USDA Natural Resources Conservation Service

Ecological site DX032X01B123
Loamy Calcareous (LyCa) Big Horn Basin Rim

Last updated: 2/22/2019
Accessed: 05/19/2024

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.

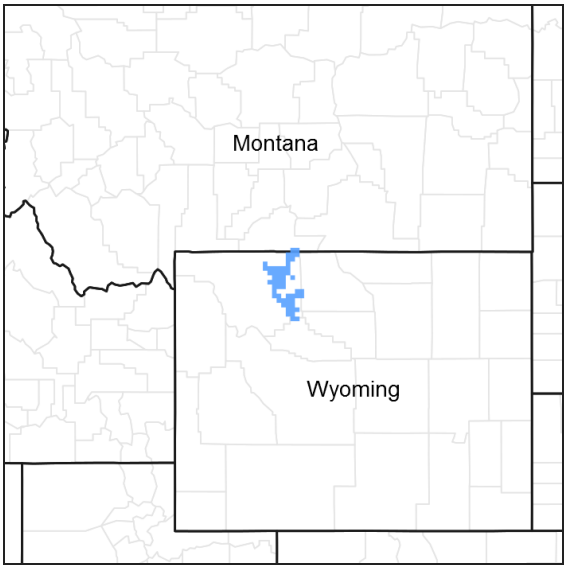


Figure 1. Mapped extent

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

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

A differentiating break in vegetation or response for this ecological site has not been identified between Big Horn Basin LRU subsets, and has only been identified in the upper regions of Subset A and throughout Subset B, so at this time the site is being placed in Subset B and will be written as a 7-12" site, as it spans the extent within Subset A thru B. If significant evidence is gathered to warrant a break into the two seperate ecological sites it will then be revised.

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 does not receive any additional water.
• Soils are:
o Not saline or saline-sodic.
o Moderately deep, deep, or very deep
o With < 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 Site begins or increases in reaction (strongly or violently effervescent) below 4" (10 cm) of the mineral soil surface.
o Textures usually range from very fine sandy loam to clay loam in the top 4" (10 cm) of the mineral soil surface.
o Site has a distinctive layer of calcium carbonate accumulation between 10-20" (25 to 51 cm), of the mineral soil surface (layer appearing whiter in color) with a Calcium Carbonate Equivalent (CCE) of > 15%.
• Clay content is = 32% in top 4" (10 cm) of the mineral soil surface. Each of the following subsurface horizons has a clay content of less than 35%.

The concept of this site is based on having a diagnostic calcic horizon or a pronounced accumulation of calcium carbonates usually identified as a white soil appearance with strong to violent effervescent starting or increasing 4

inches (10 cm) below the mineral soil surface. This site was correlated previously as a Loamy range site and the site concept absorbed the variances. But with further review, it is seen that Loamy calcareous predominately has a Bluebunch wheatgrass dominated plant community which responds in a different manner and holds a different potential with similar management than the Loamy range site. The identified breakpoint for calcium carbonate equivalent (CCE's) for this site is 15% or greater CCE's at a depth of 7-20 inches.

Currently the plant community and State and Transition for the Loamy 5-9" Big Horn Basin Precipitation Zone and 10-14" Foothills and Basins East Precipitation Zone sites are indicative of what is identified for the Loamy Calcareous site. As information is developed it will follow and appear very similar to the historic Loamy site description.

Associated sites

DX032X02B122	**Loamy (Ly) Wind River Basin Rim**
R032XY112WY	**Gravelly (Gr) 5-9" Big Horn Basin Precipitation Zone**
R032XY162WY	**Shallow Loamy (SwLy) 5-9" Big Horn Basin Precipitation Zone**
R032XY312WY	**Gravelly (Gr) 10-14" East Precipitation Zone**
R032XY362WY	**Shallow Loamy (SwLy) 10-14" East Precipitation Zone**

Similar sites

R032XY362WY	**Shallow Loamy (SwLy) 10-14" East Precipitation Zone**
DX032X01A122	**Loamy (Ly) Big Horn Basin Core**
DX032X02B122	**Loamy (Ly) Wind River Basin Rim**
R032XY162WY	**Shallow Loamy (SwLy) 5-9" Big Horn Basin Precipitation Zone**

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. wyomingensis* (2) *Krascheninnikovia lanata*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Pascopyrum smithii*

Legacy ID

R032XB123WY

Physiographic features

This site occurs on nearly level to gently rolling land and on slopes generally less than 25%. Within the Big Horn Basin, this site is found to exist predominately on the gently sloping summits of erosional remnants or fan remnants that flow from the foothills into the basin proper, but are found on several landforms. Many of these landforms cross several climatic zones and are influenced by multiple geomorphic processes, for example: alluvial fans crossed/eroded by streams/stream terraces, covered by landslides, or breached by uplifts/escarpments. On a smaller scale, this site occurs in a patch-work dynamic at the base or across the basin floor (remnants) as wind and water move and shift sediments, derived from carbonate rich parent material, across the landscape (alluvium).

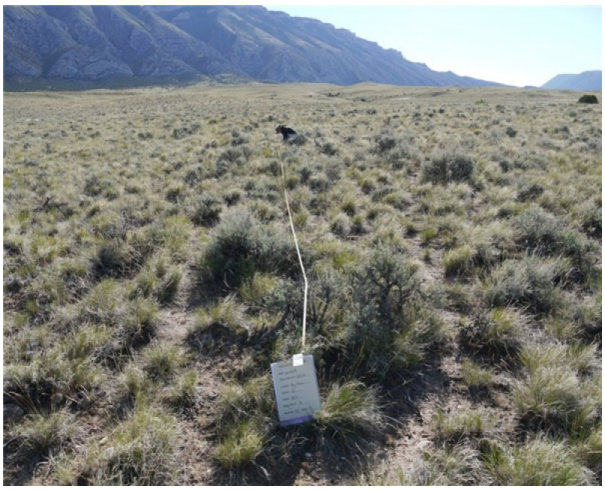


Figure 2. General Landscape View of Loamy Calcareous

Table 2. Representative physiographic features

Landforms	(1) Fan remnant (2) Stream terrace (3) Basin-floor remnant
Flooding frequency	None
Ponding frequency	None
Elevation	1,097–2,073 m
Slope	0–25%
Ponding depth	0 cm
Aspect	Aspect is not a significant factor

Climatic features

Mean Annual Precipitation ranges from 5 to 14 inches; however, when modeled, represents 7 to 12 inches of relative effective annual precipitation. 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 fronts 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. The extreme winter storms are frequent; however, the most significant impact to agricultural operations is the extreme storms occurring in late winter through spring.

High winds are generally blocked from the basin by high mountains, but can occur in conjunction with an occasional thunderstorm.

