USDA Natural Resources Conservation Service

Ecological site R043AB040MT
Loamy Steep (Lostp) LRU 43A-B

Last updated: 2/05/2022
Accessed: 05/11/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 043A–Northern Rocky Mountains

For further information regarding MLRAs refer to:
http://soils.usda.gov/survey/geography/mlra/index.html

LRU notes

Land Resource Unit 43A-B (LRU):
• Moisture Phase: xeric
• Temperature Phase: frigid, cool - frigid
• Dominant Cover: rangeland
• Representative Value (RV) Effective Precipitation: 17-20 inches
• RV Frost-Free Days: 70-105 days

Ecological site concept

Site Concept:
Site does not receive any additional water.
Soils are:
• not saline or saline-sodic.
• moderately deep, deep, or very deep with < 15% stone and boulder cover.
• not skeletal within 20” of soil surface.
• not strongly or violently effervescent in surface mineral 4”.
Surface textures usually range from very fine sandy loam to clay loam.
Slope is > 15%.
A mollic epipedon is present.
Clay content is < 32% in surface mineral 4”.

Associated sites

R043AB038MT	**Droughty Steep (Drstp) LRU 43A-B**

Similar sites

R043AB038MT	**Droughty Steep (Drstp) LRU 43A-B** This site differs by being skeletal at 10-20

Table 1. Dominant plant species

Tree	Not specified

Shrub	Not specified
Herbaceous	(1) *Festuca campestris* (2) *Festuca idahoensis*

Physiographic features

The Loamy Steep (LoStp) ecological site (R043AB040MT) is located within LRU "B" in MLRA "43A." This ecological site occurs on strongly sloping hills, mountains, alluvial fans, ridges, or moraines. Slope ranges from 15% to 55%. This site occurs on all exposures; effects of aspect can be significant in LRU assignment.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Mountain (3) Alluvial fan
Elevation	549–1,524 m
Slope	15–55%
Water table depth	107 cm
Aspect	Aspect is not a significant factor

Climatic features

The dissected Northern Rocky Mountains of MLRA 43A are considered to have a maritime climate. Precipitation is fairly evenly distributed throughout the year with less than about 35% of the annual precipitation occurring during the growing season in Montana. Rainfall occurs as high-intensity, convective thunderstorms in the spring and fall. Most of the precipitation in the winter is snow or rain on fully or partially frozen ground. Average precipitation for LRU-B is 18.5", and the frost-free period averages 87.5 days.

See Climatic Data Sheet for more details (Section II of the Field Office Technical Guide: http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=MT) or reference the following climatic Web site: http://www.wrcc.dri.edu/climsum.html.

Table 3. Representative climatic features

Frost-free period (average)	105 days
Freeze-free period (average)	125 days
Precipitation total (average)	508 mm

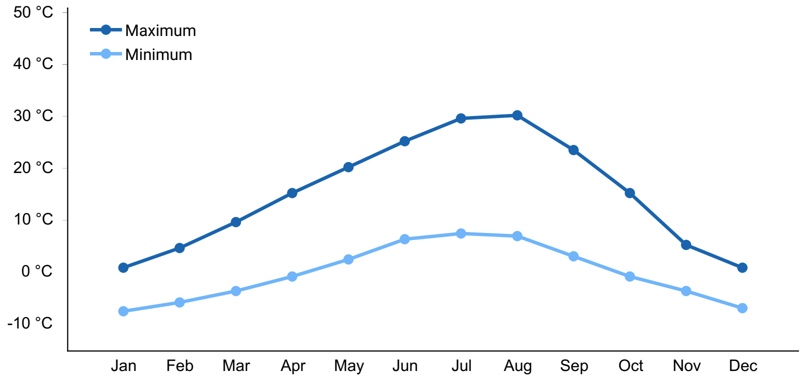


Figure 1. Monthly average minimum and maximum temperature

Influencing water features

Soil features

These soils contain a well-developed mollic epipedon and are typically very deep, well-drained soils that were formed in residuum. Surface textures (< 2mm) usually range from coarse sandy loam to clay loam; clay content is = 32%. Soil may contain gravels and/or cobbles but they will not exceed an average of 35% by volume in the 10-20" layer.

Table 4. Representative soil features

Surface texture	(1) Loam (2) Silt loam (3) Clay loam
Family particle size	(1) Loamy
Drainage class	Moderately well drained
Permeability class	Moderately slow to moderately rapid
Soil depth	51 cm
Available water capacity (0-101.6cm)	10.16–19.05 cm
Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–1 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–12
Soil reaction (1:1 water) (0-101.6cm)	6.3–8.2

Ecological dynamics

The Loamy Steep ecological site is characterized by the production and composition of plant species in the Reference Community, which is defined by soils, precipitation, and temperature regime influencing the site. The presumed Reference Plant Community type of this site is dominated by cool-season perennial bunchgrass species, primarily rough fescue (*Festuca campestris*) with minor components of perennial forbs and low-growing shrubs. LRU-B occurs in the Rocky Mountains of western Montana, on rangelands with a xeric soil moisture phase, a frigid, cool - frigid soil temperature phase, 17-20" of effective precipitation, and between 70 and 105 consecutive frost-free days annually. This site is characterized by soils having medium-textured surface horizons, with a mollic epipedon, and slopes that are > 15%.

The majority of precipitation comes early in the form of snow and spring rain. Summers are usually dry. The growing season is short and cool; primary growth typically occurs between May and July, and dominant plants are those that have adapted to these conditions.

In response to disastrous fires in 1910, new firefighting policies were established. Wildland fire suppression became an important driving factor in the ecology of western rangelands. Livestock grazing during the late 1800s and early 1900s often occurred at very heavy levels. Heavy grazing resulted in a severe reduction in fine fuels, which further reduced potential for natural fires. These two actions altered the natural fire interval.

Fire suppression, along with fine-fuels reduction, has interfered with the natural fire interval; many areas have currently not burned for over 100 years (Arno and Gruell 1986). Prior to 1900, the average natural fire return intervals were probably shorter than 35 years for this MLRA. Historic fire frequency may have ranged from 15 to 75 years. Trees and non-sprouting shrubs were restricted to small patches or widely spaced plants. Following fire on medium-textured soils, perennial bunchgrasses apparently recovered in a few years and were present to fuel subsequent fires, which suppressed woody species and kept them as a minor component of the community (Arno and Gruell 1983).

Historical records indicate, prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk and bison grazed this ecological site. Evidence shows periodic use by bison was in large numbers and concentrations (Lesica and Cooper 1997). Forage for livestock was noted as minimal in areas recently grazed by bison (Lesica and Cooper 1997).

