USDA Natural Resources Conservation Service

Ecological site R046XH124WY
Loamy Argillic Wyoming Front

Last updated: 9/05/2018
Accessed: 04/28/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

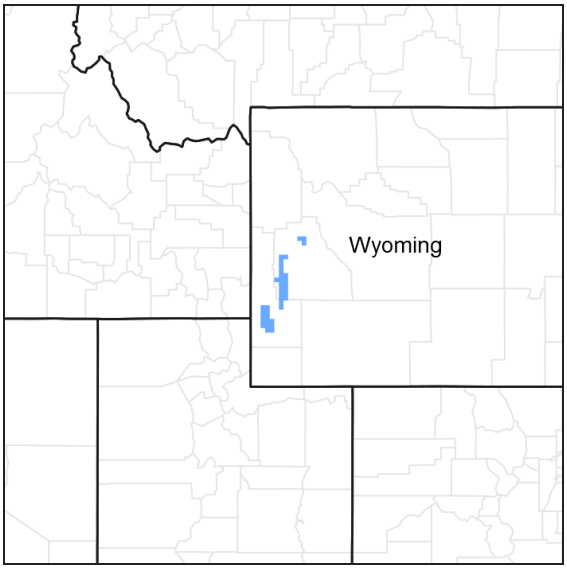


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 046X–Northern and Central Rocky Mountain Foothills

Site Name: Loamy Argillic Wyoming Front

Site Type: Rangeland

Site ID: R046XH124WY

Precipitation or Climate Zone: 15-19” P.Z.

Major Land Resource Area (MLRA): 46-Rocky Mountain Foothills
For further information regarding MLRAs, refer to:
http://soils.usda.gov/survey/geography/mlra/index.html

LRU notes

Land Resource Unit (LRU) H: Wyoming Front
• Moisture Regime: typic ustic
• Temperature Regime: cryic

• Dominant Cover: rangeland
• Representative Value (RV) Effective Precipitation: 15-19 inches
• RV Frost-Free Days: 15-45 days

Classification relationships

National Vegetation Classification System (USNVC [United States National VegetationClassification], 2017):
3 Desert & Semi-Desert Class
3.B.1 Cool Semi-Desert Scrub & Grassland Subclass
M170 Great Basin-Intermountain Dwarf Sagebrush Steppe & Shrubland Macrogroup
G308 Intermountain Low & Black Sagebrush Steppe & Shrubland Group
A3221 Alkali Sagebrush Steppe & Shrubland Alliance

EPA Ecoregion (Omerik, 2014):
Level I: 10.0 North American Deserts and 6.0 Northwestern Forested Mountains
Level II: 10.1 Cold Deserts and 6.2 Western Cordillera
Level III: 10.1.4 Wyoming Basin and 6.2.10 Middle Rockies

Ecological site concept

• Site does not receive any additional water.
• Soils are:
o not saline or saline-sodic.
o moderately deep, deep, with < 3% stone (10-25”) and boulder (>25”) cover.
o not skeletal within 20” of soil surface.
o ranges from no effervescence to violently effervescent within top 10”. Violent effervescences is rare but may occur
o Surface textures usually range from very fine sandy loam to clay loam in surface mineral 4” over a heavy argillic subsurface layer (clay loam or clay) with >40% clay.
• Slope is < 30%.

Associated sites

R046XH162WY	**Shallow Loamy Wyoming Front** Shallow Loamy sites are skeletal, often over 15% slope, and lack the heavy argillic layer and will have moderate to rapid permeability throughout the soil profile.
R046XH126WY	**Loamy Calcareous Wyoming Front** Loamy Calcareous sites are often skeletal and may have an argillic, but it will be <40% clay and not heavy enough to affect permeability, which will be moderate to rapid throughout the soil profile. Calcium carbonates are the driver of this site with an increase in carbonates (>15% CCE, or violently effervescent) at 5 to 15” in depth

Similar sites

R034AY258WY	**Shallow Clayey Foothills and Basins West (SwCy)** Shallow Clayey has the same site concept in a lower precipitation zone and is the pre-2005 site name.
DX034A02X124	**Loamy Argillic Pinedale Plateau (LyA PP)** Loamy Argillic (Pinedale Plateau) has the same site concept in a lower precipitation zone.
R034AY210WY	**Dense Clay Foothills and Basins West (DC)** Dense Clay has a higher clay content (>40%) at the surface layer.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula ssp. longiloba*
Herbaceous	(1) *Achnatherum hymenoides* (2) *Festuca idahoensis*

Physiographic features

The Loamy Argillic Wyoming Front (LyA) ecological site (R046XH124WY) is located within LRU “H” in MLRA “46.” This ecological site occurs in montane landscapes on hill, stream terrace, draw, pediment, and fan remnant landforms (see definitions below). The slope ranges from level to 30%. This site occurs on all aspects.
eroded fan remnant – All, or a portion of an alluvial fan that is much more extensively eroded and dissected than a fan remnant; sometimes called an erosional fan remnant (FFP). It consists primarily of a) eroded and highly dissected sides (eroded fan-remnant sideslopes) dominated by hillslope positions (shoulder, backslope, etc.), and b) to a lesser extent an intact, relatively planar, relict alluvial fan “summit” area best described as a tread.
foothill – A steeply sloping upland composed of hills with relief of 30 up to 300 meters and fringes a mountain range or high-plateau escarpment. Compare – hill, mountain, plateau.
hills – A landscape dominated by hills and associated valleys. The landform term is singular (hill).

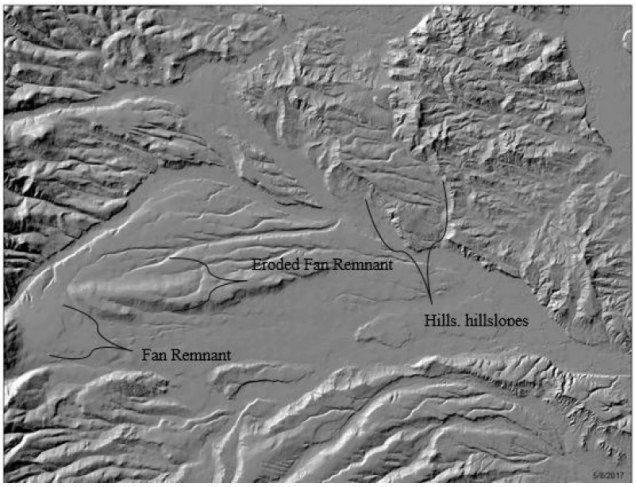


Figure 2.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Hill (2) Eroded fan remnant
Flooding frequency	None
Ponding frequency	None
Elevation	2,286–2,438 m
Slope	0–30%

Climatic features

Annual precipitation ranges from 15-19 inches per year. 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. This is predominantly due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Extreme storms may occur during the winter, but most severely affect ranch operations during late winter and spring. Prevailing winds are from the southwest, and strong winds are less frequent than over other areas of Wyoming. Occasional storms, however, can bring brief periods of high winds with gusts exceeding 50 mph. Growth of native cool season plants begins about May 15 and continues to about August 15.