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

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/. “Basin”, "Cody 12SE", "Emblem", "Greybull", “Lovell”, "Shell 1NE", "Tensleep 16SSE", and "Worland FAA AP" are the representative stations selected for this Ecological Site. 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)	116 days
Freeze-free period (average)	139 days
Precipitation total (average)	229 mm

Climate stations used

- (1) LOVELL [USC00485770], Lovell, WY
- (2) SHELL 1NE [USC00488124], Shell, WY
- (3) CODY 12SE [USC00481850], Meeteetse, WY
- (4) EMBLEM [USC00483031], Burlington, WY
- (5) TENSLEEP 16SSE [USC00488858], Ten Sleep, WY
- (6) BASIN [USC00480540], Basin, WY
- (7) GREYBULL [USC00484080], Greybull, WY
- (8) WORLAND [USW00024062], Worland, WY

Influencing water features

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. More data is needed to quantify these characteristics specifically for this site.

Major Soil Series correlated to this site include: Forkwood, Garland, Lostwells-Like, Lostwells-alkali, Rairdent, Sharland, Zigweid, Luhon-like, Naturita, Silvertip, Cushman, Keeline, Kishona, Larimer, Tensleep.

Figure 7. Soil Profile of a Loamy Calcareous Site

Table 4. Representative soil features

Parent material	(1) Alluvium–limestone and sandstone (2) Residuum–dolomite
Surface texture	(1) Sandy clay loam (2) Fine sandy loam (3) 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"	0–3%
Available water capacity (0-101.6cm)	7.62–16 cm
Calcium carbonate equivalent (0-101.6cm)	15%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–12
Soil reaction (1:1 water) (0-101.6cm)	7.8–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

The Loamy Calcareous Ecological site within the 7 – 12” precipitation zone of the Big Horn Basin was originally correlated as either a loamy or shallow loamy range site. During the review of the Loamy range site, each representative reference community site visited was found to have calcareous characteristics. Historically, classification of the soils in the Big Horn Basin did not recognize the calcareous tendencies. Although this site is very similar to the Loamy and Shallow Loamy range sites, the community potential and system resilience are altered by the chemistry within the soil. Initial correlations of these soils and communities were made to Loamy when production was prominent, or to Shallow loamy due to the dominance of Bluebunch wheatgrass and reduced production expressing a “shallow” acting characteristic of the site. The soils as previously described are very deep to moderately deep, but depth to the accumulation of calcium carbonates created a discrepancy on how the site was classified. Wyoming big sagebrush, although present on this site, is generally restricted in vigor and production compared to a true Loamy ecological site. This site is characterized by six states within the model, that once the threshold is crossed, restoration to that state requires significant resource inputs. Minimal research can be found for this particular ecological site.

Potential vegetation on this site, as with the Loamy site, is dominated by mid cool-season perennial grasses. Other significant vegetation includes Winterfat and 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 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 in areas with absence of fire and without a sufficient amount of precipitation. Wildfires have been actively controlled, resulting in persistent, aged and decadent stands of Wyoming big sagebrush. Chemical control was used in place of the historic role of fire on this site. Recently, prescribed burning has regained some popularity, but another popular treatment method is mowing or mulching of the sagebrush.

Due to the amount and pattern of the precipitation, in combination with soil limitations, the Wyoming big sagebrush component has a lower vigor and overall structure than loamy ecological sites within the same area. Sagebrush may not be resilient once it has been removed or severely reduced if a vigorous stand of grass exists and is maintained. Blue grama and/or Threadleaf sedge may become the dominant vegetation if the area is subjected to frequent and severe periods of grazing, especially year-long grazing. As a result, a dense sod cover of Blue grama/Threadleaf sedge will become established.

Within the inherent variability of each and every ecological site within the correlated landscapes, the acceptance of a small population of salt tolerant species is and has historically been allowed within the Loamy and now Loamy Calcareous ecological sites. Re-evaluation of soil characteristics has led to the removal of the salt tolerant state within this ecological site dynamic. The shift from a minor presence to a dominance of salt tolerant species on an ecological site is an indicator that a site characteristic, rather than simply a threshold, has been crossed that cannot be altered without extensive management changes and inputs. Because of the known increase in salts in the soil profile with plants such as Gardner saltbush, Greasewood, and Shadscale it is being assumed that when these become dominate there has been a shift in soil characteristics from a Loamy or Loamy Calcareous site to a Saline Upland or Saline Lowland site depending on the dynamics of the individual location. The need for further data collection to determine the extent before breeching the threshold between these two ecological sites is significant.

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

The following is a State and Transition Model (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.

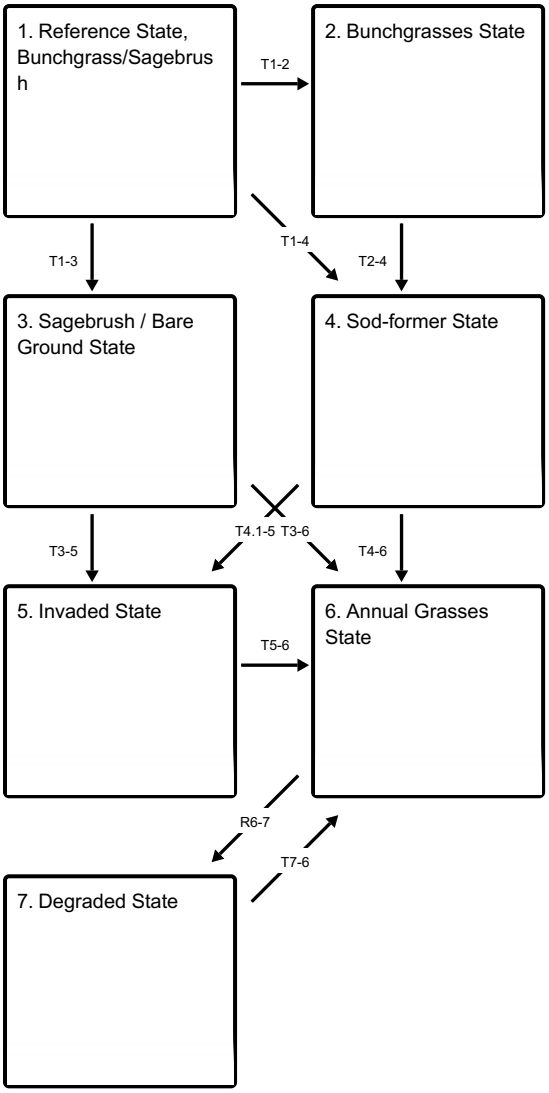
Community phases, small boxes within the bold state boxes, are generally have important management or ecological significance. Collectively, the community phases represent the range of variation within a state, including conditions that place the state at risk for transition. Community pathways are represented 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.