Significant livestock grazing has occurred on most of this ecological site in western Montana for more than 100 years (beginning with the 1860's gold boom and subsequent settlement through 1900). Indian horse herds were present and numerous for several hundred years prior. The primary type of European livestock grazed in this region has historically transitioned between sheep and cattle with early grazing (pre-1890) dominated by the cattle industry. In the 1890s Montana sheep production began to increase dramatically (> 400%) and dominated the cattle industry for approximately four decades. By the 1930s livestock production once again favored the cattle industry, which continues to dominate livestock grazing in the region today (Wyckoff and Hansen 2001). The Loamy Steep ecological site is relatively accessible and many examples were subject to heavy and/or season-long grazing until 1970 or later. Most of the deeper sites within MLRA 43A were plowed and converted to annual crops or tame pasture between 1880 and 1960.

Invasive species are an important part of the ecology of MLRA 43A. Notable invasive species include spotted knapweed (*Centaurea stoebe*), leafy spurge (*Euphorbia esula*), sulphur cinquefoil (*Potentilla recta*), and cheatgrass (*Bromus tectorum*). Most sites in MLRA 43A have no impact from these invasives. Sites are either currently invaded or have been treated to kill invasives, which reduces the production and changes the composition of forbs and shrubs. Even where invasives are not present, the threat of invasion drives management of this site.

Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), no quantitative information exists that specifically identify threshold parameters between grassland types and invaded types in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Stringham et al. 2003, Bestelmeyer et al. 2004, and Bestelmeyer and Brown 2005.

Rangeland Health Reference Worksheets have been posted for this site on the Montana NRCS Web site (www.mt.nrcs.usda.gov) in Section II of the eFOTG under (F) Ecological Site Descriptions (ESD).

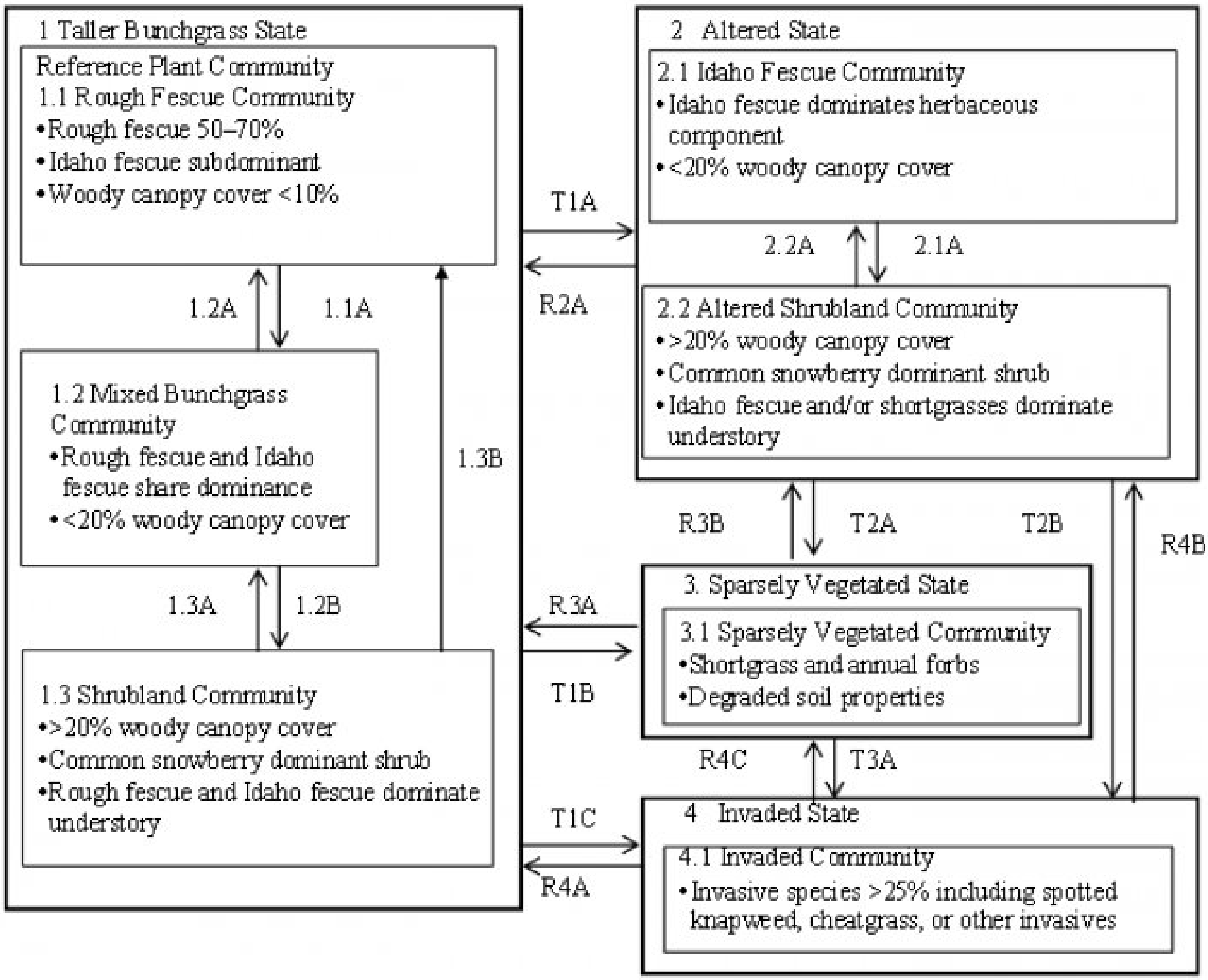
Plant Communities and Transitional Pathways
A STM for the Loamy Steep ecological site (43AB040MT) is depicted in Figure 1. Thorough descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field observations, and interpretations by experts and is likely to change as knowledge increases.

The plant communities will differ across the MLRA because of the naturally occurring variability in weather, soils, and aspect. 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 botanical descriptions of all species occurring, or potentially occurring, on this site. The species lists are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Both percent species composition by weight and percent canopy cover are used in this ESD. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs). Canopy 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 the community as a whole. Woody species are included in species composition for the site. Calculating similarity index requires use of species composition by dry weight.

This STM includes only native communities and states. The converted communities are described in the Ecological Dynamics section above.

