No Fire, Long Term Prescribed Grazing, Frequent or Severe Grazing. In general, if a site is not maintained with the conditions of which the species are adapted under, a decline in vigor will occur and then a shift in composition will occur. Since the site is altered from reference state in soils due to plowing, mining, or other similar disturbances, the plant community will not follow the same expected shifts of a native community and this will refer back to a community more reflective of a disturbed plant composition.

Transition T1-2
State 1 to 2

Frequent Grazing (Yearlong), Brush Management or Fire with Drought – With time, or acerbated with drought, severe and frequent grazing of this plant community will reduce the bunchgrasses and wheatgrasses, and will allow the short statured warm-season grasses to become dominant. In some cases, Threadleaf sedge will become dominant, or will be equally competitive in the community. When the Sagebrush component of this community has been affected, by drought or heavy use, or has been removed altogether, this transition has a high probability of occurrence on the landscape. Season of use and intensity of grazing (time and timing) may also have an effect on this transition or may help reduce the risk of this transition.

Transition T1-3
State 1 to 3

T1B - Frequent and severe Grazing, No Fire, Drought - will convert the plant community to the Wyoming Big Sagebrush/*Bare Ground* Plant Community. The probability of this occurring is high. This is especially evident on areas with historically higher precipitation and the sagebrush stand is not adversely impacted by drought or heavy browsing. Drought or shifts in spring precipitation can create this community on locations with a high dominance of Needleandthread. In a normal precipitation pattern, Needleandthread is constant and productive on a reference site. When the spring is cooler or drier than needed for Needleandthread to thrive, the site will have significant reduction in production and show more bare ground or a more open canopy.

Transition T1-4
State 1 to 4

Frequent and severe Grazing, Fire, Drought or Insect Damage and Disturbances with a seed source present - The influence of fire and other disturbances in these communities opens the canopy for invaders such as Cheatgrass (Downy brome), thistles, knapweeds, and other invasive species to become established. Drought alone, or if acerbated by fire, will also create the perfect conditions for invasion of the plant community. It has been documented across the Big Horn Basin with trend photos, that as the drought persists, Cheatgrass has increased exponentially each year, starting along roadways or disturbed areas and then radiating out from there.

Transition T2.1-3
State 2 to 3

Drought, Frequent or severe grazing – Drought alone, or with continued high levels of grazing pressure can diminish the vigor and persistence of Blue grama and Threadleaf sedge. With continued stress or pressure, more bare ground is seen in the community and the persisting plants tend to be only under the existing canopy of

Wyoming Big Sagebrush.

Transition T2-4
State 2 to 4

Fire (wild or prescribed), Brush Management, Drought, Frequent or severe grazing, Disturbance with a seed source - With the loss of vegetative structure, as Wyoming big sagebrush recedes in this community, it intensifies the drought effect on the plants and will assist in opening more bare ground, making the community vulnerable to invasion by annuals and invasive species. By adding further disturbances or a readily available seed source, the risk of transitioning to this state are extreme.

Restoration pathway R3-2.1
State 3 to 2

Long Term Prescribed Grazing, Brush Management - In this system, as the brush is managed and the stress on plants is reduced, the dominant plant or seed source will dictate the direction of recovery. In many of these communities the sod forming species are able to persist in the environment and with the increased resource they will be the first to re-establish a site leading to a recovery from bare ground and sagebrush to a sod dominated community, which will take further inputs to transition up to reference.

Conservation practices

Brush Management
Prescribed Burning
Integrated Pest Management (IPM)
Prescribed Grazing

Transition T3-4
State 3 to 4

Frequent or Severe Grazing, Brush Management, Wildfire, Drought, or No Use – Disturbance from grazing or brush management, or fire can open the canopy and provide a seed source for invasive species to establish, such as knapweed, Cheatgrass, and others. No use can also lead to decadence and loss of vigor in the community opening the canopy, leading to a risk from invaders. The amount of bare ground and the lack of perennial grasses lends to a vulnerable plant community.

Transition T3-5
State 3 to 5

Fire (wild or prescribed), Brush Management, Drought, Frequent or severe Grazing – When a disturbance decreases and then removes the sagebrush canopy of this site, the perennial grasses and forbs that are established are not able to protect or stabilize the site and it is extremely vulnerable to Cheatgrass invasion, especially following fire and drought, if a seed source is present. With the increased fire frequency as Cheatgrass establishes in a community, it leads to the removal of sagebrush and other shrubs; allowing for a monoculture stand of Cheatgrass.

