

United States Department of Agriculture Natural Resources Conservation Service Ecological Site Description

Section I: Ecological Site Characteristics

Ecological Site Identification and Concept

Site stage: Provisional

Provisional: an ESD at the provisional status represents the lowest tier of documentation that is releasable to the public. It contains a grouping of soil units that respond similarly to ecological processes. The ESD contains 1) enough information to distinguish it from similar and associated ecological sites and 2) a draft state and transition model capturing the ecological processes and vegetative states and community phases as they are currently conceptualized. The provisional ESD has undergone both quality control and quality assurance protocols. It is expected that the provisional ESD will continue refinement towards an approved status.

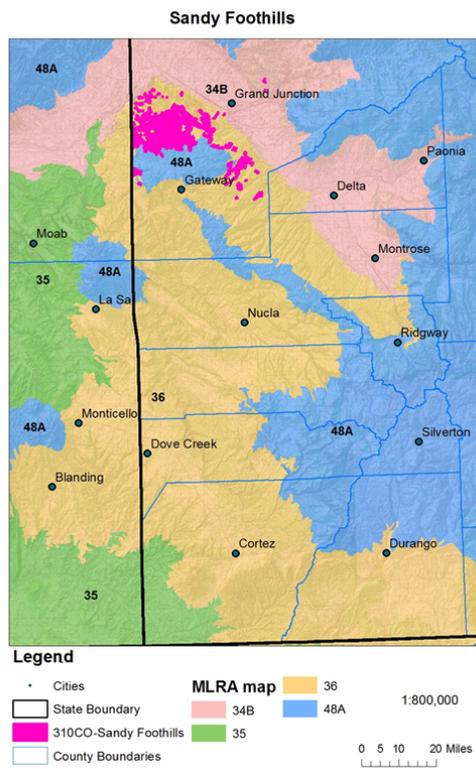
Site name: Sandy Foothills

Artemisia tridentata subsp. wyomingensis / *Hesperostipa comata* - *Achnatherum hymenoides*
(/ Wyoming big sagebrush / needle and thread - Indian ricegrass)

Site type: Rangeland

Site ID: R036XY310CO

Major land resource area (MLRA): 036-Southwestern Plateaus, Mesas, and Foothills



Sandy Foothills Location Map

Sandy Foothills ecological site is found on benches and rolling uplands in MLRA 36 (Southwestern Plateaus Mesas and Foothills). The MLRA 36 is illustrated orange color on the map. The ecological site locations as assigned in soil survey map units are shown in pink color.

The site concept was established within the MLRA 36 Foothill/Upland regions. This zone is 12 to 16 inches of precipitation and has a mesic temperature regime. This site has bimodal precipitation that is dominated by grasses with scattered Wyoming big sagebrush.

Ecological Site Concept

The 36X Sandy Foothills was drafted from the existing Sandy Foothills Range Site 34X, 35, 48A, (SCS, August, 1975). This site was written prior to MLRA 36 being mapped in Colorado and this area was in MLRA 34X when it was written. This site occurs on hills, benches and mesas. The soils are deep with sandy loams to loamy sands textures. Soils are derived from alluvium, and eolian deposits. It is a grass community with scattered Wyoming big sagebrush. It has an aridic ustic moisture regime and mesic temperature regime. The effective precipitation ranges from 12 to 16 inches.

Physiographic Features

This site occurs as rolling uplands and may occur at the base of sandstone bluffs. This site ranges is on fan remnants, dunes, terraces, structural benches and gently rolling mesas.

The slope may vary between 0 to 12 percent. Elevation ranges from 5500 to 7800 feet.

Landform: (1) Fan remnant
(2) Dune
(3) Terrace

	<u>Minimum</u>	<u>Maximum</u>
<i>Elevation (feet):</i>	5500	7800
<i>Slope (percent):</i>	0	12
<i>Flooding</i>		
<i>Frequency:</i>	None	None
<i>Ponding</i>		
<i>Frequency:</i>	None	None
<i>Runoff class:</i>	Very low	Low
<i>Aspect:</i>	No Influence on this site	

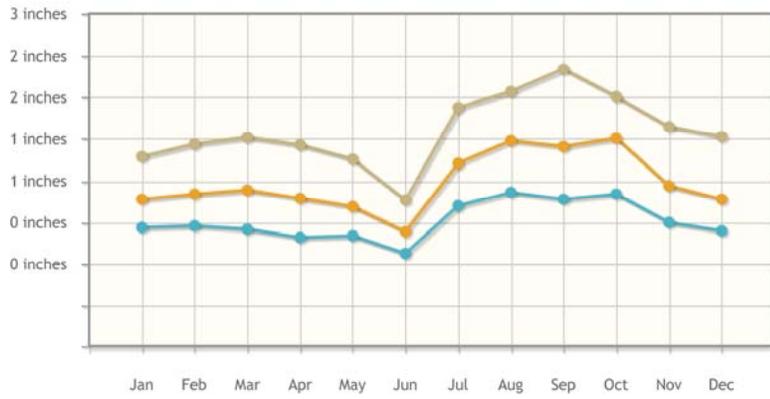
Climatic Features

Average annual precipitation is about 12 to 16 inches. Of this, 40-50% falls as snow, and 40-45% falls between May 1 and September 30. Summer moisture is mostly from thundershowers in late July, August, and September. The driest period is usually from April to early June; and June is normally the driest month. There is fall growth from late summer rains on this site during August and September, usually from the warm season plants. The average annual total snowfall is 38.3 inches. The highest winter snowfall record in this area is 117.5 inches which occurred in 1978-1979. The lowest snowfall record is 3.0 inches during the 1937-1938 winter. This area is located where there is winter precipitation and summer monsoonal rains. Moisture that comes during summer will favor the warm season plants. Mean daily annual air temperature is about 48°F to 52°F, averaging about 31°F for the winter and 60°F through the growing season, March through October. Summer temperatures of 100°F or more are not unusual. The frost-free period typically ranges from 110 to 130 days. The last spring frost is the end of April to the end of May and the first fall frost is the first week of October to the end of October. Mean annual temperature ranges from 64 to 37°F. The coldest winter temperature recorded was -23°F on February 8, 1933 and the coldest summer temperature recorded was 28°F on June 3, 1908. The hottest day on record is 110 °F on June 22, 1905. Wide yearly and seasonal fluctuations are common for this climatic zone. Data taken from Western Regional Climate Center (2015) for Blanding, Utah, Colorado Climate Station. Blanding is on the Western edge of the MLRA. Most Climate station in this LRU (Land Resource Unit) are either on the low end of the range (~12") or the high end (15 to 16") of the precipitation range. Blanding and Uravan are the only ones in the middle and Blanding has the longest record.

	<u>Averaged</u>
<i>Frost-free period (days):</i>	122
<i>Freeze-free period (days):</i>	147
<i>Mean annual precipitation (inches):</i>	14.06

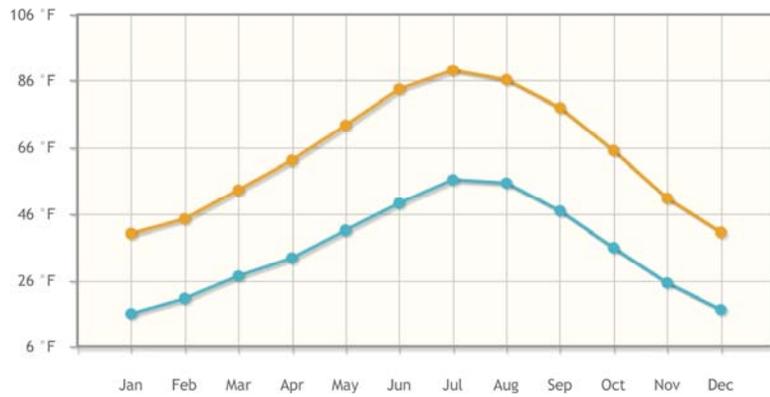
Monthly Precipitation (Inches):