State and transition model



1.1A Lack of Fire, Improper Grazing Management
1.2A Fire, Proper Grazing Management
1.2B Lack of Fire, Improper Grazing Management
1.3A Fire, Proper Grazing Management
1.3B Fire, Proper Grazing Management
2.1A Overgrazing, Lack of Fire
2.2A Fire, Proper Grazing Management
T1A Overgrazing, Lack of Fire
T1B Overgrazing, Soil Erosion
T1C Introduction of Weedy Propagules
T2A Overgrazing, Soil Erosion
T2B Introduction of Weedy Propagules
T3A Introduction of Weedy Propagules
R2A Mechanical Brush Management, Range Seeding
R3A Proper Grazing Management, Range Seeding
R3B Range Seeding
R4A Weed Management, Range Seeding
R4B Weed Management, Woody Propagules Present
R4C Weed Management, Wood Propagules Not Present

Figure 2. 43AB040MT Loamy Steep

State 1

Taller Bunchgrass State

This state is characterized by cool-season bunchgrasses and is represented by three communities that differ mainly in the percent composition rough fescue, Idaho fescue (*Festuca idahoensis*), and shrubs. Forbs are a minor component in this state.

Community 1.1
Reference Plant Community - Rough Fescue Community

Figure 3. 43AB Loamy Steep

The Rough fescue Community (1.1) is dominated by rough fescue, a taller cool-season bunchgrass, with a minor forb and shrub component. Rough fescue is typically the dominant species in the Rough Fescue Community (1.1), while Idaho fescue is subdominant. Bluebunch wheatgrass (*Pseudoroegneria spicata*) can be a subdominant species in the xeric portion of this LRU. Many common forb species exist on this site, including prairie smoke (*Geum triflorum*), and silky lupine (*Lupinus sericeus*.). Shrub species, including Woods' rose (*Rosa woodsii*) and common snowberry (*Symphoricarpos albus*) are present as a minor part of the community. The Taller Bunchgrass State generally occurs on the Loamy Steep site in areas where proper grazing management practices have been implemented over a long period. The Rough Fescue Community can be maintained through the implementation of properly managed grazing that provides adequate growing-season deferment to allow establishment of taller grass propagules and/or the recovery of vigor of stressed plants. The Rough Fescue Community (1.1) in general is resistant to change with proper grazing management and near normal precipitation. However, rough fescue lacks resistance to grazing during the spring growing season. Subdominant species, such as Idaho fescue, tolerate higher grazing pressure and may increase in cover under prolonged drought conditions. This increase drives the community shift to the Mixed Bunchgrass Community (1.2). The Rough Fescue Community (1.1) is moderately resilient to shrub invasion if properly managed. However, if continuous overgrazing does occur shrub canopy will increase and desirable understory will decrease. There will be a notable increase in less desirable plants such as Idaho fescue and shortgrasses. When this occurs the Rough Fescue Community (1.1) will shift to a Mixed Bunchgrass Community (1.2). Once the site becomes dominated Idaho fescue it will transition to the Altered State (2). Periodic fire increases the resilience of the Rough Fescue Community (1.1) by reducing competition and canopy cover of woody species. Fire also removes decadent herbaceous material, particularly from taller bunchgrasses, which promotes increased vigor and seedling establishment. Timing and intensity of a fire are critical components that can have varying positive or negative effects on this plant community. Fire does increase risk of invasion from invasive species, most notably cheatgrass. At least two growing seasons of rest are recommended to allow for plants to recover after fire. Without fire and/or brush control, woody species on the site will increase and the site will shift to the Shrubland Community (1.3). This can occur with or without the degradation of the herbaceous community from rough fescue dominated to a community dominated by Idaho fescue. If degradation of the herbaceous component does occur, the site will transition to the Altered State (2). Because the woody species that dominate in the Shrubland Community (1.3) are native species in the Taller Bunchgrass State, the shift to the Shrubland Community is a linear process with shrubs starting to increase soon after fire or brush control ceases. Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to erosion. Litter and mulch will move off-site as plant cover declines. When canopy cover decreases to below 50%, the surface horizon becomes less stable and erosion can occur. This will make it more difficult to reestablish rough fescue plants due to decreased soil fertility. When overgrazing continues, invasive grass and forb species move into the plant community and the site transitions to the Altered State (2), Sparsely Vegetated State (3) or the Invaded

State (4). Until the Rough Fescue Community (1.1) crosses the threshold into the Altered State (2), Sparsely Vegetated State (3) or the Invaded State (4), this community can be managed back toward the Rough Fescue Community (1.1) using management practices including prescribed grazing, prescribed burning, and strategic weed control. It may take several years to achieve this state, depending upon the climate and the aggressiveness of the treatment. While the Rough Fescue Community (1.1) is resilient to degradation under proper management, the community remains at risk of invasion by aggressive nonnative species because of the ability of spotted knapweed, leafy spurge, and cheatgrass to invade healthy rangelands and the widespread presence of propagules. Healthy plant communities are the most resilient to invasives. Mismanagement increases the risk of invasion, but many examples exist of well-managed areas that have been invaded by spotted knapweed. Invasives impact plant communities even if the site does not yet have a critical population of invasives. Almost all reference sites had at least trace amounts of spotted knapweed and/or cheatgrass. It is believed that most sites with only trace amounts have been chemically treated for invasives at some point. These treatments would have impacted other broad-leafed species (forbs and shrubs). It is likely that this site had more potential for forb and shrub production than found on current reference sites. The natural fire regime would have favored an increase in forbs while maintaining shrubs as a very minor component. Rock cover on the soil surface is minimal and does impact productivity of this site. Plant basal cover is expected to be about 20 to 30% and bare ground is expected to be between 5 to 15%. Soil stability of this site is stable. There should be no signs of current erosion occurring on the site. The following production figures do not represent the lowest or highest possible production for the reference community (1.1). For example, the high figure is not the most production that can occur in a wet year in the most mesic portion of the LRU. These values represent the range of variability for each species across the extent of the ecological site. Usually, values in the low production column represent production at the dry end of the LRU and those in the high production column represent production at the wet end of the LRU. Even the most stable communities exist within a range of dynamic equilibrium of species composition. The following table shows an example of species composition; the example is not the only mix of species possible in the Rough Fescue Community (1.1).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1166	1524	1883
Forb	146	191	235
Shrub/Vine	146	191	235
Total	**1458**	**1906**	**2353**

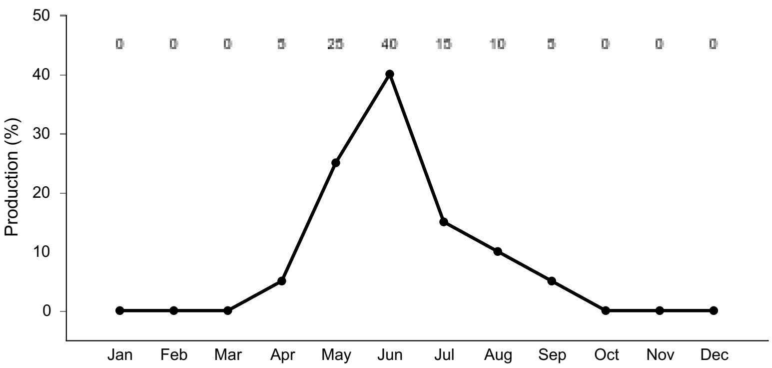


Figure 5. Plant community growth curve (percent production by month). MT0431, 43A - Uplands. Includes all upland sites in 43A.