The following information is from the “Merna” climate station:

Minimum Maximum 5 yrs. out of 10 between

Frost-free period (days): 11 59 July 5 – August 15
Freeze-free period (days): 43 94 June 15 – August 24

Annual Precipitation (inches): <9.15 >20.17 (2 years in 10)

Average annual precipitation: 15.21 inches

Average annual air temperature: 34.2□F (20.3□F Avg. Min. to 48.2□F Avg. Max.)

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at http://www.wcc.nrcs.usda.gov/cgibin/state.pl?state=wy website.

Table 3. Representative climatic features

Frost-free period (average)	
Freeze-free period (average)	
Precipitation total (average)	381 mm

Influencing water features

NONE

Soil features

The soils of this site are moderately deep to deep (greater than 20" to bedrock). Surface textures range from loam to clay loam. Subsurface textures range from clay loam to clay with a strong argillic (>40% clay) as the diagnostic horizon for identifying this site. The surface has moderate to moderately slow permeability over a subsurface layer with moderately slow to very slow permeability. Saturated hydraulic conductivity (Ksat) in the subsurface layer is moderately low to low. This results in a site that is saturated in the spring, but very dry in the summer/fall months. Sometimes there may be a calcic horizon or rock fragments, but sharply contrasting textural differences between the surface and subsurface layer typically occur higher in the profile, within 15 inches of the surface.

Major Soil Series correlated to this site includes: Fossilbutte, Quackingasp, Conwaycreek, and Jerry, series.

Other Soil Series correlated to this site in MLRA 34A include: Nathrop, Schideler, Sledrunner, and Mahogany series.

Typical taxonomy: fine, smectitic Vertic Haplocryalfs

Table 4. Representative soil features

Parent material	(1) Alluvium–sedimentary rock (2) Slope alluvium–sedimentary rock
Surface texture	(1) Gravelly loam (2) Sandy clay loam (3) Clay loam
Permeability class	Moderately slow to slow
Depth to restrictive layer	18–30 cm
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–10%
Available water capacity (50.8-152.4cm)	8.18–15.24 cm
Calcium carbonate equivalent (50.8-152.4cm)	0–15%

Electrical conductivity (50.8-152.4cm)	0–2 mmhos/cm
Sodium adsorption ratio (50.8-152.4cm)	0–5
Soil reaction (1:1 water) (50.8-152.4cm)	6.6–8.4
Subsurface fragment volume <=3" (50.8-152.4cm)	0–20%
Subsurface fragment volume >3" (50.8-152.4cm)	0–15%

Ecological dynamics

DEFINITIONS (From the National Range and Pasture Handbook (1997), unless otherwise noted.)

Community (plant community): An assemblage of plants occurring together at any point in time, while denoting no particular ecological status. A unit of vegetation.
Community pathway: A trajectory of system change between communities within a state (phases) triggered by management actions and/or natural mechanisms (Stringham et al. 2003).
Community phase: A vegetation community seral stage within a state (Stringham et al. 2003).
Decreaser: A plant species that is less resistant to livestock grazing and tends to decrease in abundance in the community in response to improper grazing management.
Deferment: Delay of livestock grazing in an area for an adequate period to provide for plant reproduction, establishment of new plants, or restoration of vigor of existing plants.
Historic climax plant community (HCPC): The plant community that was best adapted to the unique combination of factors associated with the ecological site. It was in a natural dynamic equilibrium with the historic biotic, abiotic, climatic factors on its ecological site in North America at the time of European immigration and settlement.
Improper grazing management: Management that allows grazing to exceed the recovery capacity of individual species or the plant community.
Increaser: A plant species that is more resistant to livestock grazing and tends to increase in abundance in the community in response to improper livestock management. If the improper grazing continues, livestock can shift to the increaser species, causing them to eventually decrease in abundance.
Introduced species: A species not a part of the original fauna or flora of the area in question.
Invader: Plants that are not a part of the original plant community that invade an area because of disturbance, or plant community deterioration, or both.
Native species: A species that is part of the original fauna or flora of the area in question.
Noxious weed: An unwanted plant specified by Federal or State laws as being especially undesirable, troublesome, and difficult to control. It grows and spreads in places where it interferes with the growth and production of the desired vegetation.
Seral stages: The developmental stages of ecological succession.
State: A recognizable, resistant, and resilient complex of 2 components, the soil base and the vegetation structure. The vegetation and soil components are necessarily connected through integrated ecological processes that interact to produce a sustained equilibrium that is expressed by a specific suite of vegetation communities (Stringham et al. 2003).
Threshold: Boundary in space and time between any and all states, , such that one or more of the primary ecological processes has been changed and must be actively restored before return to a previous state is possible (Stringham et al. 2003).
Transition: A trajectory of system change away from the current stable state that is triggered by natural events, management actions, or both. A transition is reversible when it occurs within a state, but is irreversible without active restoration after a threshold has been breached (Stringham et al. 2003).

STATES and COMMUNITY PHASES

Ecological Dynamics of the Site
This ecological site is dominated (species composition by dry weight) by early sagebrush and perennial grasses

with forbs as a minor component. The site consists of three states: the Reference State (1.0), the Grazing Resistant State (2.0), and the Eroded State (3.0).

The Reference State is a collection of 2 distinct Plant Communities that exist on a continuum relative to disturbances, primarily grazing, pests, drought, and fire, with absence of disturbance also causing successional changes over time. These Plant Communities represent the best adapted plant communities to the soils and climate found on the site, and they represent the best estimation of ecological dynamics present on this site at the time of European settlement.

The Reference Plant Community (big sage/bunchgrass) of this site is dominated by early sagebrush (*Artemisia arbuscula*r ssp. longiloba) and cool-season perennial bunchgrass species, primarily Idaho fescue (*Festuca idahoensis*), Letterman's needlegrass (*Achnatherum lettermanii*) Indian Ricegrass (*Achnatherum hymenoides*), kingspike fescue (Leucopoa kingie), mutton bluegrass (Poa fenderiana), and bluebunch wheatgrass (*Pseudoroegneria spicata*) with rhizomatous grasses like thickspike wheatgrass (*Elymus lanceolatus* ssp. lanceolatus) and western wheatgrass (*Pascopyrum smithii*) subdominant. Minor components include short-statured bunchgrasses such as Sandberg bluegrass (*Poa secunda*), perennial forbs, and shrubs, including green rabbitbrush (*Chrysothamnus viscidiflorus*). Annual forbs comprise <1% of the plant community.