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
<i>High</i>	1.29	1.44	1.52	1.43	1.26	0.77	1.88	2.07	2.34	2.01	1.65	1.53
<i>Medium</i>	0.78	0.84	0.89	0.79	0.69	0.39	1.21	1.48	1.41	1.51	0.94	0.78
<i>Low</i>	0.44	0.46	0.42	0.32	0.34	0.13	0.70	0.86	0.78	0.84	0.50	0.40



Monthly Temperature (°F):

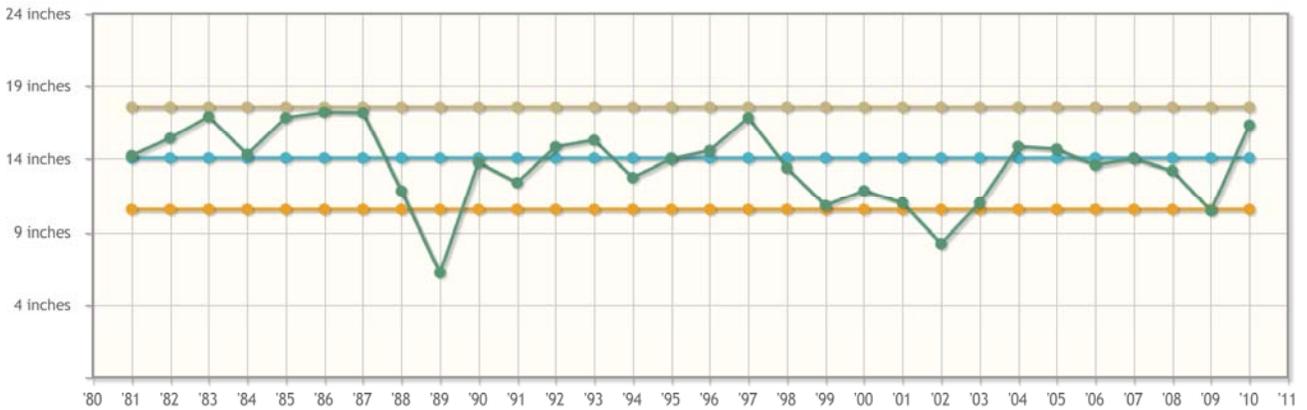
	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
High	40.5	44.9	53.6	62.5	73.0	83.8	89.5	86.6	78.3	65.4	51.1	40.9
Low	16.3	20.9	27.7	33.2	41.5	49.6	56.7	55.7	47.3	36.3	25.6	17.6



30 Year Annual Rainfall (inches):

<u>1981 N</u>	<u>1982 N</u>	<u>1983 N</u>	<u>1984 N</u>	<u>1985 N</u>	<u>1986 N</u>	<u>1987 N</u>	<u>1988 N</u>	<u>1989 D</u>	<u>1990 N</u>	<u>1991 N</u>	<u>1992 N</u>	<u>1993 N</u>	<u>1994 N</u>	<u>1995 N</u>
14.23	15.44	16.93	14.31	16.86	17.24	17.2	11.83	6.19	13.78	12.4	14.84	15.3	12.75	14.01
<u>1996 N</u>	<u>1997 N</u>	<u>1998 N</u>	<u>1999 N</u>	<u>2000 N</u>	<u>2001 N</u>	<u>2002 D</u>	<u>2003 N</u>	<u>2004 N</u>	<u>2005 N</u>	<u>2006 N</u>	<u>2007 N</u>	<u>2008 N</u>	<u>2009 D</u>	<u>2010 N</u>
14.59	16.86	13.4	10.82	11.84	11	8.21	10.99	14.86	14.68	13.59	14.04	13.21	10.46	16.34

D-Drought N-Normal H-Heavy



Climate stations: (1) CORTEZ [USC00051886], Montezuma County CO 81321. Period of record 1981-2010
 (2) NORTHDALE [USC00055970], Dolores County CO 81324. Period of record 1981-2010
 (3) URAVAN [USC00058560], Montrose County CO 81422. Period of record 1981-2010

- (4) YELLOW JACKET 2 W [USC00059275], Montezuma County CO 81335. Period of record 1981-2010
 (5) BLANDING [USC00420738], San Juan County UT 84511. Period of record 1981-2010
 (6) LA SAL 1SW [USC00424947], San Juan County UT 84530. Period of record 1981-2010

Influencing Water Features

There are no water features associated with this site.

Representative Soil Features

Soils are generally deep sandy loams to loamy sands. Surface soil textures are fine sandy loams and loamy fine sands ranging from 8 to 15% clay. Subsoil at 20" in depth has clay ranging from 6 to 15% clay (loamy sand, sandy loam, sand or light loam textures). They have a moderate to poor water holding capacity but do take water rapidly making it favorable for good plant growth.

Soils associated with this site are:
 Luster, Palma, Pinavetes and Yarts.

Parent materials

Kind: Alluvium, Eolian sands, Eolian deposits

Origin: Sandstone

Surface texture: (1) Loamy fine sand
 (2) Fine sandy loam
 (3) Very fine sandy loam

Subsurface texture group: Sandy

	<u>Minimum</u>	<u>Maximum</u>
<i>Surface fragments <=3" (% cover):</i>	0	0
<i>Surface fragments >3" (% cover):</i>	0	0
<i>Subsurface fragments <=3" (% volume):</i>	0	0
<i>Subsurface fragments >3" (% volume):</i>	0	0
<i>Drainage class:</i> Well drained to excessively drained		
<i>Permeability class:</i> Moderately rapid to rapid		

	<u>Minimum</u>	<u>Maximum</u>
<i>Depth (inches):</i>	60	
<i>Available water capacity (inches):</i>	3.60	5.90
<i>Electrical conductivity (mmhos/cm):</i>	0	0
<i>Sodium adsorption ratio:</i>	0	0
<i>Calcium carbonate equivalent (percent):</i>	0	5
<i>Soil reaction (1:1 water):</i>	6.6	8.4

Plant Communities

Ecological Dynamics of the Site

MLRA 36 occurs on the higher elevation portion of the Colorado Plateau. The Colorado Plateau is a physiographic province which exists throughout eastern Utah, western Colorado, western New Mexico and northern Arizona. It is characterized by uplifted plateaus, canyons and eroded features. The Colorado Plateau lies south of the Uintah Mountains, north of the Mogollon transition area, west of the Rocky Mountains, and east of the central Utah highlands. The higher elevation portion of the Colorado Plateau which is represented by MLRA 36 is characterized by broken topography, and lack of perennial water sources. This area has a long history of past prehistoric human use for thousands of years. MLRA 36 shows archaeological evidence indicating that pinyon-juniper woodlands were modified by prehistoric humans and not pristine and thus were altered at the time of European settlement (Cartledge & Propper, 1993). This area also included natural influences of herbivory, fire, and climate. This area rarely served as habitat for large herds of native herbivores or large frequent historic fires due to the broken topography. This site is extremely variable and plant community composition will vary with the water fluctuations on this site.

There is a winter-summer bimodal precipitation pattern on this part of the Colorado Plateau. Meaning that this site developed under climatic conditions that include wet, cold winters, and hot, dry summers with summer rains. This area has climatic fluctuations and prolonged droughts are common occurrences. Between an above average year and a drought year, forbs are the most dynamic (Passey et.al. 1982) and can vary up to 4 fold. The precipitation and climate of MLRA 36 are conducive to producing Pinyon/juniper, and sagebrush complexes with high productive sites in the bottoms of the canyons. Predominant species on the Colorado Plateau are Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), mountain big sagebrush (*A. tridentata* var. *vaseyana*), and black sagebrush (*A. nova*), Basin Big Sagebrush (*A. tridentata* var. *tridentata*), Utah Juniper (*Juniperus utahensis*) and Pinyon (*Pinus edulis*).