Transition T4-5
State 4 to 5

Fire (wild), Frequent or severe grazing, Drought with Insect Damage / Brush Management. – The threshold species in this system is the Wyoming big sagebrush, which is providing a niche for the perennial natives to persist in the landscape. Once the sagebrush is affected by the altered (shortened) fire frequency of this state due to the invasive species (primarily Cheatgrass), or with the persistence of drought or other environmental stresses such as insects, and frequent or severe grazing, then this niche begins to fade or can be taken rather suddenly in the case of a fire. Once the sagebrush has died back or has been removed by fire it is very difficult to return and may require several years (25 years or greater) to return or may not without outside assistance.

Restoration pathway R5-6
State 5 to 6

Integrated Pest Management, with Seeding the site to a native mixture - Success is not known to have occurred, and is rated to be low and highly variable for the rate of control of most species. Cheatgrass and knapweeds are two of the most invasive species for many of these sites but there are many others, for example, Halogeton, that can dominate these sites. It is a consensus that the site in theory could be brought to a community that looks similar to an at-risk community within the reference state, but that it is not possible to reach the reference community condition once annuals have established on a site. But this community and the risk of the site will never allow it to react the same to management and environmental change the same as a truly native community and so remains in a reclaimed stated.

Conservation practices

Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Upland Wildlife Habitat Management
Early Successional Habitat Development/Management
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control

Transition T6-5
State 6 to 5

No Use, Fire (wild or prescribed), Frequent or severe Grazing, Drought with Seed source Present – Extended periods of no use allow plants to become decadent, with a large proportion of dead growth persisting around the crown of the plants; reducing vigor and production. This creates a vulnerability to weed invasions. Frequent or sever grazing or drought as well can open the community to invasion by several weedy species, transitioning the site to an invaded state.

Additional community tables

Table 11. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				50–219	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	50–219	10–30
2	**Rhizomatous Wheatgrasses**			50–112	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	50–112	10–15
	western wheatgrass	PASM	*Pascopyrum smithii*	50–112	10–15
3				50–146	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	50–146	10–20
	needle and thread	HECO26	*Hesperostipa comata*	50–146	10–20
4	**Miscellaneous Grasses/Grasslikes - Primary**			11–28	
	squirreltail	ELEL5	*Elymus elymoides*	6–28	1–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	6–28	1–5

	Sandberg bluegrass	POSE	*Poa secunda*	6–28	1–5
5	**Miscellaneous Grasses/Grasslikes - Secondary**			0–22	
	blue grama	BOGR2	*Bouteloua gracilis*	0–22	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–22	0–5
6	**Other Native Perennial Grasses**			0–34	
	Grass, perennial	2GP	*Grass, perennial*	0–34	0–5
Forb					
7	**Primary Perennial Forbs**			11–56	
	textile onion	ALTE	*Allium textile*	1–22	1–5
	aster	ASTER	*Aster*	1–22	1–5
	milkvetch	ASTRA	*Astragalus*	1–22	1–5
	fleabane	ERIGE2	*Erigeron*	1–22	1–5
	desertparsley	LOMAT	*Lomatium*	1–22	1–5
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	1–22	1–5
8	**Secondary Perennial Forbs**			6–22	
	sandwort	ARENA	*Arenaria*	0–22	0–5
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–22	0–5
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–22	0–5
	little larkspur	DEBI	*Delphinium bicolor*	0–22	0–5
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–22	0–5
	skeletonplant	LYGOD	*Lygodesmia*	0–22	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–22	0–5
	silky phacelia	PHSE	*Phacelia sericea*	0–22	0–5
	yellow salsify	TRDU	*Tragopogon dubius*	0–22	0–5
	Nuttall's violet	VINU2	*Viola nuttallii*	0–22	0–5
9	**Other Perennial Native Forbs**			0–22	
	Forb, perennial	2FP	*Forb, perennial*	0–22	0–5
10	**Annual Forbs**			0–6	
	madwort	ALYSS	*Alyssum*	0–6	0–1
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–6	0–1
Shrub/Vine					
11				22–106	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	22–106	5–15
12	**Secondary Shrubs**			6–22	
	prairie sagewort	ARFR4	*Artemisia frigida*	6–22	1–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–22	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–22	0–5
13	**Miscellaneous Shrubs**			0–6	
	Shrub, other	2S	*Shrub, other*	0–6	0–1
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–6	0–1
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–6	0–1