Events that kill entire stands of sagebrush are rare since this site has a lower fuel load, and it often provides a fuel break on the landscape where it occurs (Steinberg, 2002). When fires do occur, they are spotty. Sagebrush thinning via other disturbances, such as pests and climatic events, is more likely and the community phase shifts from sagebrush dominated to bunchgrass dominated.

Mid-stature bunchgrasses act as decreaser species in the Reference Community. Low stature bunchgrasses and rhizomatous grasses tolerate higher grazing pressure and grow on less fertile soils (USDA/NRCS 2007) than mid stature bunchgrasses. They often fill in the vegetation gaps created when mid stature bunchgrasses decline; hence they are collectively referred to as increaser species.

Early sagebrush is the dominant shrub on this site. Due to the heavy argillic subsurface layer on this site, it experiences flooding conditions in the spring (not conducive to big sagebrush species), and in the fall this site is drier than surrounding sites. Early sage is uniquely adapted to this feast-or-famine site.

Prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk, mule deer, and pronghorn grazed this ecological site, primarily as transitional and summer range (spring, summer, fall). Significant livestock grazing has occurred on most of this ecological site for more than 100 years. The Trans-Continental Railroad in the 1860s brought the first herds, and homesteaders began settling the area through the turn of the century. Livestock grazing in this region has historically been cattle, sheep, and horses with continuous grazing resulting in dominance of early sage and grazing resistant species such as rhizomatous wheatgrasses and Sandberg bluegrass.

This site is relatively resistant to weed invasion, but it has very low resilience once disturbed. The potential for soil erosion is high once this site is disturbed, and recovery may never occur. Sheep trailing is a common disturbance on this site since the sagebrush is smaller and more navigable than adjacent big sagebrush sites. Soil erosion from sheep trailing, in the form of gullies, can be seen along most historic sheep trailing routes. Soil erosion can also occur after catastrophic fire as a result of shrub cover levels above reference state conditions.

Historic mechanical treatments designed to reduce sagebrush and increase herbaceous species for livestock forage have most often resulted in a degradation of soil and site stability. There have been some successes in achieving those goals (decrease shrub cover, increase production of herbaceous forage species) using chemical treatments, but the timing is specific to avoid conversion to rabbitbrush dominance on the site (Eckert R. B., 1972) (Eckert R. E., 1968).

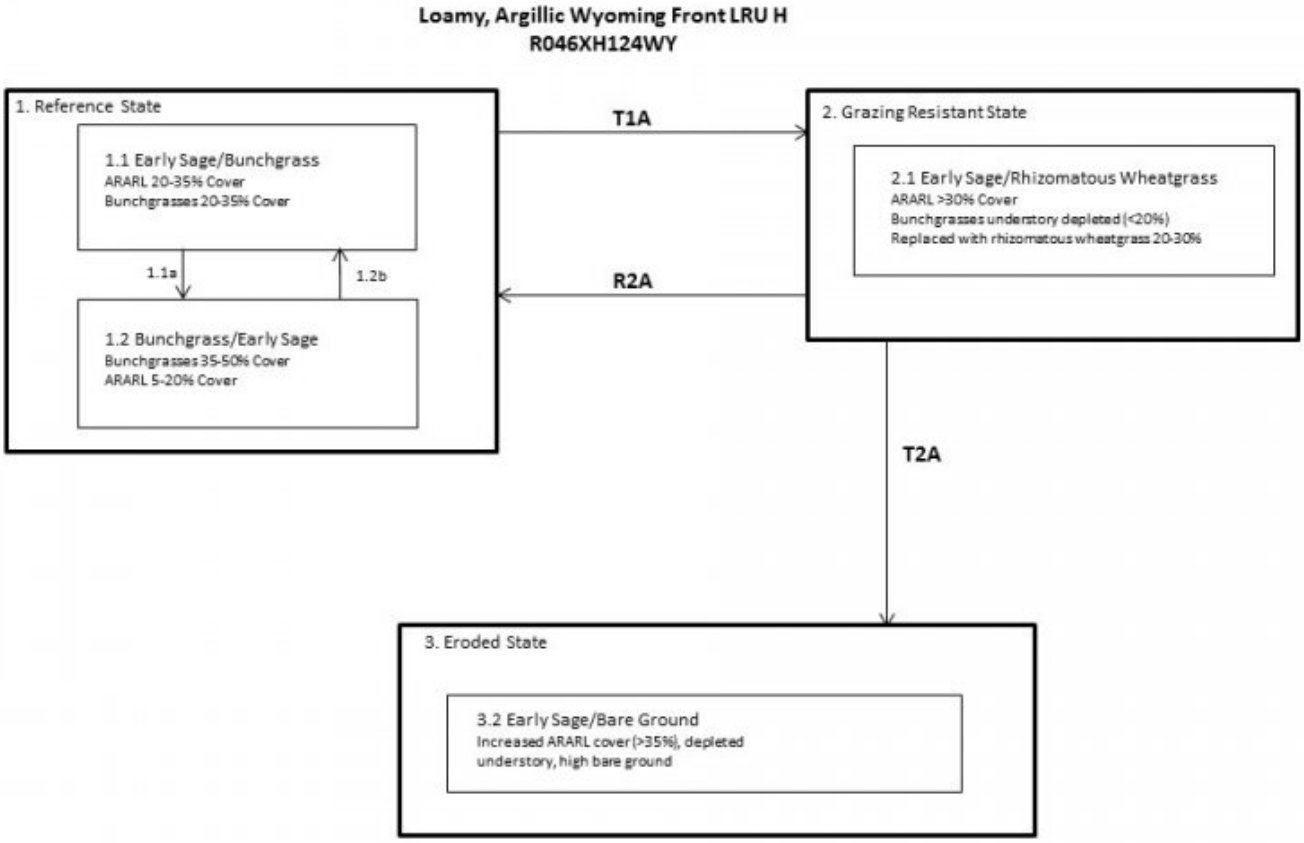
Plant Communities and Transitional Pathways
A State and Transition Model (STM) for the Loamy Argillic ecological site (R46XH124WY) is depicted in Figure 1. Thorough descriptions of each state, transition, plant community, and pathway are found after the model in this document. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. While based on the best available information, the STM will change over time as knowledge of ecological processes increases.

Plant communities within the same ecological site differ across the LRU due to the naturally occurring variability in weather, soils, and aspect. Not all managers will choose the reference plant community as the management goal. Other plant communities may be desired to meet land management objectives. This is valid as long as the Rangeland Health attributes assessment departures are slight to moderate or none to slight for the Reference State. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not a floristic inventory of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by dry weight and foliar cover (plant canopy) are used in this ESD. Most observers find it easier to visualize or estimate percent cover for woody species (trees and shrubs). Foliar cover drives the transitions between communities and states because of the influence of shade and interception of rainfall. Species composition by dry weight remains an important descriptor of the herbaceous community and of site productivity as a whole. Woody species are included in species composition by weight for the site. Calculating similarity index requires use of species composition by dry weight.

Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), no quantitative information exists that specifically identifies threshold parameters between reference states and degraded states in this ecological site (Bestelmeyer B. &., 2005) (Bestelmeyer B. B., 2003) (Bestelmeyer B. H., 2004) (Stringham, 2003)

State and transition model



State 1
Reference State

The Reference State consists of two Plant Communities: the Early Sage/Bunchgrass Community (1.1) and the Bunchgrass/Early Sage Plant Community (1.2). Each community differs in percent composition of bunchgrasses and percent woody canopy cover. Forbs are a minor component on this site. Woody foliar cover is less than 35 percent. Two important processes occurring in this state result in plant community changes within Reference State: sagebrush killing disturbances (browse, insects, drought, fire) and time without those disturbances (referred to as "natural succession"). Early sagebrush (*Artemisia arbuscula*r ssp. longiloba) is a unique sagebrush species due to its spring flowering period and its ability to tolerate both flooding and extreme drought (Shultz, 2009). The shift from the Bunchgrass/Early Sage Plant Community (1.2) to the Early Sage/Bunchgrass Plant Community (1.1) is dependent on an increase of woody cover. Without sagebrush killing disturbance, shrubs will increase on this ecological site even with proper grazing management. Improper grazing management may accelerate the rate of increase and amount of woody species, resulting in a transition to the Grazing Resistant State (2). The shift from the Early Sage/Bunchgrass to the Bunchgrass/Early Sage Plant Communities is dependent on sagebrush killing disturbances such as fire, drought, browse, and insects. Although this site is often not economical to treat for forage production, management actions have historically been used to mimic these processes through chemical treatments that focus on thinning and not removal. If total shrub removal occurs, soil erosion occurs, resulting in a degradation of soil and site stability. Prescribed fire is not often used on this site due to current land uses and lack of fuels and adequate burn windows. Mechanical treatments often result in degradation of soil and site stability.

Community 1.1
Early Sagebrush/Bunchgrass

Early sagebrush is dominant in the Early Sage/Bunchgrass Community (1.1) with sagebrush canopy cover ranging from 20% to 35%. The diversity in plant species allows for drought tolerance, and natural plant mortality is very low. Abundant plant litter is available for soil building and moisture retention. Plant litter is properly distributed with very little movement off-site. This plant community provides for soil stability and a properly functioning hydrologic cycle. An Early Sagebrush/Bunchgrass Community with a degraded understory is an “at-risk” community. There are generally few canopy gaps, and are all small (1-2 feet). Basal gaps are small (1-2 feet). Most shrub interspaces have canopy or litter cover.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	247	432	555
Grass/Grasslike	157	275	353
Forb	45	78	101
Total	**449**	**785**	**1009**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	20-35%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	60-90%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0-15%

Table 7. 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	0-10%
Biological crusts	0-10%
Litter	0%
Surface fragments >0.25" and <=3"	0-15%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	0%

Figure 4. Plant community growth curve (percent production by month). WY0201, 15-19W Upland sites.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				10	35	30	20	5			

Community 1.2
Bunchgrass/Early Sagebrush

The Bunchgrass/Big Sagebrush Community (1.2) can occur across the entire ecological site on a given landscape but more likely occurs in a mosaic pattern associated with the disturbance cycle at any given location. Mid-stature bunchgrasses dominate with sagebrush sub-dominant with cover ranging from 5% to 20%. There are generally few canopy gaps, and most basal gaps are generally small (1-2 feet). This plant community can be achieved through chemical means (USDI, Bureau of Land Management, 2002), however mechanical treatments that involve ground disturbance will most likely result in degradation of the soil resource and possibly crossing a threshold to an alternate state.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	269	471	605
Shrub/Vine	135	235	303
Forb	45	78	101
Total	**449**	**784**	**1009**

Table 9. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%

Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	60-90%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0-15%

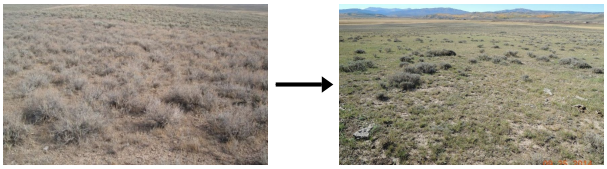
Table 10. Soil surface cover

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

Figure 6. Plant community growth curve (percent production by month). WY0201, 15-19W Upland sites.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				10	35	30	20	5			

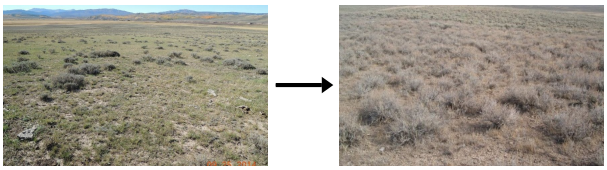
Pathway 1.1a
Community 1.1 to 1.2



Early Sagebrush/Bunchgrass **Bunchgrass/Early Sagebrush**

The driver for community shift 1.1a is the increase in density and vigor of mid-stature bunchgrasses to the point that they dominate species composition by weight. The trigger for this is a sagebrush killing event, such as fire, pests, or chemical control of sagebrush that favors the existing herbaceous vegetation.

Pathway 1.2b
Community 1.2 to 1.1



Bunchgrass/Early Sagebrush Early Sagebrush/Bunchgrass

The driver for community shift 1.1 is natural succession. The trigger for this shift is an increase in shrub canopy cover and relative decline in bunchgrasses.

State 2
Grazing Resistant State

The Grazing Resistant State (2.0) is characterized by an herbaceous layer dominated by short-statured bunchgrasses such as Sandberg bluegrass and rhizomatous grasses, upland sedges, and/or mat-forming forbs such as phlox, pussytoes, and buckwheat. Mid-stature bunchgrasses such as Idaho fescue, bluebunch wheatgrass, and bottlebrush squirreltail have become scarce or absent. There is one community in the Grazing Resistant State: the Early Sagebrush/Rhizomatous Wheatgrass Plant Community (2.1). The site crosses the threshold to the Grazing Resistant State (2.0) from the Reference State (1.0) when desirable mid-stature bunchgrasses lose dominance. Once these key species become scarce, it is unlikely that they have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. The Plant Community in the Grazing Resistant State (2.0) is very resistant to change and therefore common in this MLRA. In many cases, the transition to the Grazing Resistant State (2.0) may have occurred many decades ago during an era of higher stocking rates and continuous grazing during the growing season. However, continual grazing during the critical growth period (roughly May-June) at proper stocking rates will facilitate the transition to this state and maintain it in a stable state. While dominance by rhizomatous grasses makes the return to the Reference State (1.0) plant community difficult, it also makes the site resistant to further degradation except in cases where overstocked or in the case of prolonged drought with full stocking. The main factor creating high resistance is that the bluegrass and rhizomatous grasses are highly grazing tolerant. Sandberg bluegrass and rhizomatous grasses are low to the ground, so, even under heavy grazing, enough biomass remains for the grasses to maintain plant vigor. Rhizomatous grasses successfully reproduce through underground rhizomes. The rhizomatous grasses can form mats that provide soil protection by protecting the soil from raindrop impact, decreasing the risk of soil erosion. However, overall soil health is lower than the reference state, primarily due to a reduction in soil organic matter due to a reduction in litter. The decreased infiltration is due to increased bare ground patch size and lack of litter that acts as a mulch in retaining soil moisture and retarding runoff.