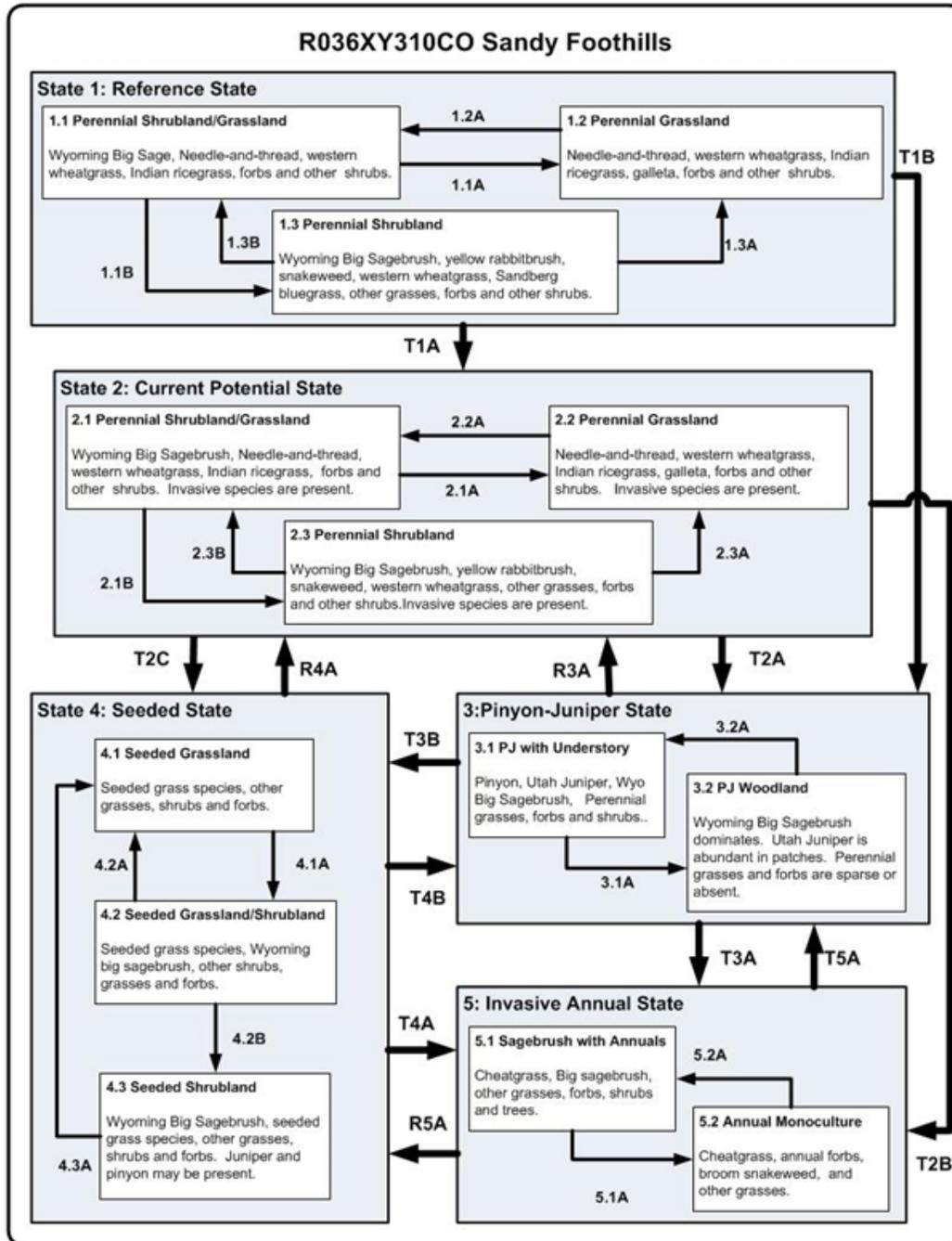
This site is characterized by big sagebrush. It is not a sagebrush steppe, but a sagebrush shrub-land where there is naturally less understory herbaceous production, more bare ground, and biological crusts are common (Boyle and Reeder, 2005). Recovery from fire, grazing, or other disturbances is usually slower and attempts at land restoration are less successful than in the sagebrush steppe (West 1983). The sites in this area are developed with the natural influences of grazing, fire, climatic variability (i.e. extended drought) and insect herbivory. This area has

climatic fluctuations and prolonged droughts are common. Between an above average year and a drought year, forbs are the most dynamic (Passey et.al. 1982) and can vary up to 4 fold.

The ability for an ecological site to carry fire depends primarily on the present fuel load and plant moisture content—sites with small fuel loads will burn more slowly and less intensely than sites with large fuel loads. Fire is an important aspect of big sagebrush dominated ecological sites. Fire intervals are historically 10-70 years (Howard, 1999) and fires are typically patchy, forming mosaics. Shrub vegetation is able to reestablish from seed dispersal from the adjacent non burned sagebrush stands; however the process is relatively slow. Fire also decreases the extent of Utah juniper/pinyon pine invasions, which allows the historic plant community to maintain integrity. When the plant community is burned shrubs decrease, while perennial and annual grasses increase. The perennial shrubs associated with this site are able to recover at a faster rate than the invading trees. When the site is degraded by the presence of invasive annuals, the fire return interval is shortened due to increased fuels. The shortened fire return interval is often sufficient to suppress the native plant community.

Variability in climate, soils, aspect and complex biological processes will cause the plant communities to differ. These factors contributing to annual production variability include wildlife use, drought, and insects. Factors contributing to special variability include soil texture, depth, rock fragments, slope, aspect, and micro-topography. The species lists are representative and not a complete list of all occurring or potentially occurring species on this site. The species lists are not intended to cover the full range of conditions, species and responses of the site. The State & Transition model depicted for this site is based on available research, field observations and interpretations by experts and could change as knowledge increases. As more data is collected, some of these plant communities may be revised or removed, and new ones may be added. The following diagram does not necessarily depict all the transitions and states that this site may exhibit, but it does show some of the most common plant communities.

State-and-Transition Diagram



STM

Legend

Legend

1.1A, 2.1A, 4.2A – fire, insect herbivory, and/or drought
 1.1B, 2.1B, 1.2A, 2.2A, 4.1A, 4.2B – lack of fire, time without disturbance and improper grazing
 1.3A, 2.3A, 1.3B, 2.3B, 3.2A, R3A, 4.3A – fire, vegetation treatments, insect herbivory, drought, and/or tree encroachment removal
 T1A - invasive species establishment, improper grazing, fire, surface disturbances, and/or extended droughts.
 T1B, T2A, 3.1A, T4B – fire suppression, time without disturbance, insect herbivory, and tree encroachment
 T2B, T3A, T4A – invasive species establishment, frequent fire and/or long term drought
 T2C, T3B – Seeding and removal of tree encroachment
 R4A – Lack of disturbance, and/or removal of encroached PJ
 5.1A – Frequent fire, and/or drought
 5.2A, T5B – fire suppression and/or seeding
 T5A – treat invasive species, and seeding

STM Legend

State 1: Reference State

This state includes the biotic communities that become established on the ecological site under the natural disturbance regime prior to pre-European settlement. The main pathways on this site are fire and drought. Drought is frequent on this site. Historically, fires were of mixed severity, and various sizes. The fire frequency was 10-70 years in Big Sagebrush communities that occur in the uplands. The reference state is generally dominated by Wyoming big sagebrush, needle-and-thread, western wheatgrass, Indian ricegrass, galleta, other native perennial grasses and native perennial and annual forbs which creates a diverse understory. Soil crusts are a very important part of this community. Crusts recycle nutrients, aid in moisture retention, fix nitrogen, fix carbon, and stabilize the soil reducing wind and water erosion (Belnap, 1994; Belnap and Gillette, 1998; Beymer and Klopatek 1991). The reference state is self-sustaining and resistant to change due to high resistance to natural disturbances and high resilience following natural disturbances.

The primary drivers in the reference state include fire, insect herbivory, and fluctuations in climate (drought or wet periods) and grazing by livestock and wildlife. For example, improper grazing can result in a loss of herbaceous understory, the establishment of non-native invasive plants, and a reduction in the fire return interval. When natural disturbances occur, the rate of recovery is variable due to disturbance intensity. Once invasive plants establish, return to the reference state may not be possible.