Community 1.2
Mixed Bunchgrass Community

Rough fescue and Idaho fescue share dominance in this community. There may be a moderate overstory of common snowberry. Common snowberry and Idaho fescue increase in species composition when rough fescue decreases due to improper grazing management and lack of fire and brush control. Rough fescue will have lower relative production and lower total production than in the Rough Fescue Community (1.1). Bluebunch wheatgrass can be a subdominant species in the xeric portion of this LRU. Other subdominant grass species that are more tolerant to grazing are likely to increase include Sandberg bluegrass (*Poa secunda*), prairie junegrass (*Koeleria macrantha*) and Kentucky bluegrass (*Poa pratensis*). Some increaser forbs species may include silky lupine

(*Lupinus sericeus*), field chickweed (*Cerastium arvense*), ballhead sandwort (*Arenaria congesta*), northern bedstraw (*Galium boreale*) and pussytoes (Antennaria spp.). Woods' rose (*Rosa woodsii*) and common snowberry (Symphoricarpus albus) are shrubs that also increase under prolonged drought or heavy grazing. Heavy continuous grazing will reduce plant cover, litter, and mulch. Bare ground will increase and expose the soil to erosion. Litter and mulch will move off-site as plant cover declines. As long as the canopy cover remains > 50% and production of rough fescue and bluebunch wheatgrass is > 10% of total biomass production, the site can return to the Rough Fescue Community (Pathway 1.2A). The Mixed Bunchgrass (1.2) and the Shrubland Community (1.3) are "At-Risk" Communities. The transition to the Altered State (2) can occur from any community within the Rough Fescue State (1), it is not dependant on an increase of woody canopy cover, but on the decrease of rough fescue composition to < 10%. Fire and/or brush control can be used to maintain the site in the Taller Bunchgrass State (1) as long as rough fescue production does not fall below 10%. Depending on the amount of increase in snowberry, the Mixed Bunchgrass Community (1.2) can transition to either the Idaho Fescue Community (2.1) or Altered Shrubland Community (2.2). Until the Mixed Bunchgrass Community (1.2) crosses the threshold into the Altered State (2.0), this community can be managed back toward the Rough Fescue Community (1.1) using management practices including prescribed grazing combined with prescribed burning and strategic brush control. It may take several years to make this shift, depending upon weather and aggressiveness of grazing management and brush treatment. Fire can be used to control smaller shrubs and trees. Chemical or mechanical treatment of larger shrubs and trees may be necessary in older stands. Without any form of brush control, woody species continue to increase in canopy cover. Once woody canopy exceeds approximately 20% and attains reproductive capability, a shift to the Shrubland Community (1.3) has occurred.

Community 1.3
Shrubland Community

The Shrubland Community (1.3) is characterized by greater than 20% woody canopy cover with rough fescue in the understory. Once woody canopy cover reaches 20%, the site will begin to take on the appearance of a shrubland. Rough fescue may remain dominant in the understory or share dominance with Idaho fescue. Without fire, woody canopy cover increases and the Mixed Bunchgrass Community (1.2) shifts to the Shrubland Community (1.3). The dominant shrub species is common snowberry (*Symphoricarpos albus*). The understory is dominated by rough fescue. Other shrub species include Saskatoon serviceberry (*Amelanchier alnifolia*), black hawthorn (*Crataegus douglasii*), chokecherry (*Prunus virginiana*), and Woods' rose. The Shrubland Community (1.3) differs from the Altered Shrubland Community (2.2) in the amount of degradation present in the understory. Under proper grazing management, the herbaceous component will be dominated by rough fescue. As long as rough fescue has not fallen below 10% species composition, the Shrubland Community (1.3) can be managed back to the Rough Fescue Community (1.1) using prescribed grazing and strategic weed control. It may take several years to achieve this recovery, depending on growing conditions, vigor of remnant rough fescue plants, and the aggressiveness of the weed treatments. With improper grazing management, rough fescue will decline and less palatable grass species, such as Idaho fescue and forb species will dominate understory and the site transitions to the Altered State (2).

Pathway 1.1A
Community 1.1 to 1.2

Rough fescue loses vigor when overgrazed. When vigor declines enough for plants to die or become smaller, species with higher grazing tolerance (most often Idaho fescue increase in vigor and production as they use the resources previously used by rough fescue. Decrease of species composition by weight of rough fescue to < 50% indicates that the plant community has shifted to the Mixed Bunchgrass Community (1.2). The driver for community shift 1.1A is improper grazing management; this shift is triggered by the loss of vigor of rough fescue.

Pathway 1.2A
Community 1.2 to 1.1

The Mixed Bunchgrass Community (1.2) will return to the Rough Fescue Community (1.1) with proper grazing management that provides sufficient critical growing season deferment in combination with proper grazing intensity. Favorable moisture conditions will facilitate or accelerate this transition. The driver for this community shift (1.2A) is the increase in vigor of rough fescue to the point that it represents more than 50% of species composition. The trigger for this shift is the change in grazing management that favors rough fescue.

Pathway 1.2B
Community 1.2 to 1.3

Shrubs make up a portion of the plant community in the Rough Fescue Community (1.1), hence woody propagules are present. Therefore, the Taller Bunchgrass State is always at risk for shrub dominance and a shift to the Shrubland Community (1.3) in the absence of fire and brush management. The drivers for Community Shift 1.2B are overgrazing and lack of fire and/or brush control. The mean fire return interval in the Taller Bunchgrass State is likely < 35 years. Even with proper grazing and favorable climate conditions, lack of fire or brush control for 20 years will allow shrubs and trees to increase in canopy to reach the 20% threshold level. Improper grazing, prolonged drought, and a warming climate will provide a competitive advantage to shrubs, which will accelerate this process. The driver for this community shift is improper grazing management in combination with lack of fire and/or brush control.

Pathway 1.3B
Community 1.3 to 1.1

The Shrubland Community can return to the Rough Fescue Community after a fire as long as the understory is able to carry the fire and rough fescue crowns survive the fire and re-sprout and/or there is sufficient seed for rough fescue to re-vegetate the area.