Community 2.1
Early Sagebrush/Rhizomatous Wheatgrass

The Early Sagebrush/Rhizomatous Wheatgrass Plant Community (2.1) is characterized by an herbaceous component dominated by Sandberg bluegrass, rhizomatous wheatgrasses, upland sedges, and/or mat forbs, with few mid-stature bunchgrasses. Once these key species become scarce, they are unlikely to have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. The plant community is highly resistant to changes in composition,

due to the dominance and competition of established bluegrass, rhizomatous wheatgrass, and/or mat forbs. This community is shrub dominated. Sagebrush foliar cover is usually great than 30%. The dominant shrub is early sagebrush. Areas that catch and retain snow are more likely to have higher shrub cover. Range Health Indicators: Production is lower than in Reference State (1.0), leading to lower soil organic matter content and therefore lower soil stability than in the Reference State. Ground cover is still high. Infiltration is lower than in the Reference State and the water cycle has reduced function due to decreased soil organic matter.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	154	308	432
Grass/Grasslike	99	196	275
Forb	28	56	78
Total	**281**	**560**	**785**

Table 12. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0%
Biological crusts	0%
Litter	40-60%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	10-30%

Table 13. 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	0-10%
Biological crusts	0-10%
Litter	0%
Surface fragments >0.25" and <=3"	0-30%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	0%

Figure 8. Plant community growth curve (percent production by month). WY0201, 15-19W Upland sites.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				10	35	30	20	5			

State 3
Eroded State

This state contains one plant community, the Early Sagebrush/*Bare Ground* Community (3.1). It is characterized by sparse herbaceous plant cover dominated by early sagebrush and bare ground. Communities in the Eroded State (3.0) have crossed a threshold (T2A) because of soil erosion, loss of soil fertility, and/or degradation of soil properties usually caused by mechanical disturbance and/or catastrophic wildfire outside of the natural fire regime. The consequent soil erosion affects the hydrology, soil chemistry, soil microorganisms, and soil physics and there is currently no known restoration pathway from this state.

Community 3.1
Early Sagebrush/Bareground

Herbaceous canopy cover in the Early Sagebrush/*Bare Ground* Community (3.1) is significantly reduced. Annual production is less than half of the Reference State (1). Perennial grass species (e.g., Idaho fescue, Letterman's needlegrass) may exist only in patches and are typically low in vigor. This community tends to be dominated by early sagebrush (>35% cover) and bare ground in large patches in the interspaces of the shrub canopy. The majority of annual production may be from early sagebrush and/or less palatable herbaceous species, so this site provides very little value for grazing. This plant community rarely produces sufficient quantity of fine fuels necessary to carry a fire. Therefore, fire no longer influences community dynamics. It differs from other communities, because it is characterized by sparse plant cover and soil surface erosion. Sparse vegetation creates low levels of foliar and basal cover. This, in turn, leads to low litter production, which is combined with reduced ability to retain litter on site. Soil is exposed to wind and water erosion (primarily water) in the plant interspaces. These factors combine to create a decrease in soil organic matter. Reduced litter cover, combined with reduced herbaceous cover, results in higher soil temperature, poor water infiltration rates, and high evaporation, thus favoring species which are more adapted to drier conditions. Soil fertility is reduced, soil compaction is increased, and resistance to soil surface erosion has declined compared to the other states. This community has lost most, if not all, of the attributes of a functioning, healthy rangeland, including good infiltration, minimal erosion and runoff, nutrient cycling, and energy flow.

Table 14. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	90	269	448
Grass/Grasslike	17	50	84
Forb	6	17	28
Total	**113**	**336**	**560**

Figure 10. Plant community growth curve (percent production by month). WY0201, 15-19W Upland sites.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				10	35	30	20	5			

Transition T1A
State 1 to 2

The driver for Transition T1A is continuous season-long grazing and/or long-term drought. Continuous grazing and drought can lead to a decline in palatable mid-stature bunchgrasses such as Idaho fescue and bluebunch wheatgrass (USDA, NRCS, 2018). Letterman's needlegrass is more grazing tolerant, but will eventually decline in plant density and vigor. As bunchgrasses diminish or die during periods of stress, low- stature bunchgrasses and rhizomatous grasses gain a competitive advantage, creating a shift in species composition towards less productive, shorter species. Bare ground often increases with larger gaps between the canopy and fewer herbaceous plants in the interspaces of the shrub canopy. Many of the remaining desirable bunchgrasses will be only found in the understory of the sagebrush canopy. Once mid-stature bunchgrasses species become scarce, it is unlikely that they have sufficient reproductive capability (seed source, tillering, or resprouting) to recover dominance in a reasonable time frame without extra energy being added to the system. When the understory vegetation has been degraded to this point, the transition to the Grazing Resistant State (2.0) can occur, typically from the Early Sage/Bunchgrass Plant Community (1.1). An increase in woody canopy cover often occurs as well. Management should focus on grazing management strategies that will prevent further degradation. This can be achieved through a grazing management scheme that varies the season of use to provide periodic deferment during the critical growth period (roughly May-June). Forage quantity and/or quality in the Grazing Resistant State (2.0) may be substantially reduced compared to the Reference State. Rangeland Health Implications/Indicators: The Biotic Integrity is impaired through the shift in relative dominance of functional/structural groups, a decrease in the number of species within a functional/structural group, and/or reduced site productivity. The changes in bare ground affect both Soil Site Stability and Hydrologic Function.

Restoration pathway R2A
State 2 to 1

The drivers for this restoration pathway are reduction of woody species and restoration of native herbaceous species by chemical treatment of sagebrush, and grazing rest or deferment. If some mid-stature bunchgrasses remain under the sage canopy, proper grazing management can move the site back to the Reference State (1.0) combined with a chemical sagebrush treatment. This could take multiple generations of management or could be accelerated with rest or deferment combined with successive wet springs conducive to seed germination and seedling establishment.

Transition T2A
State 2 to 3

The driver for Transition T2A is continuous high intensity grazing and/or long-term drought. It can also be caused by mechanical treatments, sheep trailing, or catastrophic fire. Soil erosion is accompanied by decreased soil fertility and soil and site stability. Several other key factors signal the approach of transition T2A: an increase in soil physical crusting, an increase in soil surface aggregate stability as the subsurface horizon is exposed, and/or evidence of erosion, including water flow patterns, development of plant pedestals, rills, and gullies. Very little litter is retained on the site to promote hydrologic function.