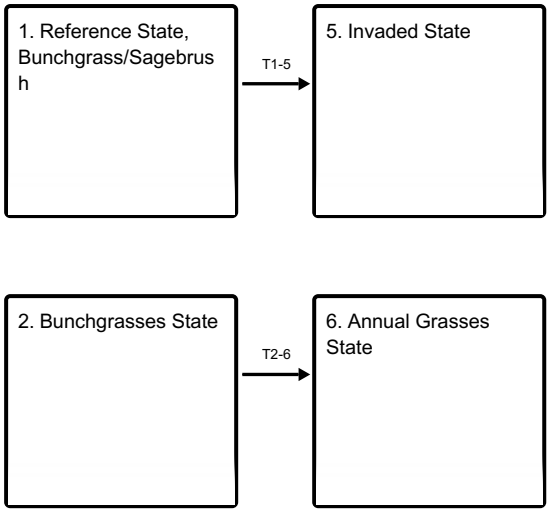
No plant communities should necessarily be thought of as “Desired Plant Communities”. According to the USDA NRCS National Range and Pasture Handbook, Desired Plant Communities (DPC’s) will be determined by the decision-makers and will meet minimum quality criteria established by the NRCS. The main purpose 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

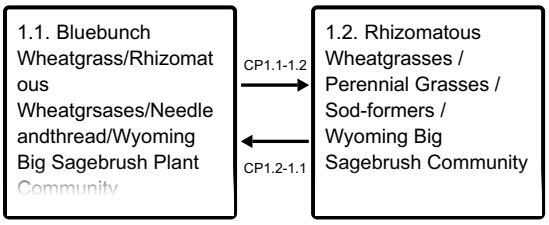
Ecosystem states



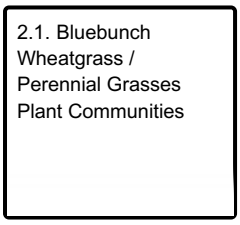
States 1, 5, 2 and 6 (additional transitions)



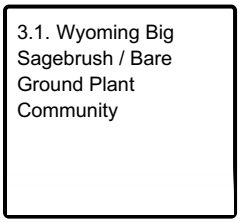
State 1 submodel, plant communities



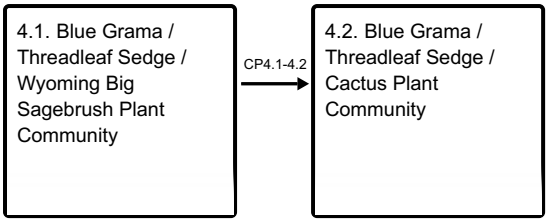
State 2 submodel, plant communities



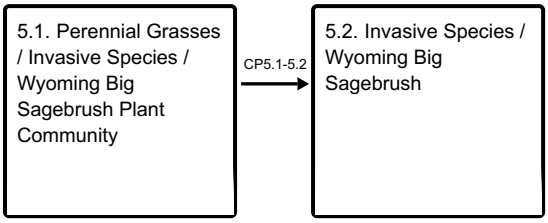
State 3 submodel, plant communities



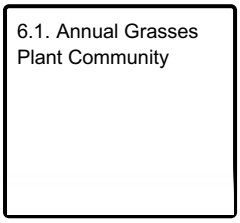
State 4 submodel, plant communities



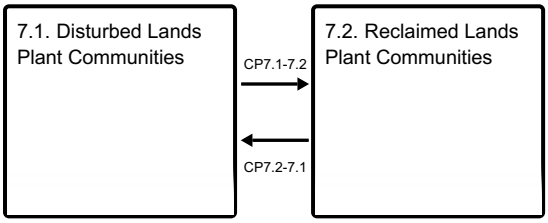
State 5 submodel, plant communities



State 6 submodel, plant communities



State 7 submodel, plant communities



State 1
Reference State, Bunchgrass/Sagebrush

The reference state is characterized by the dominance of Wyoming big sagebrush, at 15% or less composition by weight, with Bluebunch wheatgrass, at 40% or less composition by weight. But with these two dominant species, the site holds a healthy mix of rhizomatous wheatgrass, Western and Thickspike, as well as Indian ricegrass, Needleandthread, and to a minor extent sod-formers such as Threadleaf sedge and Blue grama. In refining the ecological site characteristics and the reference state, the reference was made to soils that classified as fine-loamy in comparison to coarse loamy soil texture classification and how the plant communities varied. The initial thought was that these two classifications needed to be separated. As a review of the specific locations where this was visible on the landscape, a phenomenon on the landscape was documented showing a plant community shift as soil surface structure changes. A rangeland trend plot study site has two differing plant communities occurring alternating along a transect. Both communities are within the reference state, but at separate ends of the plant composition spectrum. One community was expressing a higher occurrence of Indian ricegrass, Threadleaf sedge and Blue grama (coarse-loamy) while the second plant community was expressing a higher composition of Western wheatgrass and Needleandthread (fine-loamy). The transitions appeared to be abrupt in nature between these plant communities. Soils were reviewed, and found no apparent difference in the soil profile excluding the surface horizon or cap. Under the Indian ricegrass community, the soil surface has granular structure, where the Western wheatgrass community soils have a thin vesicular crust or platy structure. Beyond this minimal surface difference there appeared to be no difference in soil structure, texture, or classification. The lack of distinction limits the ability to separate the two communities into individual ecological sites or communities, but the range of plant composition will capture this characteristic within the plant community tables. The photo documenting the occurrence of this phenomenon is in the photo for Community 1.2, demonstrates these two plant communities as they co-exist on the landscape.

Community 1.1
Bluebunch Wheatgrass/Rhizomatous Wheatgrsases/Needleandthread/Wyoming Big Sagebrush Plant Community

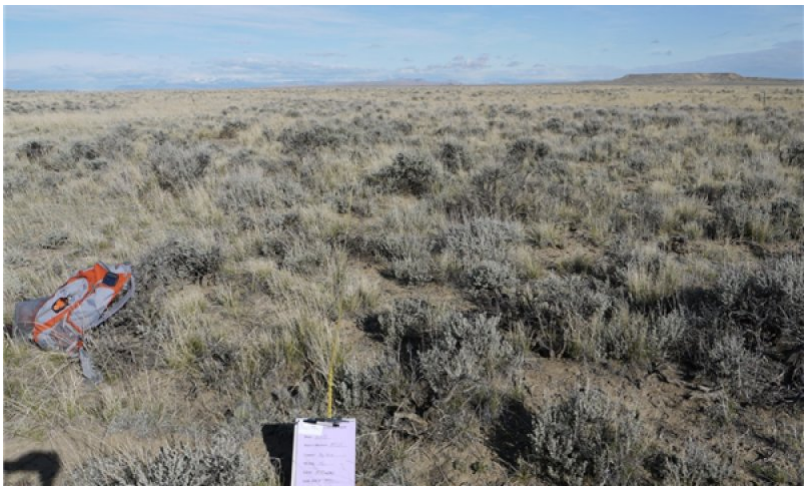


Figure 8. Loamy Calcareous in Reference State Community 1.1.