Community Phase 1.1: Perennial Shrubland/Grassland

This community phase is dominated by Wyoming big sagebrush, needle-and-thread, western wheatgrass, Indian ricegrass, and galleta. This phase has the most diverse understory of native perennial grasses and forbs. Abundance, and production of warm or cool season herbaceous plants and forb production are dependent on the timing of precipitation, and can vary widely between years. The sagebrush will be a mixed age stand. Biological crusts (lichen, moss, and cyanobacteria) should be present but are variable based on plant community and state. Small amounts of low woody and semi-woody plants such as, yellow rabbitbrush, and broom snakeweed are common.

This community is comprised of 70-85% grasses, 5-10% forbs, and 10-20% shrubs.

Community Phase Pathway 1.1A

This transition is caused by naturally occurring fires, herbivory of sagebrush, and/or drought that suppresses sagebrush establishment. These events tend to favor grass establishment. With a mature sagebrush community, this pathway can be caused by high intensity fire that burns hot enough to remove big sagebrush. Low-intensity fire after sagebrush has had a chance to set seed, improper grazing and/or browsing by native ungulates, and possible stem-root pathogens will revert a young sagebrush community to a grassland with the potential to become a sagebrush-grass community once again (Winward, 2004).

Community Phase Pathway 1.1B

This transition is from the native shrub and perennial warm and cool season grass state, to a state that is dominated by big sagebrush. This pathway happens when fire does not occur within the historical fire regime interval for the site. Improper continuous grazing of perennial grasses will speed up this pathway. This will lead to an old decadent stand of sagebrush with little to no understory. This allows the possibility of Utah juniper and/or two-needle pinyon to become established on the site.

Perennial Shrubland/Grassland Plant Species Composition

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre)		Foliar cover (percent)	
					Low	High	Low	High
1					700	900		
		Indian ricegrass	ACHY	Achnatherum hymenoides	50	150		
		sedge	CAREX	Carex	10	50		
		squirreltail	ELELE	Elymus elymoides subsp. elymoides	25	75		
		needle and thread	HECO26	Hesperostipa comata	100	300		
		prairie Junegrass	KOMA	Koeleria macrantha	25	75		
		basin wildrye	LECI4	Leymus cinereus	25	75		
		western wheatgrass	PASM	Pascopyrum smithii	100	200		
		James' galleta	PLJA	Pleuraphis jamesii	50	150		
		Sandberg bluegrass	POSE	Poa secunda	25	75		
		sand dropseed	SPCR	Sporobolus cryptandrus	10	50		

Forb

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre)		Foliar cover (percent)	
					Low	High	Low	High
2		common yarrow	ACMI2	Achillea millefolium	25	75		
		arrowleaf balsamroot	BASA3	Balsamorhiza sagittata	50	100		
		buckwheat	ERIOG	Eriogonum	25	75		
		lupine	LUPIN	Lupinus	25	75		
		scarlet globemallow	SPCO	Sphaeralcea coccinea	25	75		

Shrub/Vine

Group	Group name	Common name	Symbol	Scientific name	Annual Production (pounds per acre)		Foliar cover (percent)	
					Low	High	Low	High
3		Wyoming big sagebrush	ARTRW8	Artemisia tridentata subsp. wyomingensis	50	150		
		yellow rabbitbrush	CHV18	Chrysothamnus viscidiflorus	10	50		
		broom snakeweed	GUSA2	Gutierrezia sarothrae	10	50		
		plains pricklypear	OPPO	Opuntia polyacantha	10	20		

Annual Production by Plant Type

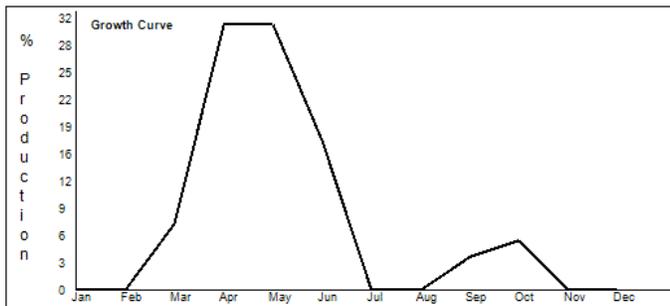
Plant type	Annual Production (lbs/ac)		
	Low	Representative value	High
Grass/Grasslike	460	775	890
Forb	45	75	105
Shrub/Vine	95	150	205
Total	600	1000	1200

Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Community Phase 1.2: Perennial Grassland

This post-fire community would be dominantly characterized by perennial grasses and native forbs (annual and perennial). This community would exist for short time period until sagebrush began to become established and set seed. Scattered, sparse sagebrush may be present and will increase with time. This site would stay in grassland if fire returned to this site and did not allow big sagebrush time to re-seed and establish.

Community Phase Pathway 1.2A

This pathway favors shrub establishment. This pathway is cause by time without disturbance (i.e. fire) and favorable conditions for young sagebrush establishment.

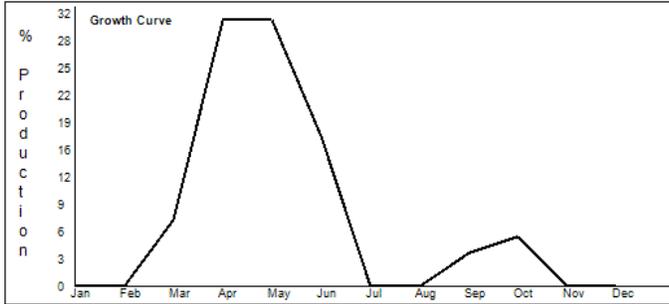
Plant Growth Curve

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 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

0 0 8 32 32 18 0 0 4 6 0 0



Community Phase 1.3: Perennial Shrubland

This community consists big sagebrush with sparse understory. Sagebrush canopy cover would typically be greater than 35%. Scattered Utah juniper and maybe two-needle pinyon might be present and tree canopy cover would be 0-10%. Biological crusts are typically well developed in the interspaces; however, bare ground is most common in this community phase. Improper grazing use can aid the establishment of pinyon and juniper seedlings through reduced competition, exposure of mineral soil, and reduction of fuel to carry fires. This combined with increasing control of fires has caused large portions of the site to be taken over by pinyon and juniper since the coming of livestock. Two-needle pinyon and Utah juniper are natural invaders if stands are found adjacent to this site. Trees left uncontrolled can form dense stands and eventually dominate the site.

Community Phase Pathway 1.3A

This pathway is caused by naturally occurring fires and/or insect herbivory removes the shrubs and possible trees if they have encroached on this site. It reverts the system back to a grassland phase.

Community Phase Pathway 1.3B

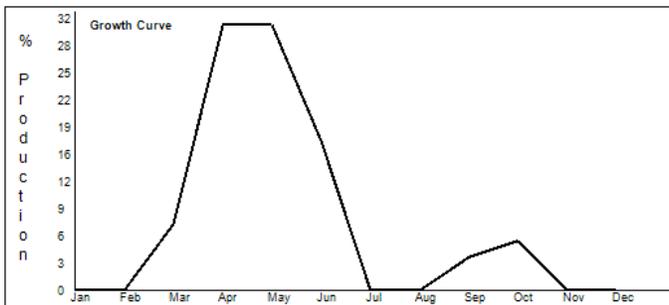
Pathways can be one or more of the following: brush treatments, seeding, insect herbivory/pathogen, proper grazing, drought, and fire. Insect herbivory and/or root and stem pathogen die-off will thin the stands and allow perennial plants to establish if it is properly grazed.

Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0 0 8 32 32 18 0 0 4 6 0 0



Transition T1A

The native understory in the reference state has been invade by non-native species. Plant may include cheatgrass, Russian thistle, and annual wheatgrass. Some invasive plants can become established in undisturbed and healthy native plant communities. Possible events that can cause this transition include improper domestic livestock, severe surface disturbances, fire, and/or extended droughts.

Transition T1B

This transition is from the native shrub and perennial warm and cool season grass state, to a state that is dominated by two-needle pinyon and Utah juniper encroachment. Events include time without disturbance, insect herbivory, and continuous season long grazing of perennial grasses. Once junipers reach 50 years old they are much harder to kill with fire (Miller and Eddleman, 2001). As canopy density increase, bare ground will increase further increasing the fire return interval, accelerating erosion, increasing run-off and further affecting the watershed functionality. This transition also favors the establishment of invasive annual species such as cheatgrass.