Additional community tables

Table 15. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-size Cool Season Grasses**			39–118	
	Idaho fescue	FEID	*Festuca idahoensis*	8–118	1–15

	spike fescue	LEKI2	*Leucopoa kingii*	8–78	1–10
	muttongrass	POFE	*Poa fendleriana*	39–78	5–10
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–78	0–10
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	39–78	5–10
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	39–78	5–10
2	**Rhizomatous Grasses**			39–78	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	39–78	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	39–78	5–10
3	**Misc Grasses/Grasslikes**			39–78	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–39	0–5
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–39	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–39	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–39	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–39	0–5
	basin wildrye	LECI4	*Leymus cinereus*	0–39	0–5
	oniongrass	MEBU	*Melica bulbosa*	0–39	0–5
Forb					
4	**Perennial Forbs**			39–71	
	balsamroot	BALSA	*Balsamorhiza*	0–39	0–5
	buckwheat	ERIOG	*Eriogonum*	0–39	0–5
	tansyaster	MACHA	*Machaeranthera*	0–39	0–5
	phlox	PHLOX	*Phlox*	0–39	0–5
	aster	SYMPH4	*Symphyotrichum*	0–39	0–5
	goldenrod	SOLID	*Solidago*	0–24	0–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–24	0–3
	fleabane	ERIGE2	*Erigeron*	0–24	0–3
	beardtongue	PENST	*Penstemon*	0–24	0–3
	bluebells	MERTE	*Mertensia*	0–24	0–3
	Lewis flax	LILE3	*Linum lewisii*	0–24	0–3
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–24	0–3
	cryptantha	CRYPT	*Cryptantha*	0–24	0–3
	Wyoming besseya	BEWY	*Besseya wyomingensis*	0–24	0–3
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–24	0–3
	milkvetch	ASTRA	*Astragalus*	0–24	0–3
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–24	0–3
	textile onion	ALTE	*Allium textile*	0–8	0–1
	sego lily	CANU3	*Calochortus nuttallii*	0–8	0–1
	shootingstar	DODEC	*Dodecatheon*	0–8	0–1
	bitter root	LERE7	*Lewisia rediviva*	0–8	0–1
	desertparsley	LOMAT	*Lomatium*	0–8	0–1
	tufted evening primrose	OECA10	*Oenothera caespitosa*	0–8	0–1
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–8	0–1

	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–8	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–8	0–1
5	**Annual Forbs**			0–8	
	pygmyflower rockjasmine	ANSE4	*Androsace septentrionalis*	0–8	0–1
	tiny trumpet	COLI2	*Collomia linearis*	0–8	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–8	0–1
	yellow owl's-clover	ORLU2	*Orthocarpus luteus*	0–8	0–1
	Forb, annual	2FA	*Forb, annual*	0–8	0–1
Shrub/Vine					
6	**Shrubs**			196–353	
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	196–353	25–45
7	**Misc Shrubs**			0–78	
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–39	0–5
	little sagebrush	ARARA	*Artemisia arbuscula ssp. arbuscula*	0–39	0–5
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	0–39	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–39	0–5
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–39	0–5
	Woods' rose	ROWO	*Rosa woodsii*	0–39	0–5
	western snowberry	SYOC	*Symphoricarpos occidentalis*	8–39	1–5
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–24	0–3
	slender buckwheat	ERMIL2	*Eriogonum microthecum var. laxiflorum*	0–24	0–3
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–8	0–1

Table 16. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-size Cool Season Grasses**			118–314	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	39–118	5–15
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	39–118	5–15
	Idaho fescue	FEID	*Festuca idahoensis*	8–118	1–15
	spike fescue	LEKI2	*Leucopoa kingii*	8–118	1–15
	muttongrass	POFE	*Poa fendleriana*	39–118	5–15
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	0–118	0–15
2	**Rhizomatous Grasses**			39–78	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	39–78	5–10
	western wheatgrass	PASM	*Pascopyrum smithii*	39–78	5–10
3	**Misc Grasses**			39–78	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–39	0–5
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–39	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–39	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–39	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–39	0–5

	basin wildrye	LECI4	*Leymus cinereus*	0–39	0–5
	oniongrass	MEBU	*Melica bulbosa*	0–39	0–5
Forb					
4	**Perennial Forbs**			39–71	
	buckwheat	ERIOG	*Eriogonum*	0–39	0–5
	aster	SYMPH4	*Symphyotrichum*	0–39	0–5
	tansyaster	MACHA	*Machaeranthera*	0–39	0–5
	phlox	PHLOX	*Phlox*	0–39	0–5
	balsamroot	BALSA	*Balsamorhiza*	0–39	0–5
	Wyoming besseya	BEWY	*Besseya wyomingensis*	0–24	0–3
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–24	0–3
	milkvetch	ASTRA	*Astragalus*	0–24	0–3
	beardtongue	PENST	*Penstemon*	0–24	0–3
	goldenrod	SOLID	*Solidago*	0–24	0–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–24	0–3
	bluebells	MERTE	*Mertensia*	0–24	0–3
	Lewis flax	LILE3	*Linum lewisii*	0–24	0–3
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–24	0–3
	cryptantha	CRYPT	*Cryptantha*	0–24	0–3
	fleabane	ERIGE2	*Erigeron*	0–24	0–3
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–24	0–3
	textile onion	ALTE	*Allium textile*	0–8	0–1
	sego lily	CANU3	*Calochortus nuttallii*	0–8	0–1
	shootingstar	DODEC	*Dodecatheon*	0–8	0–1
	desertparsley	LOMAT	*Lomatium*	0–8	0–1
	bitter root	LERE7	*Lewisia rediviva*	0–8	0–1
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–8	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–8	0–1
	tufted evening primrose	OECA10	*Oenothera caespitosa*	0–8	0–1
5	**Annual Forbs**			0–8	
	pygmyflower rockjasmine	ANSE4	*Androsace septentrionalis*	0–8	0–1
	tiny trumpet	COLI2	*Collomia linearis*	0–8	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–8	0–1
	yellow owl's-clover	ORLU2	*Orthocarpus luteus*	0–8	0–1
	Forb, annual	2FA	*Forb, annual*	0–8	0–1
Shrub/Vine					
6	**Srubs**			39–196	
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	39–196	5–25
7	**Misc Shurbs**			0–39	
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–39	0–5
	little sagebrush	ARARA	*Artemisia arbuscula ssp. arbuscula*	0–39	0–5
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	0–39	0–5

	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–39	0–5
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–39	0–5
	Woods' rose	ROWO	*Rosa woodsii*	0–39	0–5
	western snowberry	SYOC	*Symphoricarpos occidentalis*	8–39	1–5
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–24	0–3
	slender buckwheat	ERMIL2	*Eriogonum microthecum var. laxiflorum*	0–24	0–3
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–8	0–1