This plant community is extremely stable and well adapted to the Northern Intermountain Desertic Basins climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity). This plant community is the interpretive plant community for this site and is considered to be the Reference Plant Community. This state evolved with grazing by large herbivores and periodic fires. The cyclical natural of the fire regime in this community prevented Wyoming big sagebrush from being the dominant landscape. This plant community can be found on areas that are properly managed with grazing and/or prescribed burning, and on areas receiving occasional short periods 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-grasses. The major grasses include bluebunch wheatgrass, rhizomatous wheatgrasses (Western and Thickspike), Needleandthread, and Indian ricegrass. Other grasses occurring in this state include Bottlebrush squirreltail, Prairie junegrass, and Sandberg bluegrass. 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. Winterfat is a common component found on this site. A variety of forbs also occurs in this state and plant diversity is high (see Plant Composition Table). The total annual production (air-dry weight) of this state is about 400 lbs./acre, but it can range from about 150 lbs./acre in unfavorable years to about 525 lbs./acre in above average years.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	149	336	395
Shrub/Vine	11	104	161
Forb	10	15	34
Total	**170**	**455**	**590**

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	0-6%
Litter	0-2%
Surface fragments >0.25" and <=3"	0-5%

Surface fragments >3"	0-4%
Bedrock	0%
Water	0%
Bare ground	20-35%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	–	1-6%
>0.15 <= 0.3	–	–	–	–
>0.3 <= 0.6	–	4-12%	–	–
>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 Wheatgrasses / Perennial Grasses / Sod-formers / Wyoming Big Sagebrush Community

Figure 11. LyCa transition to at-risk community

Historically, this plant community evolved under grazing and a low fire frequency. Currently, it is found under moderate, season-long grazing by livestock and will be exacerbated by prolonged drought conditions. In addition, the fire regime for this site has been modified and extended periods without fire is now common. This plant community is still dominated by cool-season grasses, while short warm-season grasses and miscellaneous forbs account for the balance of the understory. Wyoming big sagebrush is now a conspicuous part of the overall production and accounts for the majority of the over story. The dominant grasses include Bluebunch wheatgrass, rhizomatous wheatgrasses, and Needleandthread. Grasses and grass-like species of secondary importance include Prairie junegrass, Blue grama, Sandberg bluegrass, and Threadleaf sedge. Forbs commonly found in this plant community include Scarlet globemallow, Fringed sagewort, and Spiny phlox. Wyoming big sagebrush can make up

to 25% of the annual production. The over story of sagebrush and understory of grasses and forbs provide a diverse plant community. When compared to the Reference Community 1.1, Wyoming big sagebrush, Blue grama, and Threadleaf sedge have increased. Plains prickly pear cactus will also have invaded, but occurs only in small patches. Indian ricegrass has decreased and may occur in only trace amounts under the sagebrush canopy or within the patches of prickly pear. In addition, the amount of Winterfat may or may not have changed depending on the season of use. The total annual production (air-dry weight) of this state is about 250 pounds per acre, but it can range from about 160 lbs./acre in unfavorable years to about 425 lbs./acre in above average years. This plant community is resilient, but is subject to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing, lack of management or use causing decadence and decrease in vigor of the cover present or natural/manmade disturbance. Rangeland Health Implications/Indicators: 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	164	230	392
Forb	8	34	58
Shrub/Vine	10	17	26
Total	**182**	**281**	**476**

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	0-2%
Litter	11-62%
Surface fragments >0.25" and <=3"	0-13%
Surface fragments >3"	0-2%
Bedrock	0%
Water	0%
Bare ground	22-47%

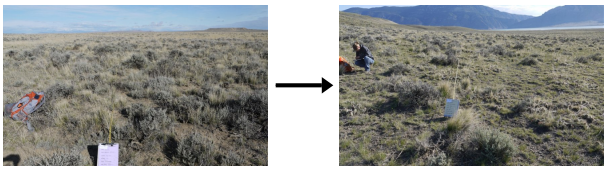
Table 10. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	–	1-11%
>0.15 <= 0.3	–	0-1%	–	–
>0.3 <= 0.6	–	9-23%	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 13. 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

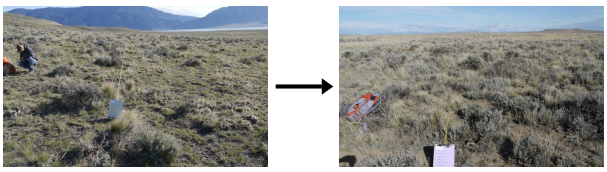


Bluebunch Wheatgrass/Rhizomatous Wheatgrsases/Needleandthread/Wyoming Big Sagebrush Plant Community

Rhizomatous Wheatgrasses / Perennial Grasses / Sod-formers / Wyoming Big Sagebrush Community

Moderate, continuous season-long grazing will convert the plant community to the Rhizomatous/Perennial Grass/Big Sagebrush Plant Community. Prolonged drought will exacerbate this transition. The stressers reduce the bunchgrasses such as Bluebunch Wheatgrass, Needleandthread, Indian ricegrass; allowing the solitary growth and sod-formers to increase in dominance in the community.

Pathway CP1.2-1.1
Community 1.2 to 1.1



Rhizomatous Wheatgrasses / Perennial Grasses / Sod-formers / Wyoming Big Sagebrush Community

Bluebunch Wheatgrass/Rhizomatous Wheatgrsases/Needleandthread/Wyoming Big Sagebrush Plant Community

Prescribed grazing or possibly long-term prescribed grazing, will allow recovery of this plant community to the Reference community. The probability of this occurring is high especially if rotational grazing along with short deferred grazing is implemented as part of prescribed method of use. In addition, the removal of fire suppression will allow a somewhat natural fire regime to reoccur to more easily transition between this plant community and the reference community. A prescribed fire treatment can be useful to hasten this transition, if desired and if invasive species risk is low. Other brush management techniques, such as mechanical or chemical are alterntives.

Conservation practices

Brush Management
Prescribed Burning
Grazing Land Mechanical Treatment
Integrated Pest Management (IPM)
Prescribed Grazing
Invasive Plant Species Control

State 2
Bunchgrasses State

During the late 1960's and throughout current time, there have been large areas of sagebrush control completed using techniques such as aerial applied chemicals, burning, mowing, spike treatments and other land based hand treatments. Many of the treatments today are done on a smaller scale, mosaic pattern to better benefit wildlife, however, some of the older style treatments were used to eradicate large areas of sagebrush in one prescription. Prescribed grazing or possibly long-term prescribed grazing, will allow recovery of this plant community to a community similar to the Reference state if there is relict or nearby seed source for sagebrush species. The process may take several years or may need mechanical, localized plantings to assist the process. The use of drought recovery plans are essential to the success of re-introducing shrub species once they are removed due to the already altered hydrologic function of the site. Again, the process will be slow and the probability of recovering to the 1.1 community is marginal, but there is the ability to recover the 1.2 state with time and possibly minor mechanical improvements. As a consequence, there are large acreages of landscape that have lost all sagebrush cover and may never recover, unless seeding or transplants are completed. The plant community, and state, created by this loss of sagebrush is dominated by the Perennial bunchgrasses and forbs as the only cover. The variability of this plant community is a reflection of the treatment that occurred and the state or condition of the landscape prior to the treatment.