State 2: Current Potential State

The current potential state is similar in structure and function to the reference state, however invasive species are present in all community phases. The current potential state is generally dominated by big sagebrush and perennial grasses, but has an additional phase due to juniper encroachment as a result of fire suppression. The current potential state is less resilient than the reference state due to the presence of non-native/invasive species in the plant community.

Community Phase 2.1: Perennial Shrubland/Grassland

This community phase is dominated by Wyoming big sagebrush, needle-and-thread, western wheatgrass, Indian ricegrass, and galleta. This phase has the most diverse understory of native perennial grasses and forbs. Abundance, and production of warm or cool season herbaceous plants and forb production are dependent on the timing of precipitation, and can vary widely between years. The sagebrush will be a mixed age stand. Biological crusts (lichen, moss, and cyanobacteria) should be present but are variable based on plant community and state. Small amounts of low woody and semi-woody plants such as, rubber rabbitbrush, and broom snakeweed are common. Nonnative invasive species, such as cheatgrass are present but in insignificant amounts.

Community Phase Pathway 2.1A

This transition is caused by naturally occurring fires, herbivory of sagebrush, and/or drought that suppresses sagebrush establishment. These events tend to favor grass establishment. With a mature sagebrush community, this pathway can be caused by high intensity fire that burns hot enough to remove big sagebrush and PJ, if it has started to encroach. Low-intensity fire after sagebrush has had a chance to set seed, improper grazing and or browsing by native ungulates, and possible stem-root pathogens will revert a young sagebrush community to a grassland with the potential to become a sagebrush-grass community once again (Winward, 2004). Vegetation treatments (mechanically, prescribed fire, chemically, etc.) can also be employed to imitate the natural disturbances regime.

Community Phase Pathway 2.1B

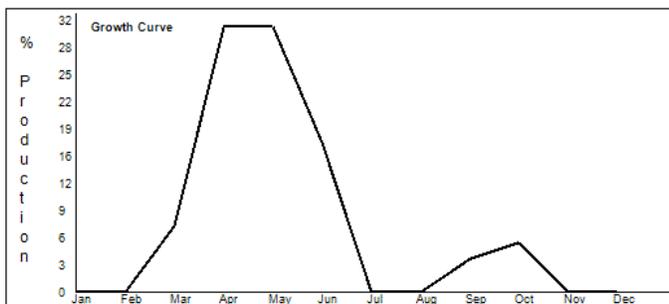
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Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Community Phase 2.2: Perennial Grassland

This post-fire community would be dominantly characterized by perennial grasses and native forbs (annual and perennial). Annual plant production is high in this phase due to the grass production. This community would exist for short time period until sagebrush began to become established and set seed. Scattered, sparse sagebrush may be present and will increase with time. This site would stay in grassland if fire returned to this site and did not allow big sagebrush time to re-seed and establish. Nonnative invasive species, such as cheatgrass are present but in insignificant amounts.

Community Phase Pathway 2.2A

This pathway favors shrub establishment. This pathway is cause by time without disturbance (i.e. fire) and favorable conditions for young sagebrush establishment.

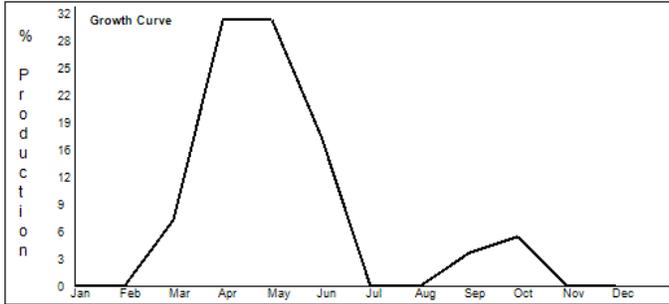
Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0

0 0 8 32 32 18 0 0 4 6 0 0



Community Phase 2.3: Perennial Shrubland

This community consists big sagebrush with sparse understory. Sagebrush canopy cover would typically be greater than 35%. Scattered Utah juniper and maybe two-needle pinyon might be present and tree canopy cover would be 0-10%. Biological crusts are typically well developed in the interspaces; however, bare ground is most common in this community phase. Improper grazing use can aid the establishment of pinyon and juniper seedlings through reduced competition, exposure of mineral soil, and reduction of fuel to carry fires. This combined with increasing control of fires has caused large portions of the site to be taken over by pinyon and juniper since the coming of livestock. Two-needle pinyon and Utah juniper are natural invaders if stands are found adjacent to this site. Trees left uncontrolled can form dense stands and eventually dominate the site. Nonnative invasive species, such as cheatgrass are present but in insignificant amounts.

Community Phase Pathway 2.3A

This pathway is caused by naturally occurring fires, vegetation treatments, and/or insect herbivory removes the shrubs and possible trees if they have encroached on this site. It reverts the system back to a grassland phase.

Community Phase Pathway 2.3B

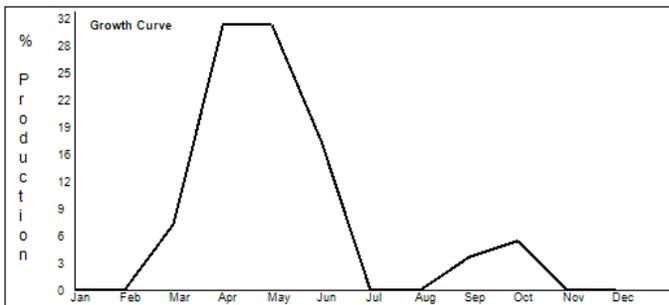
Pathways can be one or more of the following: brush treatments, seeding, insect herbivory/pathogen, proper grazing, drought, and fire. Insect herbivory and/or root and stem pathogen die-off will thin the stands and allow perennial plants to establish if it is properly grazed.

Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0 0 8 32 32 18 0 0 4 6 0 0



Transition T2A

This transition is from the native shrub and perennial warm and cool season grass state, to a state that is dominated by two-needle pinyon and Utah juniper. Events include time without disturbance, insect herbivory, continuous season long grazing of perennial grasses, and tree invasion. Once junipers reach 50 years old they are much harder to kill with fire (Miller and Eddleman, 2001). As canopy density increase, bare ground will increase further increasing the fire return interval, accelerating erosion, increasing run-off and further affecting the watershed functionality. This transition also favors the establishment of invasive annual species such as cheatgrass.

Transition T2B

This transition is from big sagebrush dominated state, to a state that is dominated by invasive species. Events include establishment of invasive species, fire (<5-20 years), continuous season long grazing of perennial grasses, long term drought.

Transition T2C

This transition is from a big sagebrush dominated state, to a state that has been seeded with introduced perennial grasses. High energy inputs are needed for this transition. Sagebrush and/or trees will need to be removed with vegetation treatment techniques (i.e. chemical, mechanical, or fire) and introduced species that are adapted to the area and adapted to management needs have been seeded and become established.

State 3: Pinyon-Juniper State

It is thought that pinyon and juniper, with an understory of mostly perennial grasses, may dominate the site in the longtime absence of fire, but lightning fires following warm dry early summer weather are a natural feature of the region. This could have maintained much of the site in a grassland cover, as reported by many early settlers except for occasional trees and isolated patches. Such vegetation is the basis for the potential described here. Without fire, simulated clearing methods may be necessary to maintain it (SCS, 1975, Miller and Tausch 2002). This state typically occurs when there is a long time span between fires. The transition to this state also has a reduction in fine fuels plays a part in increasing the fire return intervals once the site has transition to this pinyon-juniper state. Thus, state can persist for long time periods until the conditions needed for a fire occur or vegetation treatments are done to move the community to a different state.

Community Phase 3.1: PJ with understory

It is dominated by a dense closed canopy of Utah juniper and pinyon. They will be with a sparse understory of big sagebrush with little to no grass or forbs. Also, Invasive annuals grasses and forbs will be present in the understory.