Pathway 1.3A
Community 1.3 to 1.2

The Shrubland Community can return to the Mixed Bunchgrass Community after a fire as long as the understory is able to carry the fire and rough fescue crowns survive the fire and re-sprout and/or there is sufficient seed for rough fescue to re-vegetate the area.

State 2
Altered State

This state is characterized by having < 10% rough fescue and < 50% canopy cover. State 2 is represented by two communities that differ in the percent canopy cover of woody species. Production in this state is considerably lower than in the Taller Bunchgrass State (1). Some native plants tend to increase under prolonged drought and/or heavy grazing practices. A few of these species include Idaho fescue, Sandberg bluegrass, silky lupine, field chickweed, ballhead sandwort, common snowberry, Wood’s rose and fringed sagewort.

Community 2.1
Idaho Fescue Community

The Idaho Fescue Community (2.1) is characterized by an herbaceous component dominated by Idaho fescue with rough fescue being < 10% of species composition by dry weight. This makes it difficult for rough fescue to increase with simply a change in grazing management alone. This community may or may not have a shrub component with canopy cover up to 20%. If a shrub component is present, it will most likely be dominated by common snowberry. Idaho Fescue Community tends to occur if the forage component has been degraded but fire or brush control has kept the shrub community to < 20% cover. This community is at risk of shifting to the Altered Shrubland Community (2.2) without fire or other brush control. This shift can be accelerated when improper grazing management occurs. This most often happens when stocking rates are not adjusted to compensate for the decrease in forage production as shrub production increases. Canopy cover will likely be < 50%. Wind and water erosion may erode soil from plant interspaces. Soil fertility is reduced, soil compaction is increased, and resistance to soil surface erosion is less than the Taller Bunchgrass State (1).

Community 2.2
Altered Shrubland Community

The Altered Shrubland Community (2.2) is characterized by > 20% woody canopy cover with Idaho fescue or shortgrasses in the understory. It has the appearance of shrub dominance with a degraded understory. The overstory is similar to the Shrubland Community (1.3) in the Taller Bunchgrass State (1). Common snowberry typically dominates the shrub component The understory in the community is dominated by mid-grasses (Idaho fescue) or forbs and shortgrasses. Failure to adjust stocking rate as shrub cover increases results in further degradation of the herbaceous community causing an increase in bare ground between shrubs. This community can have a dense canopy of shrubs with sparse understory making the site difficult to return to the Idaho Fescue Community or a community within the Taller Bunchgrass State, even if brush is removed. Reseeding and other cultural practices may be needed. When overgrazing continues, invasive grass and forb species move into the plant community and the site can transition to the Sparsely Vegetated State (3) or the Invaded State (4). Until the Altered Shrubland Community (2.2) crosses the threshold into the Sparsely Vegetated State (3) or the Invaded State (4) this community can be managed toward the Idaho Fescue Community (2.1) using prescribed grazing and strategic weed control.

Pathway 2.1A
Community 2.1 to 2.2

The Altered State is always at risk for shrub dominance and a shift to the Altered Shrubland Community (2.2) in the absence of fire and brush management. The drivers for Community Shift 2.1A are overgrazing and lack of fire and/or brush control. The mean fire return interval in the Altered State is likely < 35 years. Even with proper grazing and favorable climate conditions, lack of fire or brush control for 20 years will allow shrubs and trees to increase in canopy to reach the 20% threshold level. Improper grazing, prolonged drought, and a warming climate will provide a competitive advantage to shrubs, which will accelerate this process. The driver for this community shift is improper grazing management in combination with lack of fire and/or brush control.

Pathway 2.2A
Community 2.2 to 2.1

The Altered Shrubland Community (2.2) can return to the Idaho Fescue Community (2.1) after a fire as long as the understory is able to carry the fire and Idaho fescue crowns survive the fire and re-sprout and/or there is sufficient seed to re-vegetate the area.

State 3
Sparsely Vegetated State

The single community described below characterizes this state.

Community 3.1
Sparsely Vegetated Community

Long-term grazing mismanagement with continuous growing-season pressure will reduce total productivity of the site and lead to an increase of bare ground. Once plant cover is reduced, the site is more susceptible to erosion. Soil erosion reduces soil fertility creating a reduction in plant production. This soil erosion or loss of soil fertility indicates the transition to the Sparsely Vegetated State (3). The decline may be exacerbated by extended drought conditions. Very sparse plant cover and soil surface erosion characterize this community. Canopy cover may be very sparse or clumped (canopy cover < 25%). Weeds, annual species, or shortgrass species dominate the plant community. Mid-stature perennial bunchgrass species (e.g., rough fescue) may exist, but only in patches. This community has crossed a threshold (T1B, T2A) compared to the Taller Bunchgrass State (1) and the Altered State (2) because of soil erosion, loss of soil fertility, or degradation of soil properties. If further soil erosion occurs, there will be a critical negative shift in the ecological processes of this site. The affects of soil erosion can alter hydrology, soil chemistry, soil microorganisms, and soil physics to the point where intensive restoration is required to restore the site to another state or community. Simply changing grazing management cannot create sufficient change to restore the site within a reasonable period. It will require a considerable input of energy to move the site back to the Taller Bunchgrass State (1). This state has lost soil or vegetation attributes to the point that recovery to the Taller Bunchgrass State (1) will require reclamation efforts, i.e., soil rebuilding, intensive mechanical treatments, and/or reseeding. In this community phase there may be a significant amount of bare ground, and large gaps may occur between plants. The transition to this state could occur due to overgrazing (often due to failure to adjust stocking rates in response to declining forage production due to increased dominance of unpalatable invasive species), long-term lack of fire, warming climate, or extensive drought. Potential exists for soils to erode to the point that irreversible damage may occur. If herbaceous cover decreases to the point that soils are no longer stable, the shrub overstory may not prevent soil erosion. This plant community may be in a terminal state that will not return to the reference state because of degraded soil properties and loss of higher successional native plant species.

State 4
Invaded State

The single community described below characterizes this state.