Community 2.1
Bluebunch Wheatgrass / Perennial Grasses Plant Communities

Figure 14. Loamy Calcareous after fire removed Sagebrush

This plant community is evolving with the hydrologic shift caused by the loss of the shrub component. The photo above shows the remnant sagebrush skeletons that will help to hold a minor amount of moisture, but the site holds a reduced potential and vulnerability due to the loss of the structure component of the canopy. Currently, it is found under moderate, season-long grazing by livestock and will be exacerbated by prolonged drought conditions. In addition, the fire regime for this site has been modified. This site appears to respond with an exaggerated shift in production from wet, normal and dry seasons and thus the fire threat will vary drastically from one production cycle to the next. This plant community is still dominated by cool-season grasses, while short warm-season grasses and miscellaneous forbs account for the balance of the understory. Under continued drought or intense grazing, this community is at-risk, shifting to a sod-forming, warm-season dominated grass community. Wyoming big sagebrush

is relict in small depressions on the landscape, or may be replaced with rabbitbrush species or broom snakeweed, but has little to no production and is not included as a component of the over story. The dominant grasses include Bluebunch wheatgrass, rhizomatous wheatgrasses, and needleandthread. Grasses and grass-like species of secondary importance include Prairie junegrass, Blue grama, Sandberg bluegrass, and Threadleaf sedge. Forbs commonly found in this plant community include Scarlet globemallow, milkvetches, and Spiny phlox. This site can still provide a diverse plant community, but lacks the structure for cover and wildlife habitat. When compared to the Reference Community 1.1, Wyoming big sagebrush is absent, while Sandburg bluegrass, Blue grama, and Threadleaf sedge have increased. Plains prickly pear cactus will also have invaded. Indian ricegrass has decreased and may occur in only trace amounts within the patches of Plains prickly pear. Season of use and treatment type may have limited or removed Winterfat from this site. The total annual production (air-dry weight) of this state is about 280 pounds per acre, but it can range from about 160 lbs./acre in unfavorable years to about 420 lbs./acre in above average years. Rangeland Health Implications/Indicators: This plant community is resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. 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, but has been altered or affected by the loss of snow catch by the sagebrush and ability to slow water movement over the surface; however, the biotic community is intact.

Figure 15. 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 3
Sagebrush / Bare Ground State

If continued pressure or disturbance occurs on the vulnerable community within the reference state (State 1), it can be forced into the Sagebrush/*Bare Ground* State. This state name is somewhat misleading in the perception considering that bare ground may only increase slightly and in many cases there is no change or a light decrease in cover by sagebrush. Over time, drought or grazing pressures on this state will eventually drive the sagebrush/shrub canopy out or decrease the health and vigor of the plant to a non-sustainable level. The herbaceous plant production may remain only slightly decreased, but the thriving species usually occur under the canopy of Wyoming Big sagebrush or similar shrub species (rabbitbrush) and within the protection of Prickly pear cactus. Brush management, followed by prescribed grazing, may return this plant community to a similar or near Reference Plant Community. If prescribed fire is used as a means to reduce or remove the shrubs, sufficient fine fuels will need to be present. This may require deferment from grazing prior to treatment. Post management is critical to ensure success. This can range from two or more years of rest to partial growing season deferment, depending on the condition of the understory at the time of treatment and the growing conditions following treatment. In the case of an intense wildfire that occurs when desirable plants are not completely dormant, the length of time required to reach a community within the Reference State may be increased and seeding of natives is recommended. A site was identified that was dominated by Wyoming big sagebrush with an understory of bottlebrush squirreltail, Bluebunch wheatgrass, Sandberg bluegrass, and annual forbs. Production was low; Wyoming big sagebrush was at approximately 25% canopy. The site was selected for a trial sagebrush treatment by Bureau of Land Management (BLM), one area was treated with small patch burns and several other areas were treated with a mowing prescription, at varying times of year and heights. The canopy of herbaceous cover for the burned site is delayed and very slow to respond, where the canopy under the mowing treatments responded within a growing season. Transects established on the location were dominated by Bottlebrush squirreltail, and minimal other species. The sites continue to be monitored. It is the consensus, that the timing and the climate for that year was optimal for the residual seed bank of Bottlebrush squirreltail. So the mowing treatment acted as a seed dispersal process allowing the plant species to flourish.

Community 3.1
Wyoming Big Sagebrush / Bare Ground Plant Community

Figure 16. Extensive over use transition to Sagebrush/Bare Ground

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 ranges from 10 to 25% or greater. Wyoming big sagebrush is a significant component of the plant community and the preferred cool season grasses have been greatly reduced. The dominant grasses are Prairie junegrass, Sandberg bluegrass, and Blue grama. Cactus and sageworts often invade. The interspaces between plants have expanded leaving the amount of bare ground more prevalent. As compared with the reference state and inclusive community, the annual production may show a decline, but initially the shrub production compensates for some of the decline in the herbaceous production. The open interspaces leave this site vulnerable to weedy annual species such as Cheatgrass to occupy the site if a seed source is available. Noxious weeds such as Russian knapweed, Leafy spurge, or Canada thistle may invade the site if a seed source is available. If these species gain a foothold, they push the state across a threshold into an invaded or annual grass state. The total annual production (air-dry weight) of this state is about 300 pounds per acre, but it can range from about 180 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. 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 reference communities. 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 17. 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
Sod-former State

Blue grama and Threadleaf sedge are sod-forming species that exist 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 appears to be dependent on which species is more prevalent in the community before the negative pressures are applied.

Community 4.1
Blue Grama / Threadleaf Sedge / Wyoming Big Sagebrush Plant Community

Figure 18. LyCa Site transition to 4.1 - Sod/Sagebrush

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. Other factors that can affect the shrubs include drought, heavy browsing, wildfires, and/or human brush control measures. 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 reduced to small patches or in some cases removed. Rubber rabbitbrush may be the sole remaining shrub on the site. When compared to the Historic Climax Plant 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. Production has been significantly decreased. The total annual production (air-dry weight) of this state is about 100 pounds per 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 transition 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 19. 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 4.2
Blue Grama / Threadleaf Sedge / Cactus Plant Community