Table 12. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrasses**			28–151	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	28–151	10–30
	western wheatgrass	PASM	*Pascopyrum smithii*	28–151	10–30
2	**Primary Bunchgrasses**			56–224	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	28–101	5–20
	needle and thread	HECO26	*Hesperostipa comata*	28–101	5–20
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–101	0–20
3	**Miscellaneous Grasses - Primary**			6–56	
	squirreltail	ELEL5	*Elymus elymoides*	6–56	2–10
	prairie Junegrass	KOMA	*Koeleria macrantha*	6–56	2–10
	Sandberg bluegrass	POSE	*Poa secunda*	6–56	2–10
4	**Miscellaneous Grasses - Secondary**			0–28	
	blue grama	BOGR2	*Bouteloua gracilis*	0–28	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–28	0–5
5	**Other Native Perennial Grasses**			0–22	
	Grass, perennial	2GP	*Grass, perennial*	0–22	0–5
Forb					
6	**Perennial Forbs - Primary**			22–56	
	textile onion	ALTE	*Allium textile*	1–28	1–5
	aster	ASTER	*Aster*	1–28	1–5
	milkvetch	ASTRA	*Astragalus*	1–28	1–5
	fleabane	ERIGE2	*Erigeron*	1–28	1–5
	desertparsley	LOMAT	*Lomatium*	1–28	1–5
	spiny phlox	PHHO	*Phlox hoodii*	1–28	1–5
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	1–28	1–5
7	**Perennial Forbs - Secondary**			6–28	
	sandwort	ARENA	*Arenaria*	0–28	0–5
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–28	0–5
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–28	0–5
	little larkspur	DEBI	*Delphinium bicolor*	0–28	0–5
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–28	0–5
	skeletonplant	LYGOD	*Lygodesmia*	0–28	0–5
	silky phacelia	PHSE	*Phacelia sericea*	0–28	0–5
	yellow salsify	TRDU	*Tragopogon dubius*	0–28	0–5
	Nuttall's violet	VINU2	*Viola nuttallii*	0–28	0–5
8	**Succulents**			6–17	
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–34	0–7
9	**Other Perennial Forbs**			0–6	
	Forb, perennial	2FP	*Forb, perennial*	0–6	0–1
10	**Annual Forbs**			0–6	
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–6	0–1
	woolly plantain	PLPA2	*Plantago patagonica*	0–6	0–1

	woolly plantain	PLPA2	*Plantago patagonica*	0–6	0–1
Shrub/Vine					
11	**Primary Shrub**			28–129	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	28–129	10–25
13	**Secondary Shrubs**			0–28	
	prairie sagewort	ARFR4	*Artemisia frigida*	6–28	1–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–28	0–5
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–28	0–5
14	**Miscellaneous Shrubs**			0–11	
	Shrub, other	2S	*Shrub, other*	0–6	0–1
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–6	0–1
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–6	0–1

Animal community

Animal Community – Wildlife Interpretations:

1.1 - Bluebunch Wheatgrass/Rhizomatous Wheatgrasses/Needleandthread/Wyoming Big Sagebrush (Reference Community): The predominance of grasses in this plant community favors grazers and mixed-feeders, such as 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. 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 meadowlarks, horned larks, and golden eagles. Many grassland obligate small mammals would occur here.

1.2 - Rhizomatous Wheatgrasses/Perennial Grasses/Sod formers/Wyoming Big Sagebrush Plant Community: The combination of an overstory of sagebrush and an understory of grasses and forbs provide a very diverse plant community for wildlife. The crowns of sagebrush tend to break up hard crusted snow on winter ranges, so mule deer 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.

2.1 - Blue Grama/Threadleaf Sedge/Wyoming Big Sagebrush Plant Community: This community provides limited foraging for antelope and other grazers. They may be used as a foraging site by sage grouse where reference state community phases are limited. Generally, these are not target plant communities for wildlife habitat management.

2.2 - Blue Grama/Threadleaf Sedge Sod/Cactus Plant Community: This community provides limited foraging for antelope and other grazers. They may be used as a foraging site by sage grouse if proximal to woody cover and if the Reference Plant Community or the Rhizomatous wheatgrasses/Perennial Grasses/Sod-formers/Wyoming Big Sagebrush Plant Community are limited. Generally, these are not target plant communities for wildlife habitat management.

3.1 - Wyoming Big Sagebrush/*Bare Ground* 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 excellent escape and thermal cover for large ungulates, as well as nesting habitat for sage grouse.