Community 4.1
Invaded Community

The Invaded State (4) is characterized by > 25% of invasive species: spotted knapweed, leafy spurge, sulphur cinquefoil, and/or cheatgrass are the dominant invasive species in MLRA 43A. Introduced exotic plant species have been identified as one of the greatest threats to the integrity and productivity of native rangeland ecosystems and conservation of indigenous biodiversity (DiTomaso 2000 and Mack et al. 2000). In addition to environmental consequences, damages caused and costs incurred to control invasive plants are several billion dollars each year in the United States (Pimentel et al. 2000). Invasives are the driving factor throughout western Montana, and they are a focal part of the ecology of MLRA 43A. Their ability to take over and dominate a site has become a big concern. Improper grazing management has contributed to the spread of these species. The potential for altered ecosystem structure and function is high in the Invaded State (4) and can occur in many ways. The increase in invasive species, especially noxious weeds, can lead to reduction of the native bunchgrasses and an increase in the proportion of bare ground, which often results in reduced infiltration rates and increased surface runoff and erosion. Invasion by cheatgrass reduces above and below ground biomass (Ogle et al. 2003), increases plant litter, changes plant community canopy architecture (Belnap and Phillips 2001), reduces soil biota richness and abundance, reduces plant community richness (Belnap et al. 2005), increases wildfire frequency (Whisenant 1990), and potentially facilitates invasion by other noxious or invasive plants. Dense populations of invasive species can cause soil loss to increase because of lack of surface cover (Lacey et al. 1989). Early in the invasion process there is a lag phase where invasive plant populations remain small and localized before expanding exponentially (Hobbs and Humphries 1995). Based on research conducted in noxious weed-invaded plant communities in Montana, it is reasonable to estimate that 25% dry weight composition of invasive plant species is the point in the invasion process where spread and abundance is increasing exponentially and where a plant community has crossed a threshold (Masters and Sheley 2001). For aggressive invasive species (i.e., spotted knapweed), this threshold could be < 10%. Once invasive species dominate the site, either in species composition by weight or in their impact on the community, the threshold has been crossed to the Invaded State (4). Once invasive species become established, they are very difficult to eradicate. Therefore, considerable effort should be placed in preventing plant communities from crossing a threshold to the Invaded State (4) through early detection and proper management. Preventing new invasions is by far the most cost-effective control strategy and typically places an emphasis on education. Control measures used on the noxious plant species impacting this ecological site include chemical, biological, and cultural control methods. The best success has been found with an integrated weed management strategy that incorporates one or several of these options along with education and prevention efforts (DiTomaso 2000). Production in the invaded community may vary greatly. A site dominated by spotted knapweed, where soil fertility and chemistry remain near potential, may have production near that of the reference community. A site with degraded soils and infestation of cheatgrass may produce only 10-20% of the reference community. Invasive plant species have effective reproductive strategies, long seed viability in the soil seed bank, and/or allelopathic properties (Williamson; Fitter 1996). Spotted knapweed has allelopathic properties whereby its roots exude catechin, which may limit the growth and establishment of other plant species (Callaway and Vivanco 2007; Bais et al. 2002), thus promoting its own success. An in-vitro experiment showed that other weeds like Dalmatian toadflax (*Linaria dalmatica*), kochia (Kochia scoparia), diffuse knapweed (*Centaurea diffusa*), and crops, such as wheat (*Triticum aestivum*), showed mortality on the fourteenth day after addition of root exudates from spotted knapweed (Bais et al. 2002). This allelopathic property creates highly resilient communities. Cheatgrass has the ability to establish rapidly and attain community dominance following disturbances such as wildfire (Young and Evans 1978) or other disturbances creating bare soil. Cheatgrass is a successful invader because it has the ability to respond rapidly to increases in resource availability (Norton et al. 2004 and Lowe et al. 2003) as well as to compete for water (Pellant 1996). Cheatgrass was introduced into the United States in packing materials, ship ballast, and likely as a contaminant of crop seed. Cheatgrass was first found in the United States near Denver, Colorado, in the late 1800s. In the late 1800s and early 1900s, cheatgrass spread explosively in the ready-made seedbeds prepared by the trampling livestock hooves of overstocked rangelands. Cheatgrass has developed into a severe weed in several agricultural systems throughout North America, particularly western pastureland, rangeland, and winter wheat fields (NRCS

2009). Today, cheatgrass is found in most of the western states having reached its range of current distribution by 1930. In fact, a survey of 11 western states showed that cheatgrass was present on at least 60 million acres (Pellant 1996). After arriving in 1893 on the San Juan Islands in Washington, spotted knapweed had established in over 24 counties in three northwestern states by 1924, with several large infestations near Missoula, Montana (Sheley et al. 2005). By 1975, spotted knapweed had spread into most of the western counties of Montana, and today, it is found in every county in Montana. Leafy spurge, a native to Eurasia, was sighted in Park County, Montana as early as 1925 and has since been found in every county in Montana. Overgrazing by livestock has contributed to the spread of leafy spurge (Sheley et al. 2005).

Transition T1A
State 1 to 2

The Taller Bunchgrass State (1) transitions to the Altered State (2) if rough fescue falls below 10% species composition. The trigger for this transition is the loss of taller bunchgrasses, which creates a shift in species composition towards lower productive species, especially Idaho fescue. This transition can occur from any community within the Taller Bunchgrass State (1), it is not dependant on an increase of woody canopy cover, but on the decrease of rough fescue production. The driver for this transition is improper grazing management and/or long-term drought leading to a decrease in rough fescue composition to < 10%.

Transition T1B
State 1 to 3

The Taller Bunchgrass State (1) transitions to the Sparsely Vegetated State (3) if plant canopy cover declines to < 25% and rough fescue decreases to below 10% by dry weight. The trigger for this transition is the loss of taller bunchgrasses, which creates open spots of bare soil. Soil erosion is accompanied by decreased soil fertility driving the transitions to the Sparsely Vegetated State. There are several other key factors signaling the approach of transition T1B: increases in soil physical crusting, decreases in cover of cryptogamic crusts, decreases in soil surface aggregate stability and/or evidence of erosion including water flow patterns, development of plant pedestals, and litter movement. The driver for this transition is improper grazing management and/or long-term drought leading to a decrease in rough fescue composition to < 10%.

Transition T1C
State 1 to 4

Regardless of grazing management, without some form of weed management (chemical, mechanical, or biological control) the Taller Bunchgrass State (1) can transition to the Invaded State (4) if aggressive invasive species such as spotted knapweed and cheatgrass are introduced, even if the herbaceous component of the Reference Plant Community (1.1) is thriving. Healthy plant communities are most resilient to invasives. Long-term stress conditions for native species (e.g., overgrazing, drought, and fire) accelerate the process. If populations of invasive species reach critical levels, the site transitions to the Invaded State. The driver for this transition is the presence of aggressive invasive species.

Restoration pathway R2A
State 2 to 1

Restoration of the Altered State to the Taller Bunchgrass State requires substantial energy input. The drivers for this restoration pathway are removal of woody species, restoration of native herbaceous species by reseeding rough fescue.

Transition T2A
State 2 to 3

Removal of shrubs without proper grazing management can lead to an increase in bare ground and erosion of the fertile surface horizon and the site can degrade to the Sparsely Vegetated State (3). The driver for this transition is brush management without proper grazing management.