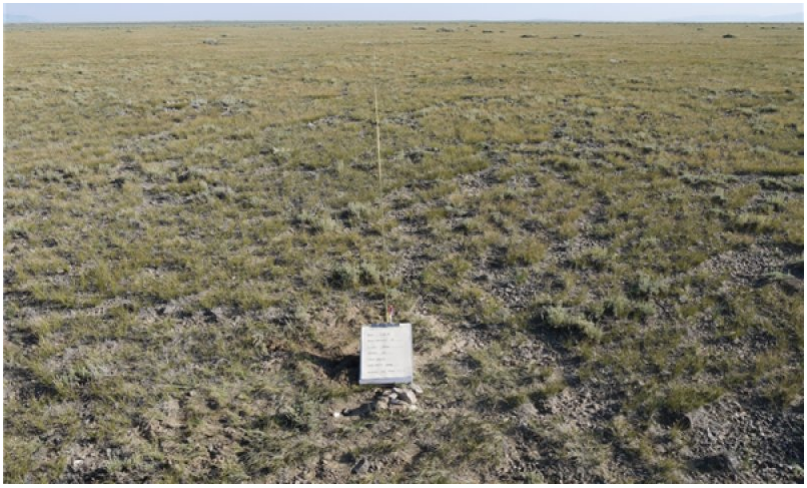


Figure 20. LyCa Site dominated by Threadleaf Sedge and Cactus

This plant community can occur fairly easily through drought, wildfire 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 1.1, 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 extended drought conditions. Blue grama over the past years has shown the stress of this drought and have weekend and opened up the canopy and have had die back of the root systems. 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 was 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 21. 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 CP4.1-4.2
Community 4.1 to 4.2

Blue Grama / Threadleaf Sedge / Wyoming Big Sagebrush Plant Community

Blue Grama / Threadleaf Sedge / Cactus Plant Community

Frequent or Severe Grazing, Drought/Insect Damage, Fire/Wildfire – 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 5
Invaded State

Invasive plant species are a permanent concern with rangelands and management. Each year new species are discovered and will alter this section as they are. 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 5.1
Perennial Grasses / Invasive Species / Wyoming Big Sagebrush Plant Community

Figure 22. LyCa Plant Community 5.1 - Perennial Grasses/Sagebrush

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 23. 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 5.2
Invasive Species / Wyoming Big Sagebrush

Figure 24. LyCa Site with Wyoming Big Sagebrush and Cheatgrass

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 6, Annual Grasses/Invaders. 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 25. 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 CP5.1-5.2
Community 5.1 to 5.2

Perennial Grasses / Invasive Species / Wyoming Big Sagebrush Plant Community

Invasive Species / Wyoming Big Sagebrush

Frequent or Severe Grazing, Drought, Disturbances (mechancial) and Wildfire – 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 mechanical disturbances or, 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 6
Annual Grasses State

Currently within the Big Horn Basin, Cheatgrass or Downy brome (*Bromus tectorum*) is the invasive annual grass species that has been a concern for management. Although there are many other species of forbs that are becoming monoculture stands, Cheatgrass is the species that is taking large acres of land quickly in this region. Knapweed, namely spotted, also became dominate in large dense stands and produces an even more challenging set of 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 ever go away or become less of a management challenge. This state is characterized by the lack of all or most of the shrub component of this site. Whether drought or wildfire has removed this component, 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 shrubs.

Community 6.1
Annual Grasses Plant Community

Figure 26. Cheatgrass Invasion Post-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 seed 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 all changes. 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. 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 27. 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 7
Degraded State

The 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 7.1
Disturbed Lands Plant Communities

The title Disturbed Lands is encompassing three broad classifications of these land types. Go-back fields are referring to sites that were once cultivated or have had minor surface disturbance, and have since been left to natural processes. Homestead and abandoned farming sites can be identified on the landscape (through photo-tone shifts in aerial photographs) and are generally a mix of natives that have moved into disturbed sites or a co-mingling of introduced species and natives. These sites are difficult to reclaim, generally due to the introduced species that persist on the landscape. And once reclaimed, do not tend to respond to the natural disturbance regimes in the same manner that a native, mechanically undisturbed site would respond. In a similar process, mined lands or lands affected by energy development including transmission corridors, transportation corridors and development sites provide a host of successional processes. Many times, these locations are re-exposed to disturbance frequently by mechanical means leaving annual weeds and primary successional species as the dominate canopy. Older, established sites or abandoned locations, have established communities similar to those expected on go-back fields and may be stable in nature. The last type of Disturbed lands is the “introduced grass plantings”. Although this could be considered reclaimed or restored, there are sites that were seeded to introduced or improved species, such as crested wheatgrass, smooth brome, or tall wheatgrass in a monoculture. These communities will transition or mature as the stand density declines with lack of management or inputs, the canopy opens and allows natives, if present, to begin to establish. Although each planting is highly variable on the exact composition that will be present, they appear to be stable and can be productive sites. The growth curve of this plant community will vary depending on the species that are selected for seeding. 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 7.2
Reclaimed Lands Plant Communities

Reclamation practices have shifted greatly over the last several decades. Crested wheatgrass was a species used frequently for reclamation throughout Wyoming and many of these communities persist today. Although there are areas where native species from neighboring sites are starting to slowly extend into the crested wheatgrass stands, many times, these stands remain as a monoculture until a disturbance occurs to open the canopy slightly to provide a more tolerable niche. Bozosky Russian wildrye and varieties of rhizomatous and bunch-wheatgrasses have also been used in mixes to help compensate for the chemistry of these soils. Although the success of vegetative seedings are low in this LRU, due to the low precipitation and timing of precipitation events, there are limited areas along pipeline corridors, well sites or pad sites, and along transportation corridors where re-seeded sites have succeeded. As mentioned in the community phase above, as these seedings mature and the stands open, they can be characteristically similar to other disturbed sites. Where under the more current, and understood definition of reclaimed or restored, sites are planted to as close to a natural occurring 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 seedings 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 as they mature as many of the cultivated seeds produce more biomass (possibly more litter) and thus may create more fine fuels to fuel 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 CP7.1-7.2
Community 7.1 to 7.2

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

Critical Area Planting
Grazing Land Mechanical Treatment
Range Planting
Heavy Use Area Protection
Integrated Pest Management (IPM)
Native Plant Community Restoration and Management
Prescribed Grazing
Invasive Plant Species Control
Herbaceous Weed Control

Pathway CP7.2-7.1
Community 7.2 to 7.1

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

Extensive Brush Management or Fire with Drought, creates a shift in the hydrology of the site preventing the re-establishment of Wyoming big sagebrush on the site without extensive management changes. This transition has been seen to occur with sites that were treated with chemicals aerially in the late 1960's, and in areas where wildfires burned hot or were fired with a period of extended drought inhibiting the seed bank or preventing the establishment of seedlings into the area.

Transition T1-3
State 1 to 3

Frequent and severe grazing plus no fire on soils with limited soluble salts, will convert the plant community to the 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.

Transition T1-4
State 1 to 4

Frequent and severe grazing (yearlong grazing) plus wildfire or brush control, will convert the plant community to the Blue Grama Sod Plant Community. The probability of this occurring is high, especially if the sagebrush stand has been severely affected by drought or heavy use or has been removed altogether.

Transition T1-5
State 1 to 5

Frequent/Severe Grazing, Fire, Drought, Disturbance with introduction of seed source, will allow this plant community and any of the states to shift to an Annual invaders/Wyoming Sagebrush Plant community or Annual Grass Plant Community. The risk for this transition or threshold to be crossed is high, especially with the continued increase of invaders in high traffic areas and the persistence of drought which will open the plant community and allow for the establishment of the seed source.