Community Phase Pathway 3.1A

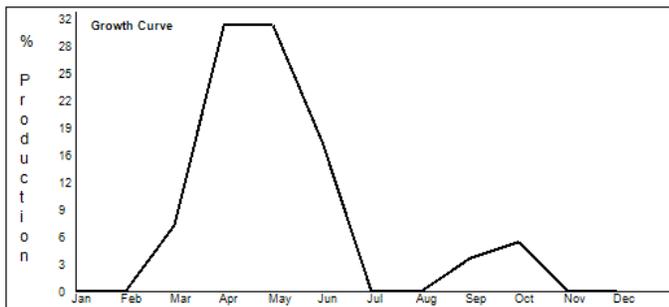
Events include time without disturbance, insect herbivory, continuous season long grazing of perennial grasses, and continued tree invasion until they dominate the site.

Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Community Phase 3.2: PJ Woodland

This state has an overstory of Utah juniper and/or two-needle pinyon with an understory of big sagebrush. There is very little herbaceous or other plant growth on this site. The production and infiltration is low. Erosion is high, and the associated watersheds will become less stable and have more runoff.

Community Phase Pathway 3.2A

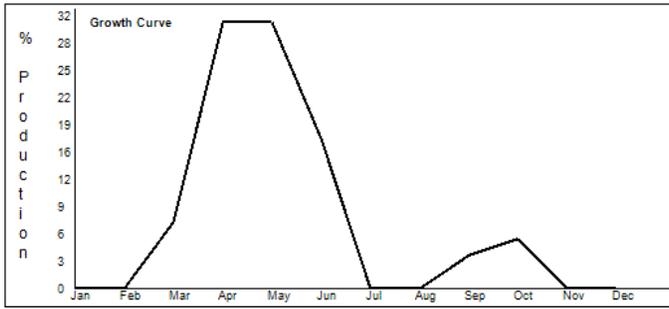
Occurs when trees are removed naturally (fire, drought, insects or other pathogens) and/or by vegetation treatments (i.e. mechanical, chemical).

Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Transition T3A

This transition is from a two needle pinyon and Utah juniper state, to a state that is dominated by invasive species. Events would include establishment of invasive species, fire, and other methods of tree removal with an understory that is dominated by invasive annual species (i.e. cheatgrass).

Transition T3B

Seeding of introduced/native species (grasses and forbs) is the pathway to state 4. Also, trees are usually removed by mechanical or chemical treatments. This transition requires energy input into the system.

Restoration Pathway R3A

Pathways can be one or more of the following: brush treatments, seeding, insect herbivory/pathogen, proper grazing, drought, and/or fire. This pathway requires lots of energy input into the system.

State 4: Seeded State

This state results from seeding introduced perennial grasses (i.e. crested wheatgrass and Russian wildrye). Native perennial grasses, forbs and shrubs may be included in the seed mix. This state behave similar community dynamics to the current potential state community. Other vegetation treatments may be necessary to get to this state, they include chaining, mowing, disking, prescribed burning and other techniques which manipulate the plant community. Applying vegetation treatments to plant communities to either the invasive annuals or juniper encroachment states to create a seeded state is often the first step in assisted restoration to plant communities an intermediate step to get to the Current Potential State. The seeded state could persist for long periods of time with proper management. Native grasses and forbs may reestablish over time from nearby seed sources. Big sagebrush will typically reestablish in 30-40 years.

Community Phase 4.1: Seeded Grassland

This community is dominated by seeded plants such as crested wheatgrass, Russian wildrye, smooth brome, and intermediate and pubescent wheatgrasses. Big sagebrush has little to no production in this phase. This site has high production due to the seed grass production. This production typically is higher than the current potential or reference state. This site usually has low species diversity.

Community Phase Pathway 4.1A

Time without disturbance and climatic conditions that favor establishment of sagebrush will assist this pathway. Improper grazing on the grasses species can favor shrub establishment and reduce their competitiveness. Also, several consecutive years of droughts can reduce grass cover.

Plant Growth Curve

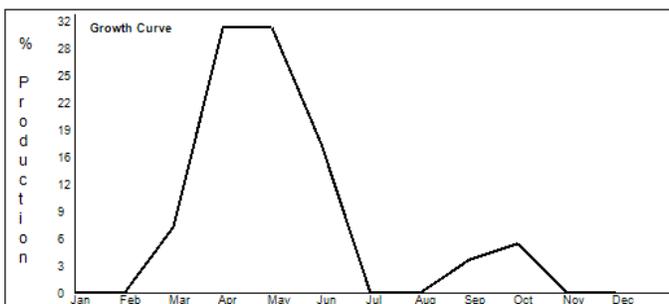
Growth curve number: CO0103

Growth curve name: MLRA 36 - Foothills Mesic

Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Community Phase 4.2: Seeded Grassland/Shrubland

This phase has big sagebrush co-dominant with the seeded grass.

Community Phase Pathway 4.2A

This transition is caused by naturally occurring fires, herbivory of sagebrush, and/or drought that suppresses sagebrush establishment. These events tend to favor grass establishment. With a mature sagebrush community, this pathway can be caused by high intensity fire that burns hot enough to remove big sagebrush and PJ, if it has started to encroach. Low-intensity fire after sagebrush has had a chance to set seed, improper grazing and or browsing by native ungulates, and possible stem-root pathogens will revert a young sagebrush community to a grassland with the potential to become a sagebrush-grass community once again (Winward, 2004). Vegetation treatments (mechanically, prescribed fire, chemically, etc.) can also be employed to imitate the natural disturbances regime.

Community Phase Pathway 4.2B

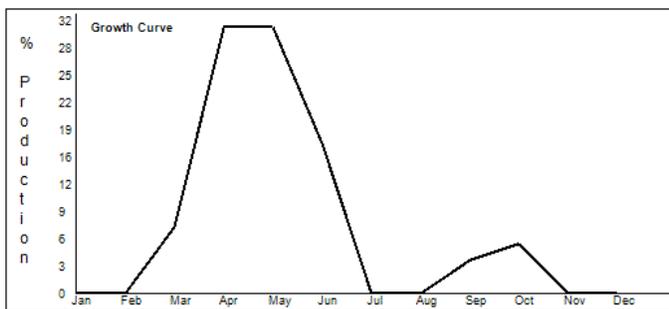
This pathway favors shrub establishment. This pathway is cause by time without disturbance (i.e. fire) and favorable conditions for young sagebrush establishment. Also, Pinyon and juniper will start to encroach under these condition. Improper continuous grazing of perennial grasses will speed up this pathway. This will lead to an old decadent stand of sagebrush with little to no understory.

Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Community Phase 4.3: Seeded Shrubland

This community consists big sagebrush with sparse understory. Sagebrush canopy cover would typically be greater than 35%. Scattered Utah juniper and maybe two-needle pinyon might have encroached. Two-needle pinyon and Utah juniper are natural invaders if stands are found adjacent to this site. Trees left uncontrolled can form dense stands and eventually dominate the site. Nonnative invasive species, such as cheatgrass are present but in insignificant amounts. Biological crusts are typically well developed in the interspaces; however, bare ground is most common in this community phase.

Community Phase Pathway 4.3A

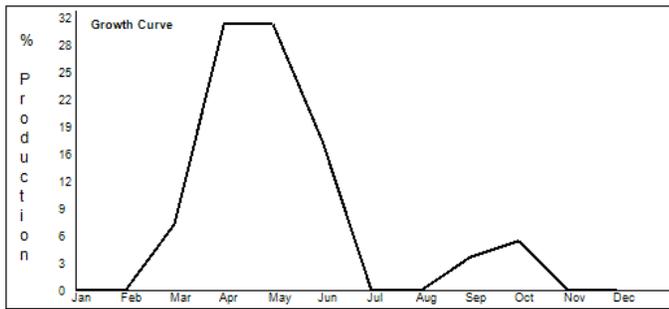
This pathway is caused by naturally occurring fires, vegetation treatments (chemical and mechanical), and/or insect herbivory removes the shrubs and possible trees if they have encroached on this site. It reverts the system back to a grassland phase. Depending on the amount of understory present, grasses and forbs may need to be reseeded to aid reestablishment.