Transition T2B

State 2 to 4

Removal of shrubs can lead to an increase in bare ground. If invasive species are present, bare ground offers opportunity for invasive species to fill open areas, leading to the Invaded State (4). The driver for this transition is brush management in presence of invasive species.

Restoration pathway R3A
State 3 to 1

The Sparsely Vegetated State (3) has lost soil or vegetation attributes to the point that recovery to the Taller Bunchgrass State (1) will require reclamation efforts, such as soil rebuilding, intensive mechanical treatments, and/or revegetation. The drivers for this restoration pathway are reclamation efforts and proper grazing management. The trigger is restoration efforts.

Restoration pathway R3B
State 3 to 2

The Sparsely Vegetated State (3) has lost soil or vegetation attributes to the point that recovery to the Altered State (2) will require reclamation efforts such as soil rebuilding, intensive mechanical treatments, and/or reseeding in recommended areas only. If the reclamation efforts are performed without reseeding rough fescue, under unfavorable climatic conditions, or without proper grazing management, the site will return to the Altered State.

Transition T3A
State 3 to 4

Invasive species can occupy the Sparsely Vegetated State (3) and drive it to the Invaded State (4). The Sparsely Vegetated State is at risk of this transition occurring if invasive propagules are present. The driver for this transition is the presence of critical population levels (> 25%) of invasive species. The trigger is the presence of propagules of invasive species.

Restoration pathway R4A
State 4 to 1

Restoration of the Invaded State (4) to the Taller Bunchgrass State (1) requires substantial energy input. The drivers for this restoration pathway are removal of invasive species, restoration of native bunchgrass species, ongoing management of invasives, and proper grazing management. Without maintenance, invasive species are likely to return (probably rapidly) because of the presence of propagules in the soil and an increase in soil disturbance. The drivers for this reclamation pathway are treatments to reduce or remove invasive/noxious species in combination with favorable growing conditions. The trigger is invasive species control.

Restoration pathway R4B
State 4 to 2

Weed management without reseeding taller bunchgrasses, favorable climatic conditions, or proper grazing management will lead to the Altered State (2).

Restoration pathway R4C
State 4 to 3

If invasive species are removed without sufficient remnant populations of reference community species (particularly rough fescue), a site in the Invaded State (4) is likely to return to the Sparsely Vegetated State (3) instead of the Taller Bunchgrass State (1). The driver for the reclamation pathway is weed management without reseeding. The trigger is invasive species control.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)

Grass/Grasslike					
1	**Cool Season Bunchgrasses**			1166–1883	
	rough fescue	FECA4	*Festuca campestris*	1020–1648	–
	Idaho fescue	FEID	*Festuca idahoensis*	437–706	–
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	146–235	–
2	**Shortgrasses/Rhizomatous Grasses/ Grasslikes**			146–235	
	Grass, perennial	2GP	*Grass, perennial*	73–118	–
	needlegrass	ACHNA	*Achnatherum*	73–118	–
	sedge	CAREX	*Carex*	73–118	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	73–118	–
	Sandberg bluegrass	POSE	*Poa secunda*	73–118	–
Forb					
3	**Forbs**			146–235	
	Forb, annual	2FA	*Forb, annual*	73–118	–
	Forb, perennial	2FP	*Forb, perennial*	73–118	–
	common yarrow	ACMI2	*Achillea millefolium*	73–118	–
	pussytoes	ANTEN	*Antennaria*	73–118	–
	sandwort	ARENA	*Arenaria*	73–118	–
	twin arnica	ARSO2	*Arnica sororia*	73–118	–
	aster	ASTER	*Aster*	73–118	–
	Wyoming besseya	BEWY	*Besseya wyomingensis*	73–118	–
	Gunnison's mariposa lily	CAGU	*Calochortus gunnisonii*	73–118	–
	bluebell bellflower	CARO2	*Campanula rotundifolia*	73–118	–
	tiny trumpet	COLI2	*Collomia linearis*	73–118	–
	fleabane	ERIGE2	*Erigeron*	73–118	–
	blanketflower	GAAR	*Gaillardia aristata*	73–118	–
	old man's whiskers	GETR	*Geum triflorum*	73–118	–
	houndstongue hawkweed	HICY	*Hieracium cynoglossoides*	73–118	–
	western stoneseed	LIRU4	*Lithospermum ruderale*	73–118	–
	desertparsley	LOMAT	*Lomatium*	73–118	–
	silky lupine	LUSE4	*Lupinus sericeus*	73–118	–
	yellow owl's-clover	ORLU2	*Orthocarpus luteus*	73–118	–
	beardtongue	PENST	*Penstemon*	73–118	–
	cinquefoil	POTEN	*Potentilla*	73–118	–
	meadow deathcamas	ZIVE	*Zigadenus venenosus*	73–118	–
Shrub/Vine					
4	**Shrubs**			146–235	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	73–118	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	73–118	–
	black hawthorn	CRDO2	*Crataegus douglasii*	73–118	–
	chokecherry	PRVI	*Prunus virginiana*	73–118	–
	Woods' rose	ROWO	*Rosa woodsii*	73–118	–
	common snowberry	SYAL	*Symphoricarpos albus*	73–118	–

Animal community

Livestock grazing is suitable on this site due to the potential to produce high quality forage. This site may be preferred for grazing by livestock, and animals may congregate in these areas, however if slopes are > 15% and distance from water is too great, livestock grazing will be limited. Management objectives should include maintenance or improvement of rangeland health attributes of this ecological site. Careful management of timing, intensity and duration of grazing to minimize grazing re-growth and providing adequate rest is important. Shorter grazing periods and changing season of use during the growing season are recommended for plant maintenance, health and recovery.

Continuous grazing with improper stocking rates throughout the growing season in pastures year after year will be detrimental, will alter the plant composition and production over time, and will result in a transition to the Mixed Bunchgrass Community (1.2) or the Shrubland Community (1.3) or potentially hasten a change to the Invaded State (4). Transition to other states will depend on how well the site is managed over time with grazing animals as well as other circumstances such as weather conditions over a period of time.

The transition to the Mixed Bunchgrass Community (1.2) or the Shrubland Community (1.3) can be the result of long-term, continuous grazing and/or repeated critical growing season grazing (early season grazing during stem elongation). This transition can also occur due to a combination of overgrazing and drought. Repeated grazing during stem elongation (generally mid-April through mid-June), can have detrimental affects, especially on the taller key bunchgrass species. Repeated spring grazing and/or repeated and prolonged summer grazing depletes stored carbohydrates, resulting in poor vigor of key forage plants over time and eventual death of these cool-season grasses – this can lead to an increase in less desirable native species and/or noxious weeds.