Transition T2-4
State 2 to 4

Frequent or Severe Grazing, Drought – A shift from the cool season perennial bunchgrasses to Threadleaf sedge or Blue grama sod can be driven by extended drought or drought like conditions brought on by high winds, lack of snow catch due to loss of sagebrush canopy and through the effects of compaction and plant reduction caused by frequent or severe grazing. As the roots and vigor of the mid-stature bunchgrasses and rhizomatous wheatgrasses that typically dominate this site are reduced with increased climatic or herbivorous pressure, the ability for water to infiltrate and to withstand dwindles, opening the canopy for the sod-formers to dominate. The sod-formers can catch more of the moisture as it is available and to utilize the quick moving storms more efficiently than the deeper rooted more spaced bunchgrasses.

Transition T2-6
State 2 to 6

Frequent or Severe Grazing, Wildfire, Disturbance - The chance of wildfire is reduced with the loss of the fuels from sagebrush to help carry across large areas, however, in favorable production years areas can produce enough fine fuels to carry a wildfire which in turn opens the canopy and provides a niche for annual invaders such as Cheatgrass and knapweeds to take hold. If the seed source is available, fire is a well-known avenue to provide the conditions for annuals to flourish, as well as general disturbance whether from herbivores or man-induced. Once the seed source gains a place in the community, it is extremely difficult to manage and may not be feasible or possible to completely remove the invaders.

Transition T3-5
State 3 to 5

A combination of Long term prescribed grazing or non-use in combination with Brush management, followed by a disturbance or frequent and severe grazing or drought will convert the plant community to the Perennial Grasses/Annual Invaders/Big Sagebrush State or could possibly push it to the Blue Grama Sod Plant Community if the source is present.

Transition T3-6
State 3 to 6

Drought, Wildfire or Brush management, followed by frequent and severe grazing, will convert the plant community to the Annual Grass State if the disturbance is extensive enough and the threat of invasives is present in the area. Or, could possibly push it to the Blue Grama Sod Plant Community if the source is present.

Transition T4.1-5
State 4 to 5

Drought, Frequent or severe grazing, Disturbance – Drought as the only factor or drought with grazing intensity together can work to weaken or kill Wyoming big sagebrush on the landscape, and once it has declined or been removed from an area it is not known if or how long it will take for it to come back without cultural methods, which do not carry a reliable success rate. Blue grama and Threadleaf sedge have been seen to die back or die out with prolonged drought opening the canopy and the community's vulnerability to invasive species. Disturbance by mechancial means or human activities that break the root masses or disturb the soil surface open this closed community to potential invasive species, especially when there is a readily available seed source for those invasive species.

Transition T4-6
State 4 to 6

Drought, Frequent or severe grazing - With the loss of structure height on the landscape as Wyoming big sagebrush recedes in this community, it intensifies the drought effect on the plants and will assist in opening more bare ground and make the community vulnerable to invasion by annuals and invasive species.

Transition T5-6
State 5 to 6

Fire (wild), Frequent or severe grazing, Drought – 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 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 R6-7
State 6 to 7

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 can be brought 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.

Conservation practices

Critical Area Planting
Range Planting

Heavy Use Area Protection
Integrated Pest Management (IPM)
Native Plant Community Restoration and Management
Prescribed Grazing
Fuel Break
Invasive Plant Species Control
Monitoring and Evaluation

Transition T7-6
State 7 to 6

Frequent or Severe Grazing, Disturbance with a seed Source, or Drought - Any stressor that is applied with the inherent seed source puts this state at risk to transitioning into an Annual Grass or 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				135–247	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	135–247	30–50
2	**Rhizomatous Wheatgrasses**			6–22	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	6–22	1–5
	western wheatgrass	PASM	*Pascopyrum smithii*	6–22	1–5
3				11–84	
	needle and thread	HECO26	*Hesperostipa comata*	11–84	5–20
4				6–22	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–22	1–5
5	**Miscellaneous Grasses/Grass-likes**			6–56	
	Grass, perennial	2GP	*Grass, perennial*	0–22	0–5
	blue grama	BOGR2	*Bouteloua gracilis*	0–22	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–22	0–5
	squirreltail	ELEL5	*Elymus elymoides*	1–22	1–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	1–22	1–5
	Sandberg bluegrass	POSE	*Poa secunda*	6–22	1–5
Forb					
6	**Primary Perennial Forbs**			0–34	
	textile onion	ALTE	*Allium textile*	1–22	1–5
	sandwort	ARENA	*Arenaria*	0–22	0–5
	aster	ASTER	*Aster*	1–22	1–5
	milkvetch	ASTRA	*Astragalus*	1–22	1–5
	bastard toadflax	COMAN	*Comandra*	0–22	0–5
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–22	0–5
	larkspur	DELPH	*Delphinium*	0–22	0–5
	fleabane	ERIGE2	*Erigeron*	1–22	1–5

	desertparsley	LOMAT	*Lomatium*	1–22	1–5
	spiny phlox	PHHO	*Phlox hoodii*	1–22	1–5
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	1–22	1–5
	Nuttall's violet	VINU2	*Viola nuttallii*	0–22	1–5
7	**Secondary Perennial Forbs**			0–28	
	Forb, perennial	2FP	*Forb, perennial*	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
8				0–6	
	alyssum	ALSI8	*Alyssum simplex*	0–6	0–1
	flatspine stickseed	LAOC3	*Lappula occidentalis*	0–6	0–1
Shrub/Vine					
9	**Primary Shrubs**			28–90	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	22–67	5–15
	winterfat	KRLA2	*Krascheninnikovia lanata*	6–22	1–5
10	**Secondary Shrubs**			0–22	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–22	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–22	0–5
11	**Other Shrubs**			0–22	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–22	0–5
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–22	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–22	0–5

Table 12. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				56–140	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	56–140	10–40
2	**Rhizomatous Wheatgrasses**			11–56	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	11–56	5–25
	western wheatgrass	PASM	*Pascopyrum smithii*	11–56	5–25
3				11–84	
	needle and thread	HECO26	*Hesperostipa comata*	11–84	5–20
4				6–28	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–28	1–5
5	**Miscellaneous Grasses/Grass-likes**			11–112	
	prairie Junegrass	KOMA	*Koeleria macrantha*	1–45	1–10
	Sandberg bluegrass	POSE	*Poa secunda*	6–45	2–10
	Grass, perennial	2GP	*Grass, perennial*	0–22	0–5
	blue grama	BOGR2	*Bouteloua gracilis*	0–22	0–5