Table 17. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Perennial Mid-size Cool Season Grasses**			0–28	
	spike fescue	LEKI2	*Leucopoa kingii*	6–28	1–5
	muttongrass	POFE	*Poa fendleriana*	28	5
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	28	0–5
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	28	5
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	28	5
	Idaho fescue	FEID	*Festuca idahoensis*	6–28	1–5
2	**Rhizomatous Grasses**			56–140	
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	28–140	5–25
	western wheatgrass	PASM	*Pascopyrum smithii*	28–140	5–25
3	**Misc Grasses/Grasslikes**			0–28	
	needleleaf sedge	CADU6	*Carex duriuscula*	0–28	0–5
	Montana wheatgrass	ELAL7	*Elymus albicans*	0–28	0–5
	squirreltail	ELEL5	*Elymus elymoides*	0–28	0–5
	needle and thread	HECO26	*Hesperostipa comata*	0–28	0–5
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–28	0–5
	basin wildrye	LECI4	*Leymus cinereus*	0–28	0–5
	oniongrass	MEBU	*Melica bulbosa*	0–28	0–5
Forb					
4	**Perennial Forbs**			28–50	
	balsamroot	BALSA	*Balsamorhiza*	0–28	0–5
	buckwheat	ERIOG	*Eriogonum*	0–28	0–5
	tansyaster	MACHA	*Machaeranthera*	0–28	0–5
	phlox	PHLOX	*Phlox*	0–28	0–5
	aster	SYMPH4	*Symphyotrichum*	0–28	0–5
	goldenrod	SOLID	*Solidago*	0–17	0–3
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–17	0–3
	fleabane	ERIGE2	*Erigeron*	0–17	0–3
	beardtongue	PENST	*Penstemon*	0–17	0–3
	bluebells	MERTE	*Mertensia*	0–17	0–3

	Lewis flax	LILE3	*Linum lewisii*	0–17	0–3
	pale bastard toadflax	COUMP	*Comandra umbellata ssp. pallida*	0–17	0–3
	cryptantha	CRYPT	*Cryptantha*	0–17	0–3
	Wyoming besseya	BEWY	*Besseya wyomingensis*	0–17	0–3
	rosy pussytoes	ANRO2	*Antennaria rosea*	0–17	0–3
	milkvetch	ASTRA	*Astragalus*	0–17	0–3
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–17	0–3
	textile onion	ALTE	*Allium textile*	0–6	0–1
	sego lily	CANU3	*Calochortus nuttallii*	0–6	0–1
	shootingstar	DODEC	*Dodecatheon*	0–6	0–1
	bitter root	LERE7	*Lewisia rediviva*	0–6	0–1
	desertparsley	LOMAT	*Lomatium*	0–6	0–1
	tufted evening primrose	OECA10	*Oenothera caespitosa*	0–6	0–1
	hollyleaf clover	TRGY	*Trifolium gymnocarpon*	0–6	0–1
	Forb, perennial	2FP	*Forb, perennial*	0–6	0–1
5	**Annual Forbs**			0–6	
	pygmyflower rockjasmine	ANSE4	*Androsace septentrionalis*	0–6	0–1
	tiny trumpet	COLI2	*Collomia linearis*	0–6	0–1
	bushy bird's beak	CORA5	*Cordylanthus ramosus*	0–6	0–1
	yellow owl's-clover	ORLU2	*Orthocarpus luteus*	0–6	0–1
	Forb, annual	2FA	*Forb, annual*	0–6	0–1
Shrub/Vine					
6	**Shurbs**			140–280	
	little sagebrush	ARARL	*Artemisia arbuscula ssp. longiloba*	140–280	25–50
7	**Misc Shrubs**			0–28	
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	0–28	0–5
	little sagebrush	ARARA	*Artemisia arbuscula ssp. arbuscula*	0–28	0–5
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	0–28	0–5
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	0–28	0–5
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–28	0–5
	Woods' rose	ROWO	*Rosa woodsii*	0–28	0–5
	western snowberry	SYOC	*Symphoricarpos occidentalis*	6–28	1–5
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–17	0–3
	slender buckwheat	ERMIL2	*Eriogonum microthecum var. laxiflorum*	0–17	0–3
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–6	0–1

Animal community

The following table lists suggested stocking rates for cattle forage preferences under continuous season-long grazing under normal growing conditions using a Harvest Efficiency of 25% and 912 pounds of forage per Animal Unit Month (AUM). 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, but recovery time for upland sites is much longer than in a low intensity system. If distribution problems occur, stocking rates must be reduced or facilitating conservation practices (i.e. cross-fencing, water development) to maintain plant health and vigor.

Plant Community Production (RV) Carrying Capacity*
(lb./ac) (AUM/ac)
Early Sagebrush/Bunchgrass (Reference) 400-900 (700) .08
Bunchgrass/Early Sagebrush 400-900 (700) .12
Early Sagebrush/Rhizomatous Wheatgrass 250-700 (400) .04
Early Sagebrush/*Bare Ground* 100-500 (300) .02
* - Continuous, season-long grazing by cattle under average growing conditions.

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 grazing capacity within a management unit. Adjustments should be made for each specific area for reduction of animal numbers based on specific characteristics of the pasture, allotment, or grazing unit. For example, 30% of a management unit may have 25% slopes and distances of greater than1 mile from water; therefore the adjustment is only calculated for 30% of the unit (e.g. 50% reduction on 30% of the acres in 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.

Wildlife Community
Reference State:
1.1 Early Sagebrush/Bunchgrass: This community phase provides excellent foraging habitat for elk, mule deer, pronghorn, and sage-grouse. A diverse suite of herbaceous species can provide important micro-nutrient requirements for big game species throughout the year, but primarily during spring and migration seasons. These areas also provide high quality bird nesting habitat where sagebrush canopy and residual bunchgrasses hide nests and young from predators. Wet conditions in the spring make these sites important forb producers for wildlife.
1.2 Bunchgrass/Early Sagebrush: This community phase tends to have higher herbaceous plant diversity that may attract more diverse wildlife use. The plant community provides good forage and cover for sagebrush obligate species. The more open canopy promotes higher diversity and quantity of forbs that are important for sage-grouse broodrearing habitat. It also provides high quality habitat for elk, mule deer and pronghorn as they transition between winter and summer ranges.
Grazing Resistant State:
2.1 Early Sagebrush/Rhizomatous Wheatgrass: This community phase is variable in its value to wildlife. The value of the sagebrush component of this community, particularly for big game species, is similar to the reference state but the value of the grass and forb community decreases. In periods of high plant vigor, the herbaceous understory may provide adequate cover and structure for nesting birds and small mammals. In periods of drought and low plant vigor, the herbaceous understory is short and likely not dense enough to provide adequate cover and habitat value declines.
Eroded State:
3.1 Early Sagebrush: This community phase provides suitable habitat for big game and sagegrouse when sagebrush plants are in healthy condition. The lack of herbaceous species limits the value of the site for birds and small mammals due to the lack of cover in the interspaces of the sagebrush plants. The lack of plant diversity limits the diversity of insects used by wildlife species. This state is vulnerable to repeated disturbance which can result in a complete loss of value for wildlife. In addition, sites in this state are more susceptible to invasion of non-native species, further degrading the value for wildlife.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration is low when soils are wet due to shallow depth to bedrock and/or impervious subsurface layer. Runoff