Plant Growth Curve

Growth curve number: CO0103
 Growth curve name: MLRA 36 - Foothills Mesic
 Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Transition T4A

This transition is from a seeded state, to a state that is dominated by invasive species. Events include increased of invasive species, shortened fire return interval, and long term drought. Improper continuous season long grazing of perennial grasses can reduce the time needed for this pathway.

Transition T4B

This transition is from the big sagebrush-seeded grass state to a state that is dominated by two-needle pinyon and Utah juniper. Events include, fire suppression, time without disturbance, insect herbivory, continuous season long grazing of perennial grasses, and tree invasion. As canopy density increase, bare ground will increase further increasing the fire return interval, accelerating erosion, increasing run-off and further affecting the watershed functionality. This transition also favors the establishment of invasive annual species such as cheatgrass.

Restoration Pathway R4A

This return path could possible occur as a result of long time frames without disturbance. Native plants from adjacent site would slow establish in the seeded state. Proper grazing from livestock and wildlife which would favor the establishment of native plants. Removal of the Utah juniper and Pinyon as they encroach would also be necessary.

State 5: Invasive Annual State

This state is dominated by invasive annual species. Invasive annual species can including cheatgrass, Russian thistle, kochia, halogeton, storksbill geranium, and annual mustards. Generally as ecological conditions deteriorate and perennial vegetation decreases due to disturbance (fire, over grazing, drought, off road vehicle overuse, erosion, etc.) annual forbs and grasses will invade the site. The presence of these species will depend on soil properties and moisture availability; however, these invaders are highly adaptive and can flourish in many locations. Once established, complete removal is difficult but suppression may be possible.

Community Phase 5.1: Sagebrush with Annuals

This state will look big sagebrush with an invasive annual species understory. Frequently, sagebrush canopy cover will be dense due to little to none perennial understory being present. Cheatgrass, and other annual introduced species are now present in the understory. It can function as a plant community this way unless the fire return interval decreases to less than 5 years (Whisenant 1986). Then it will transition to an Annual grasses phase (5.2). This phase is at risk for becoming a cheatgrass-dominated grassland.

Community Phase Pathway 5.1A

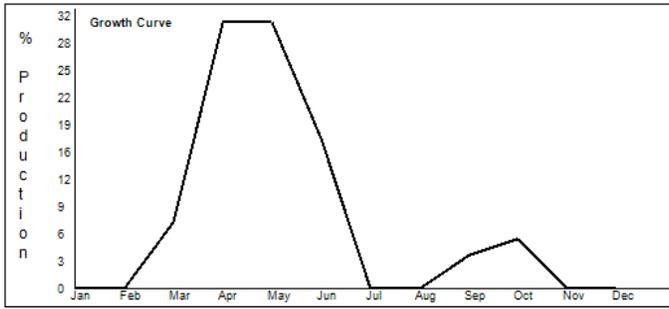
This pathway occurs when frequent fire or drought remove the big sagebrush, and favor the establishment of cheatgrass or other invasive annuals. In a degraded sagebrush community, cheatgrass will take advantage of the increased interspaces between plants will typically establish in the interspaces. Once annuals get established it creates a fine fuel load which will decrease the fire return interval. With more frequent fires, sagebrush can be eliminated from the site and a monocultures of invasive annuals can become established. These monocultures can persist for long time periods. Frequent fires also prevent the re-establishment of sagebrush on the site.

Plant Growth Curve

Growth curve number: CO0103
Growth curve name: MLRA 36 - Foothills Mesic
Growth curve description: MLRA 36

Percent Production by Month

<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
0	0	8	32	32	18	0	0	4	6	0	0



Community Phase 5.2: Annual Monoculture

This community is characterized by an almost a complete monoculture of cheatgrass and/or other invasive annuals. This community can be long-lasting phase if fires and disturbance continue to be frequent.

Community Phase Pathway 5.2A

This pathway occurs when there is a longer fire return interval. Longer fire return intervals can be enabled by using fire suppression and fire breaks to allow perennial vegetation to a change to get established. Along with this seeding and/or proper grazing may allow native perennial plants to return to this community. This pathway has very intensive energy inputs.

Plant Growth Curve

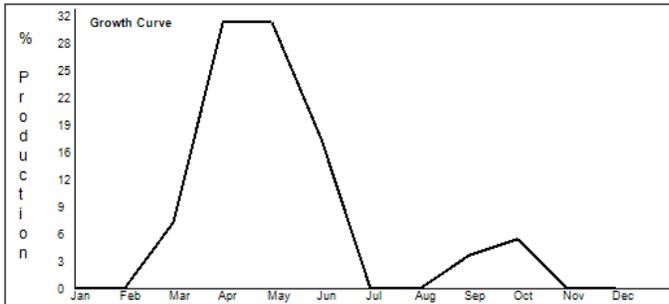
Growth curve number: CO0103

Growth curve name: MLRA 36 - Foothills Mesic

Growth curve description: MLRA 36

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	32	32	18	0	0	4	6	0	0



Transition T5A

This transition requires fire return intervals to length and fire suppression may be necessary to interrupted the shorten fire return intervals that occur when cheatgrass and other annuals invade. Juniper will encroach onto the site with time and lack of fire. Seeding may be necessary to establish perennial plants. This could require significant energy inputs to make this transition happen.

Restoration Pathway R5A

Invasive annuals will need to be treated and dominance suppress enough to allow desired seeded species the ability to complete so that they can become established. Seeding of introduced species is the pathway to state 4. This transition will be difficult and require substantial inputs and management of the site. It may not be practical on a large scale. Research is needed for species adapted to compete with annual invasive plants, and seeding techniques to add with successful transition from the invasive annual state.

Section II: Ecological Site Interpretations

Animal Community

The following is from the 1975 Range site:

WILDLIFE INTERPRETATIONS:

This site offers a high value rating for antelope, cottontail, and jackrabbit.

broom snakeweed	Gutierrezia sarothrae	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
James' galleta	Pleuraphis jamesii	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P

Animal kind: Adult sheep

Common name	Scientific name	Plant part	J	F	M	A	M	J	J	A	S	Q	N	D
Indian ricegrass	Achnatherum hymenoides	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
	Artemisia tridentata subsp. wyomingensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
Wyoming big sagebrush	Artemisia tridentata subsp. wyomingensis	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
arrowleaf balsamroot	Balsamorhiza sagittata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
yellow rabbitbrush	Chrysothamnus viscidiflorus	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
broom snakeweed	Gutierrezia sarothrae	Entire plant	U	U	U	U	U	U	U	U	U	U	U	U
needle and thread	Hesperostipa comata	Entire plant	P	P	P	P	P	P	P	P	P	P	P	P
western wheatgrass	Pascopyrum smithii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D
James' galleta	Pleuraphis jamesii	Entire plant	D	D	D	D	D	D	D	D	D	D	D	D

Legend: P=Preferred; D=Desirable; U=Undesirable; N=Not consumed; E=Emergency; T=Toxic; X=Used, but degree of utilization unknown

Hydrology Functions

Soils were originally assigned to hydrologic soil groups based on measured rainfall, runoff, and infiltrometer data (Musgrave 1955). Since the initial work was done to establish these groupings, assignment of soils to hydrologic soil groups has been based on the judgment of soil scientists. Assignments are made based on comparison of the characteristics of unclassified soil profiles with profiles of soils already placed into hydrologic soil groups. Most of the groupings are based on the premise that soils found within a climatic region that are similar in depth to a restrictive layer or water table, transmission rate of water, texture, structure, and degree of swelling when saturated, will have similar runoff responses. Four (4) Hydrologic Soil Groups are recognized (A-D). For specific definitions of each hydrologic soil group see the National Engineering Handbook, Chapter 7, Part 630 Hydrology, or visit: <http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=22526.wba>

The hydrologic soil groups are based on the following factors:

- intake and transmission of water under the conditions of maximum yearly wetness (thoroughly wet)
- soil not frozen
- bare soil surface
- maximum swelling of expansive clays

The slope of the soil surface is not considered when assigning hydrologic soil groups. In its simplest form, the hydrologic soil group is determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to any layer that is more or less water impermeable (such as a fragipan or duripan) or depth to a water table (if present) (Caudle, et. al, 2013). The runoff curve numbers are determined by field investigations using hydrologic cover conditions and hydrologic soil groups.