	blue grama	BOGR2	*Bouteloua gracilis*	0–22	0–5
	threadleaf sedge	CAFI	*Carex filifolia*	0–22	0–5
	squirreltail	ELEL5	*Elymus elymoides*	1–22	1–5
Forb					
6	**Primary Perennial Forbs**			0–28	
	textile onion	ALTE	*Allium textile*	1–22	1–5
	sandwort	ARENA	*Arenaria*	0–22	0–5
	aster	ASTER	*Aster*	1–22	1–5
	milkvetch	ASTRA	*Astragalus*	1–22	1–5
	bastard toadflax	COMAN	*Comandra*	0–22	0–5
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	0–22	0–5
	larkspur	DELPH	*Delphinium*	0–22	0–5
	fleabane	ERIGE2	*Erigeron*	1–22	1–5
	desertparsley	LOMAT	*Lomatium*	1–22	1–5
	spiny phlox	PHHO	*Phlox hoodii*	1–22	1–5
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	1–22	1–5
	Nuttall's violet	VINU2	*Viola nuttallii*	0–22	0–5
7	**Secondary Perennial Forbs**			0–28	
	Forb, perennial	2FP	*Forb, perennial*	1–22	1–5
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–22	0–5
	skeletonplant	LYGOD	*Lygodesmia*	0–22	0–5
	plains pricklypear	OPPO	*Opuntia polyacantha*	1–22	1–5
	silky phacelia	PHSE	*Phacelia sericea*	0–22	0–5
	yellow salsify	TRDU	*Tragopogon dubius*	0–22	0–5
8	**Annual Forbs**			1–6	
	alyssum	ALSI8	*Alyssum simplex*	1–6	1–2
	flatspine stickseed	LAOC3	*Lappula occidentalis*	1–6	1–2
Shrub/Vine					
9	**Primary Shrubs**			22–84	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	22–84	5–25
	winterfat	KRLA2	*Krascheninnikovia lanata*	1–11	1–5
10	**Secondary Shrubs**			0–11	
	prairie sagewort	ARFR4	*Artemisia frigida*	0–11	0–5
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–11	0–5
11	**Other Shrubs**			0–11	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–11	0–5
	Gardner's saltbush	ATGA	*Atriplex gardneri*	0–11	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–11	0–5

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 - Bluebunch Wheatgrass/Perennial Grasses Plant Community: The loss of the thermal and escape cover limit use, but is favored for grazers and mixed feeders such as bison, elk, and antelope. When found adjacent to sagebrush dominated states, this plant community may provide brood rearing/foraging areas for sage grouse, as well as lek sites. Many grassland obligate small mammals would occur here.

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 - 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.

4.2 - 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.

5.1 - 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.

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

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

7.1 - Disturbed Lands Plant Community and 7.2 - 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.

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 Production Carrying Capacity*
Plant Community Description/Title: Lbs./Acre AUM/Acre
1.1 Bluebunch Wheatgrass/Rhizomatous Wheatgrasses/Needleandthread/Wyoming Big Sagebrush 150-525 0.11
1.2 Rhizomatous Wheatgrasses/Perennial Grasses/Wyoming Big Sagebrush 160-425 0.07
2.1 Bluebunch Wheatgrass/Perennial Grasses 160-420 0.08
3.1 Wyoming Big Sagebrush/*Bare Ground* 180-400 0.08
4.1 Blue Grama/Threadleaf Sedge/Wyoming Big Sagebrush 55-150 0.03
4.2 Blue Grama/Threadleaf Sedge Sod/Cactus 50-100 0.02
5.1 Perennial Grasses/Invasive Species/Wyoming Big Sagebrush ** **
5.2 Invasive Species/Wyoming Big Sagebrush ** **
6.1 Annual Grasses ** **
7.1 Disturbed Lands ** **
7.2 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. Cryptogamic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides hunting opportunities for upland game species. The wide varieties of plants 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, however, can prove to have limitations when associated with Roadways and Trails in relation to erosion potential and functionality. The soils will be sticky or slick when wet and are more erosive than the Loamy range sites and so consideration needs to be given when crossing these areas with trails and roadways.

Wood products

No appreciable wood products are present on the site.

Other products

Herbs: Several of the forb species within the communities of the Loamy Calcareous Ecological site have medicinal characteristics and have been used by the Native Americans in this area and more recently by the naturopathic profession.

Ornamental Species: The forbs commonly found as well as the shrub component of these communities have been used in landscaping and xeriscaping.

Inventory data references

Information presented here has been derived from NRCS inventory data, Field observations from range trained personnel, and the existing range site descriptions. Those involved in 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 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.
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 (overstory 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	T51N R99W S35
UTM zone	N
UTM northing	4913449
UTM easting	681467
Latitude	44° 21′ 5″
Longitude	108° 43′ 23″

General legal description	Travel S. from Burlington 1.8 miles on Hwy 30, turn W. on Burlington-Meeteetse Hwy travel 15.1 miles, turn N. on YU Bench Road travel 2.14 miles, turn SW on BLM Access Road travel 0.5 miles, site is located 100 ft S/SE of access road.

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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; marji.patz@wy.usda.gov; 307-754-9301 ext. 118
Date	04/29/2014
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 non-existent, but will have an increase of incurrence on steeper slopes of 10-25%.

2. **Presence of water flow patterns:** Barely observable but may be occurring on steeper slopes (10-25%)

3. **Number and height of erosional pedestals or terracettes:** Essentially non-existent, or rare if occurring.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is 25 to 35% occurring in small patch-like areas throughout site.

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 non-existent.

7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement occurring. Litter remains in place and is not moved by erosional forces.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Plant cover and litter is at 60% or greater of soil surface and maintains soil surface integrity. Soil stability class is anticipated to be 3.0 or greater on average. Ranging from 1 in interspaces and up to 6 under plant canopy.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. A-horizons vary in depth from 1 to 12 inches with OM of 1-2%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of, on average, 75% grasses, 10% forbs, and 15% shrubs. This, with an evenly distributed canopy and litter, with deep healthy rooted native grasses enhancing infiltration, limits the runoff potential to little or no effect 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):** No compaction layer or soil surface crusting should be present.

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-stature cool season bunchgrasses

    Sub-dominant: perennial shrubs = cool season rhizomatous grasses

    Other: perennial forbs > short stature bunchgrass and grass-likes

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence noted, typically associated with shrub canopy. Through drought conditions will see some decadence with Bluebunch Wheatgrass.

14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5 to 25% of total canopy with total litter including beneath the plant canopy can reach up to 70%. Herbaceous litter depth typically ranges from 3-10 mm, with woody littler varying between 4-6 cm.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Total normal or average production is estimated at 420 lbs. with a low of 200 lbs. and ranging to 650 lbs.

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:** Blue grama, Sandberg bluegrass, Threadleaf sedge, Threeawn, Fringed sagewort, Prickly pear cactus, Broom snakeweed and Rubber rabbitbrush; Alyssum, Blue mustard, Annual false crested wheatgrass, as well as other Annuals, and then Exotics and species found on the noxious weed list including but not limited to: Cheatgrass, Spotted knapweed, Bull thistle.

17. **Perennial plant reproductive capability:** All species are capable of reproducing.