potential for this site varies from high to moderate depending on soil depth, bedrock type (impervious vs. permeable) and ground cover (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Active rills and gullies are not common or expected unless slopes exceed 15%. Water flow patterns are not expected unless slopes exceed 8%. Pedestals are blunt (not active) and occasionally present in association with bunchgrasses. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are not common. Cryptogrammic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides recreational opportunities for hiking, horseback riding, bird watching, and upland game hunting. The forbs have a variety of colors and shapes that appeal to photographers. This site provides valuable open space when located in large, unfragmented landscapes.

Wood products

None

Other products

None

Other information

Plant Preference by Animal Kind:
https://docs.google.com/viewera=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxtbHJhMzRhfGd4OjIyZWEyYzIyMGE5NWE4MzM
Refer to Technical Reference.

Inventory data references

Inventory Data References (narrative):
Information presented was derived from 1988 Range Site Descriptions: (Shallow Clayey Foothills and Basins West), NRCS clipping data, literature, field observations (based on sampled sites and observations), and personal contacts with range-trained personnel (i.e., agency specialists, landowners, land managers, and scientists).

Data Source # of Records Sample Period State County
Field Data 3 (1.1 Reference) 2008-2018 WY Sublette
Field Data 1 (1.2 Reference) 2014 WY Sublette
Field Data 13 (2.1 P.C.) 2008-2018 WY Sublette
Field Obs. 1 (3.1 P.C.) 2008 WY Sublette

Type locality

Location 1: Lincoln County, WY	
Township/Range/Section	T24N R118W S7
UTM zone	N
UTM northing	42.079579
UTM easting	-110.72948

Other references

USNVC [United States National VegetationClassification]. (2017). US National Vegetation Classification Database V2.01. (F. G. Committee, Editor, V. Subcommittee, Producer, & Washington DC) Retrieved 03 23, 2018, from USNVC: http://usnvc.org/explore-classification/

Bestelmeyer, B. &. (2005). State-and-transition models 101: a fresh look at vegetation change. The Ouivira Coalition Newsletter, Vol. 7, No. 3.
Bestelmeyer, B. B. (2003). Development and use of state and transition models for rangeland. Journal of Range Management, 56(2):114-126.
Bestelmeyer, B. H. (2004). Land management in the American Southwest: a state-and-transition approach to ecosystem complexity. Environmental Management, 34(1): 38-51.
Cagney, J. B. (2010). Grazing influence, objective development, and management in Wyoming's greater sage-grouse habitat. Cheyenne: BLM.
Eckert, R. B. (1972). Response of understory species following herbicidal control of low sagebrush. Journal of Range Management, 25: 280-285.
Eckert, R. E. (1968). Chemical control of low sagebrush and associated green rabbitbrush. Journal of Range Management, 21(5): 325-328.
Mahalovich, M. M. (2004). Sagebrush (Artemisia spp.) seed and plant transfer guidelines. Native Plants Journal, 5(2): 141-148.
Omerik, J. a. (2014). Ecoregions of the conterminous United States: evolution of a hierarchical spatial framework. Environmental Management, 54(6): 1249-1266.
Shultz, L. M. (2009, Oct 19). Monograph of Artemisia Subgenus Tridentatae (Asteraceae-Anthemideae). Systematic Botany Monographs, Vol. 89, Monograph of Artemisia Subgenus Tridentatae (Asteraceae-Anthemideae), 1-131. American Society of Plant Taxonomists. Retrieved from http://www.jstor.org/stable/25592362
Steinberg, P. D. (2002). *Artemisia arbuscula*. In: Fire Effects Information [Online]. Retrieved Jan 21, 2014, from http://www.fs.fed.us/database/feis/
Stiver, S., Rinkes, E., & Naugle, D. (2010). Sage-Grouse Habitat Assessment Framework. Unpublished, 100-106.
Stringham, T. K. (2003). State and transition modeling: an ecological process approach. Journal of Range Management, 56(2): 106-113.
USDA, NRCS. (2018, 03 06). Plant Fact Sheets. Retrieved from PLANTS Database: https://plants.usda.gov/java/
USDI, Bureau of Land Management. (2002). Managemet considerations for sagebrush (Artemisia) in the western U.S.: A selective summary of cumulative information about the ecology and biology of woody N. American sagebrush taxa. Washington, D.C.: USDI-BLM.

Approval

Scott Woodall, 9/05/2018

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)	K. Clause, B. Christensen
Contact for lead author	Karen Clause
Date	09/05/2018
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None to Rare. Some very minor rills may occur after a major thunderstorm event or spring runoff. Rills may also occur in areas of greater slope (>10%) and near areas with exposed bedrock, but should heal during the following growing season.

2. **Presence of water flow patterns:** Barely observable. Some minor evidence of water flow patterns may be found winding around perennial plant bases with little evidence of erosion and they are short (< 6 ft).

3. **Number and height of erosional pedestals or terracettes:** None to Rare. Plant roots are covered and most litter remains in place around plant crowns.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground can range from 20-30%.

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** Rare to nonexistent.

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Stability Index ratings range from 1 (interspaces) to 6 (under plant canopy), but average values should be 3.0 or greater.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. Described A-horizons vary from 1-12 inches (3-30 cm) with OM of 1 to 2%.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 45% grasses, 10% forbs, and 45% shrubs. Evenly distributed plant canopy (45-60%) and litter plus moderate to moderately rapid infiltration rates result in minimal runoff. Basal cover is typically less than 25% for this site and does very little to effect runoff on this site.

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

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

Sub-dominant:

Other:

Additional: Mid-size, cool season bunchgrasses perennial shrubs=cool season rhizomatous grassesperennial forbsshort cool season bunchgrasses

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

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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 5-30% of total canopy measurement with total litter (including beneath the plant canopy) from 30-70% expected. Herbaceous litter depth typically ranges from 3-10mm. Woody litter can be up to a couple inches (4-6 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** English: 500-900 lb/ac (700 lb/ac average); Metric 560-1008 kg/ha (784 kg/ha average).

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** ": Bare ground greater than 50% is the most common indicator of a threshold being crossed. Rabbitbrush, granite prickly phlox, Sandberg bluegrass, buckwheat, and phlox are common increasers. Annual weeds such as kochia, mustards, lambsquarter, and Russian thistle are common invasive species in disturbed sites.

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