4.1 - Perennial Grasses/Invasive Species/Wyoming Big Sagebrush Plant Community: The retained combination of sagebrush and the added diversity with the invasive grasses and/or forbs provide an extended plant community for wildlife. The similarities to Community Phase 1.2 (Rhizomatous Wheatgrasses/Perennial Grasses/Sod formers/Wyoming Big Sagebrush) are to some extent enhanced for some species with the added forage provided by the invasive species. But as the invasive species increase, decreasing the desirable species, the wildlife species benefits are decreased as well.

4.2 - Invasive Species/Wyoming Big Sagebrush Plant Community: Limited nesting and cover is provided by the persistent overstory cover of the Wyoming big sagebrush.

5.1 - Annual Grasses Plant Community: Early spring and fall green up of Cheatgrass provides foraging opportunities for many of our grazers and mixed feeders.

6.1 - Disturbed Lands Plant Community and 6.2 - Restored/Reclaimed Lands Plant Community: The variability of this site prevents a detailed review of wildlife benefits. However, many of the introduced grasses, forbs and shrubs can provide adequate cover, feed and nesting sites for those wildlife species that would have selected the site prior to disturbance. Limitations and enhancements need to be considered by specific locations.

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*

The Carrying capacity is calculated as the production for a normal year X .25 efficiency factor / 912.5 #/AUM to calculate the AUM's/Acre.

Plant Community Description/Title: Lbs./Acre AUM/Acre
1.1 Bluebunch Wheatgrass/Rhizomatous Wheatgrasses/Needleandthread/Wyoming Big Sagebrush 275-600 0.13
1.2 Rhizomatous Wheatgrasses/Perennial Grasses/Wyoming Big Sagebrush 250-550 0.12
2.1 Blue Grama/Threadleaf Sedge/Wyoming Big Sagebrush 55-150 0.03
2.2 Blue Grama/Threadleaf Sedge Sod/Cactus 50-100 0.02
3.1 Wyoming Big Sagebrush/*Bare Ground* 200-400 0.08
4.1 Perennial Grasses/Invasive Species/Wyoming Big Sagebrush ** **
4.2 Invasive Species/Wyoming Big Sagebrush ** **
5.1 Annual Grasses ** **
6.1 Disturbed Lands ** **
6.2 Restored/Reclaimed Lands ** **

* - 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 moderately slow to moderate. Runoff potential for this site varies from low to moderate 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. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non- existent. Cryptogrammic 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 which bloom from spring until fall have an aesthetic value that appeals to visitors. Outside of plants, the extent offers a variety of Culture Resources to view on the landscape based on the location of many of these sites on higher ground on the benches and fans which also provides a rich source of geology for exploration. The extent of this ecological site is found within three different wild horse use areas; Pryor Mountain, McCullough Peaks, and 15 Mile. Wild horse/Wildlife Excursions are found as recreational venues for BLM lands and State lands within the Big Horn Basin. This ecological site has minimal limitations when associated with Roadways and Trails, and provides a sound base for travel and camping in relation to erosion potential and functionality.

Wood products

No appreciable wood products are present on the site.

Other products

Herbs: The forb species of the Loamy 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 in the original site description was derived from NRCS inventory data. Field observations from range trained personnel were also used. Those involved in developing the original site include: Chris Krassin, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist. 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 3, and USDA NRCS Soil Surveys from various counties.

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 developing the Loamy range site include: Chris Krassin, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist.

Those involved in the development of the new concept for Loamy and Loamy Calcareous Ecological site include: Ray Gullion, Area Range Management Specialist, NRCS; Jim Wolf, Resource Manager, USDI-BLM; Jack Mononi, Range Management Specialist, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS.

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 Joranada Research Center, NM.)

Type locality

Location 1: Park County, WY	
Township/Range/Section	T48N R100W S33
UTM zone	N
UTM northing	4883386
UTM easting	671512
Latitude	44° 5′ 0″
Longitude	108° 51′ 28″
General legal description	589 m North, 236 m west of SE corner. Go 9.2 mi south on Hwy 120 from Meeteetse, WY. Turn West on Little Buffalo Basin Rd. Go 5.3 mi., turning north on oil field access road. Go 0.45 mi. taking west fork, follow for 1.4 miles to site.