The Mixed Bunchgrass Community (1.2) and the Shrubland Community (1.3) can occur across the entire ecological site or can occur in a mosaic with higher and/or lower states. This is most notable in areas that attract additional grazing, such as water sources or salting locations.

The Mixed Bunchgrass Community (1.2) or the Shrubland Community (1.3) is subject to further degradation to the Altered State (2), the Sparsely Vegetated State (3) or the Invaded State (4). Management should focus on grazing management strategies that will prevent further degradation. Forage quantity and/or quality may be substantially reduced compared to the Reference Plant Community.

In the Altered State, forage production is substantially reduced compared to the Taller Bunchgrass State. Grazing is possible in the Sparsely Vegetated State and the Invaded State, but forage production is greatly reduced in both states. Grazing should be carefully managed to avoid soil loss and degradation of soil properties as well as to ensure adequate livestock health.

Prescriptive grazing should be included in a conservation plan to maintain vigor of key native plant species while targeting the invasive species problem. In some instances, carefully targeted grazing (sometimes in combination with other treatments) can reduce or eliminate populations of invasive species.

Distance to drinking water and slope can reduce grazing capacity within a management unit. Adjustments should only 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 > 1 mile from water; therefore the adjustment is only calculated for 30% of the unit (50% reduction on 30% of management unit). The table below is a general guide for ranches in Montana (Ricketts et al. 2004). Fencing, slope length, management, access, terrain and breeds are all factors that can increase or decrease the percent of grazable acres within a management unit. Adjustments should be made that incorporate pasture conditions when calculating stocking rates.

Hydrological functions

The water cycle functions best in the Taller Bunchgrass State (1) with good infiltration and deep percolation of rainfall. The water cycle degrades as the vegetation community declines. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity accompany high total ground cover of 90%. High ground cover reduces rain drop impact on the soil surface, which keeps erosion and sedimentation transport low. Water leaving the site will have minimal sediment load, which allows for high water quality in associated streams. High rates of infiltration will allow water to move below the rooting zone during periods of heavy rainfall. The Rough Fescue Community (1.1) should have no rills or gullies present and drainageways should be vegetated and stable.

Improper grazing management results in the transition to the Altered State (2). This state has reduced canopy cover, and increased bare ground. Therefore, infiltration is reduced and runoff increased because of reduced ground cover, rainfall splash, soil capping, reduced organic matter, and poor structure.

In the Sparsely Vegetated State (3) and the Invaded State (4) canopy and ground cover are greatly reduced compared to the Taller Bunchgrass State (1), which impairs the water cycle. Infiltration will greatly decrease and runoff will increase because of reduced ground cover, rainfall splash, soil capping, reduced organic matter, and poor structure. Sparse ground cover and decreased infiltration can combine to increase frequency and severity of flooding within a watershed. Soil erosion is accelerated, quality of surface runoff is poor, and sedimentation increases.

Recreational uses

This site provides some limited recreational opportunities for hiking, horseback riding, and big game and upland bird hunting. The forbs have flowers that appeal to photographers. This site provides valuable open space.

Wood products

None

Other products

None

Other information

None

Inventory data references

Information presented was derived from NRCS clipping data, literature, field observations (based on one sampled site and observations from numerous others), and personal contacts with range-trained personnel (i.e., professional opinion of agency specialists, observations of land managers, and outside scientists).

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Approval

Kirt Walstad, 2/05/2022

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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Date	03/01/2010
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Slopes range from 15% to 55%. Rills are rare in the Taller Bunchgrass State on slopes between 15%-35%, but on slopes >35%, plant cover, basal area and litter are generally reduced and narrow rills <5 feet long may be present.

2. **Presence of water flow patterns:** Water flow patterns are generally not evident in the reference state. Following occasional (5 – 30 % probability), heavy thunderstorms and winter thaw events, few short, sinuous, discontinuous flow patterns may be apparent. On the steeper slopes (>35%) water flow patterns may become more evident and there may be areas which show accumulations of litter due to water movement.

3. **Number and height of erosional pedestals or terracettes:** None to very slight. Occasionally pedestals up to 0.5 inches may be encountered. As slopes increase pedestals may become more evident.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground should not exceed 15% - bare areas tend to be inconspicuous and not connected.

5. **Number of gullies and erosion associated with gullies:** Gullies should not occur in the Taller Bunchgrass State. If there is evidence of past erosion that has created gullies, these areas should be stabilized and have no active erosion.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Appearance or evidence of these erosional features or the landscape would not be present on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter will be evident across this site representing organic debris from the vegetation of the functional/structural groups and will not move. A severe convection storm or a significant thaw event could cause litter to move short distances, especially on slopes greater than 6%.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Resistance to erosion will be high with soil stability values of 5 or 6; areas of bare soil on this site may have values between 3 and 5 if not under plant canopy.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure is granular at the soil surface. Organic matter is about 4%. The surface horizon is 4 to 8 inches thick. Mollic epipedon present.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The reference plant community (1.1) is dominated by rough fescue which will maximize infiltration and minimize runoff throughout the site. With the increase of Idaho fescue in Plant community (1.2) infiltration may slightly decrease and runoff may slightly increase but overall this plant community will have only minor affects on infiltration and runoff.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** A compaction layer would not be expected on this ecological site. A platy soil surface structure would indicate a departure from the reference state.

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

    Dominant: Plant community 1.1 - Taller cool season bunchgrasses (rough fescue) >> mid-stature cool season bunchgrasses (Idaho fescue) > cool season rhizomatous grasses (western wheatgrass), shortgrasses (prairie junegrass) and grasslikes (sedges) = perennial forbs = shrubs. Plant community 1.2 – rough fescue and Idaho fescue share dominance – the other functional/structural groups will remain the same in descending order.

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Plant mortality for all functional groups will be low, but there will be some natural mortality of functional groups over time. Prolonged droughts and/or excessive rest may show increases in mortality and decadence for all plant

groups.

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14. **Average percent litter cover (%) and depth (in):** Note: the majority of the litter in the plant community in the Taller Bunchgrass State will be non-persistent.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 1300 #/acre – 2100 #/acre for the reference community (1.1) with a RV of 1700 #/acre. Production varies based on effective precipitation and natural variability of soil properties for this ecological site.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Cheatgrass, knapweed spp., leafy spurge, sulphur cinquefoil, dalmatian toadflax, houndstongue, whitetop, Canada thistle, Japanese brome, broom snakeweed, fringed sagewort, salsify and dandelion.

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17. **Perennial plant reproductive capability:** All native plants are capable of reproducing sexually and/or vegetatively.