Other references

Bestelmeyer, B., and J. R. Brown. 2005. State-and-transition models 101: a fresh look at vegetation change. The Quivira Coalition Newsletter, Vol. 7, No. 3.
Bestelmeyer, B., J. R. Brown, K. M. Havstad, B. Alexander, G. Chavez, J. E. Herrick. 2003. Development and use of state and transition models for rangelands. Journal of Range Management 56(2):114-126.
Bestelmeyer, B., J. E. Herrick, J. R. Brown, D. A. Trujillo, and K. M. Havstad. 2004. Land management in the American Southwest: a state-and-transition approach to ecosystem complexity. Environmental Management 34(1):38-51.
Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume I Quick Start. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.
Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume II: Design, supplementary methods and interpretation. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.
NRCS. 2014. (electronic) National Water and Climate Center. Available online at http://www.wcc.nrcs.usda.gov/
NRCS. 2014. (electronic) Field Office Technical Guide. Available online at http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=WY
NRCS. 2009. Plant Guide: Cheatgrass. Prepared by Skinner et al., National Plant Data Center.
Pellant, M., P. Shaver, D. A. Pyke, and J. E. Herrick. 2005. Interpreting indicators of rangeland health. Version 4. Technical Reference 1734-6. USDI-BLM.
Ricketts, M. J., R. S. Noggles, and B. Landgraf-Gibbons. 2004. Pryor Mountain Wild Horse Range Survey and Assessment. USDA-Natural Resources Conservation Service.
Schoeneberger, P. J., D. A. Wysocki, E. C. Benham, and Soil Survey Staff. 2012. Field book for describing and sampling soils, Version 3.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE. (http://soils.usda.gov/technical/fieldbook/)
Stringham, T. K. and W. C. Krueger. 2001. States, transitions, and thresholds: Further refinement for rangeland applications. Agricultural Experiment Station, Oregon State University. Special Report 1024.

Stringham, T. K., W. C. Kreuger, and P. L Shaver. 2003. State and transition modeling: an ecological process approach. Journal of Range Management 56(2):106-113.
United States Department of Agriculture. Soil Survey Division Staff. 1993. Soil Survey Manual, United States Department of Agriculture Handbook No. 18, Chapter 3: Examination and Description of Soils. Pg.192-196.
USDA, NRCS. 1997. National Range and Pasture Handbook. (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html)
Trlica, M. J. 1999. Grass growth and response to grazing. Colorado State University. Cooperative Extension. Range. Natural Resource Series. No. 6.108.
U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS). 2007. The PLANTS Database (http://plants.usda.gov). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS), Soil Survey Staff. 2010. Keys to Soil Taxonomy, Eleventh Edition, 2010.
USDA/NRCS Soil survey manuals for appropriate counties within MLRA 32X.
Western Regional Climate Center. (2014) (electronic) Station Metadata. Available online at: http://www.wrcc.dri.edu/summary/climsmwy.html.

Approval

Scott Woodall, 2/22/2019

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)	Marji Patz, Ray Gullion
Contact for lead author	marji.patz@wy.usda.gov or 307-754-9301 X 118
Date	07/18/2014
Approved by	Rick L. Peterson
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rare to nonexistent. Where present, short and widely spaced.

---

2. **Presence of water flow patterns:** Barely observable.

---

3. **Number and height of erosional pedestals or terracettes:** Rare to nonexistent.

---

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 20-30%.

---

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.

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter expected to move only in small amounts (to leeward side of shrubs). Large woody debris from sagebrush will show no movement.

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 1 (interspaces) to 6 (under plant canopy), but average values should be 3.0 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. Described A-horizons vary from 1-12 inches (3-30 cm) with OM of 1 to 2%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The plant community consists of 60-75% grasses, 10% forbs and 15-30% shrubs. Evenly distributed plant canopy (35-55%) and littler plus moderate to moderately rapid infiltration rates result in minimal runoff. Basal cover is typically less than 5% for this site and does very little to effect runoff on this site.

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=cool season rhizomatous grasses>>

    Other: perennial forbs>short cool season bunchgrasses

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence, typically associated with shrub component of the canopy cover.

14. **Average percent litter cover (%) and depth (in):** Litter ranges from 15-40% of total canopy measurement with total litter (including beneath the plant canopy) from 30-70% expected. Herbaceous litter depth typically ranges from 3-10mm. 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: 275 - 650 lbs/ac (500 lbs/ac average); Metric: 308 - 729 kg/ha (560.5 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:** The increase of bare ground above 50% is an indicator that a threshold is being crossed. Corresponding increase will be noted in one or more of the following species is common: Blue grama, Sandberg bluegrass, Wyoming big sagebrush, buckwheats, and Spiny phlox. Annual weeds such as kochia, mustards, Lambsquarter, Russian thistle, and pepperweeds are common invasive species in disturbed sites. Common noxious weeds that invade are: Cheatgrass (Downy brome), knapweeds, thistles (Bull, Canada), Houndstongue, Black henbane and Whitetop.

---

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