Soils Hydrologic Group

Luster - A
Palma - A
Pinavetes - A
Yarts - A

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms (Soil Survey Staff, 2017).

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission (Soil Survey Staff, 2017).

Recreational Uses

This site is used for recreational activities such as hunting, camping, hiking and off-road vehicle use. When the forbs are blooming in the spring, the site can be interesting for photographers and other visitors that enjoy vegetation.

Wood Products

Juniper and pinyon encroachment can be used as fence posts and firewood.

Other Products

None

Supporting Information

Associated Sites

<u>Site name</u>	<u>Site ID</u>	<u>Site narrative</u>
Loamy Foothills	R036XY284CO	Loamy Foothills occurs on hills, benches and mesas on moderately deep to deep loamy textured soils derived from alluvium, slope alluvium eolian deposits, and colluvium. It is a Wyoming big sagebrush – Muttongrass community. It has an aridic ustic moisture regime and mesic temperature regime. The effective precipitation ranges from 12 to 16 inches.
Clayey Foothills	R036XY289CO	Clayey Foothills occurs on benches, foot-slopes, fans, and valley. Soils are moderately deep to deep and have marine shale as parent materials. The soil textures are clay loam to clay. Dominant plants are Wyoming Big Sagebrush and western wheatgrass. This site has a high potential for shrink swell

Similar Sites

<u>Site name</u>	<u>Site ID</u>	<u>Site narrative</u>
Loamy Foothills	R036XY284CO	Loamy Foothills occurs on hills, benches and mesas on moderately deep to deep loamy textured soils derived from alluvium, slope alluvium eolian deposits, and colluvium. It is a Wyoming big sagebrush – Muttongrass community. It has an aridic ustic moisture regime and mesic temperature regime. The effective precipitation ranges from 12 to 16 inches.
Stony Foothills	R036XY287CO	Stony Foothill is a gentle sloped (<25% slope) site with moderately deep to deep that are loamy-skeletal in texture. This site is dominated by Pinyon, Utah Juniper. This site may have oakbrush in the understory. This site is in the 12 to 16 inch precipitation zone of foothills/upland.
Clayey Foothills	R036XY289CO	Clayey Foothills occurs on benches, foot-slopes, fans, and valley. Soils are moderately deep to deep and have marine shale as parent materials. The soil textures are clay loam to clay. Dominant plants are Wyoming Big Sagebrush and western wheatgrass. This site has a high potential for shrink swell
Foothill Valley	R036XY347CO	Located in valley bottoms, toe slopes and flood plain steps. The soils are moderately deep to deep. Surface textures range from sandy loam to clay loam. This site has Basin Big Sagebrush as the dominated shrub.

State Correlation

This site has been correlated with the following states: co

Other Inventory Data References

<u>Data source</u>	<u>Number of records</u>	<u>Sample period</u>	<u>State</u>	<u>County</u>
NRI Data	4	2003-2005	Colorado	Mesa

Type Locality

<i>State:</i>	CO
<i>County:</i>	Mesa
<i>General legal description:</i>	About four miles west of Glade Park Store, then along highway beneath sandstone bluffs and adjacent to alluvial bottoms following main creeks on for several miles toward Utah.

Hierarchical Classification Relationships

NRCS & BLM: Major Land Resource Area 36, Southwestern Plateaus Mesas and Foothills (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:

341Bo - North Uncompahgre Plateau, and 341Bp - Uncompahgre Plateau Subsections <341B Northern Canyonlands Section < 341 Intermountain Semi-desert and Desert (Cleland, et al., 2007).

EPA:

20b Shale Deserts and Sedimentary Basins and 20c Semiarid Benchlands and Canyonlands, < 20 Colorado Plateau < 10.I Cold Deserts < 10 North American Deserts (Griffith, 2006).

USGS: Colorado Plateau Province (Canyonlands Section)

Other References

Beymer, R.J. And J.M., Kolpatek. Potential contribution of carbon by microphytic crusts in pinyon-juniper woodlands

Belnap, J. 1994. Potential role of cryptobiotic crusts in semiarid rangelands. Ecology and management of annual rangelands, edited by S.B. Monsen and S.G. Kitchen: USDA Forest Service Technical Report INT-GTR-313. Intermountain research Station, Ogden UT.

Belnap, J. and D.A. Gillette 1998. Vulnerability of desert soil surfaces to wind erosion: impacts of soil texture and disturbance. Journal of Arid Environments. 398:133-142.

Howard, Janet L. 1999. *Artemisia tridentata* subsp. *wyomingensis*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <http://www.fs.fed.us/database/feis/> [2015, August 21].

Miller, R. F. and L. L. Eddleman. 2001. Spatial and temporal changes of sage grouse habitat in the sagebrush biome. Oregon State University Agricultural Experiment Station. Technical Bulletin 151. Corvallis, OR.

Miller, R. F. and R. J. Tausch. 2002. The role of fire in juniper and pinyon woodlands: a descriptive analysis. Proceedings: The First National Congress on Fire, Ecology, Prevention, and Management. San Diego, CA, Nov. 27 - Dec. 1, 2000. Tall Timbers Research Station, Tallahassee, FL.

Musgrave, G.W. 1955. How much of the rain enters the soil? In Water: U.S. Department of Agriculture Yearbook. Washington, D.C. P. 151-159.

National Engineering Handbook. US Department of Agriculture, Natural Resources Conservation Service. Available: <http://www.info.usda.gov/CED/Default.cfm#National%20Engineering%20Handbook> Accessed February 25, 2008.

Passey, H. B., W. K. Hugie, E. W. Williams, and D. E. Ball. 1982. Relationships between soil, plant community, and climate on rangelands of the Intermountain west. USDA, Soil Conservation Service, Tech. Bull. No. 1669.

West, N. E. 1983. Western Intermountain sagebrush steppe. P.311-397 N.E> West (ed.) Ecosystem of the World 5: Temperate deserts and semi-deserts. Elsevier Scientific Publishing Company, New York, NY.

Western Regional Climate Center. Retrieved from <http://www.wrcc.dri.edu/summary/Climsmco.html> on February 9, 2017.

Winward, A. H. 2004. Sagebrush of Colorado: taxonomy, distribution, ecology, and management. Denver. Colorado Division of Wildlife.

Whisenant, S. G. 1986. Herbicide use in *Artemisia* and *Chrysothamnus* communities: Reducing damage to non-target species. In E.D. McArthur and B.L. Welch, Compilers, Proceedings – Symposium on the Biology of *Artemisia* and *Chrysothamnus* pp 115-121 USDA Forest Service Gen. tech. rep. INT-200. 398pp. Ogden, UT.

Soil Conservation Service (SCS). August 1975. Range Site Description for Sandy Foothills #310: USDA, Denver Colorado

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at <http://websoilsurvey.nrcs.usda.gov/>. Accessed [3/3/2017].

Acknowledgments:

Project Staff:

Suzanne Mayne-Kinney, Ecological Site Specialist, NRCS MLRA, Grand Junction SSO
 Chuck Peacock, MLRA Soil Survey Leader, NRCS MLRA Grand Junction SSO

Program Support:

Rachel Murph, NRCS CO State Rangeland Management Specialist, Denver
 Scott Woodhall, NRCS MLRA Ecological Site Specialist-QA Phoenix, AZ
 Eva Mueller, Regional Director, Rocky Mountain Regional Soil Survey Office, Bozeman, MT
 B.J. Shoup, CO State Soil Scientist, Denver
 Eugene Backhaus, CO State Resource Conservationist, Denver

Partners/Contributors:

Those involved in developing earlier versions of this site description include: Herman Garcia, retired CO State RMS and NRCS MLRA Ecological Site Specialist-QA Phoenix, AZ.

--Site Development and Testing Plan--:

Future work to validate and further refine the information in this Provisional Ecological Site Description is necessary. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data.

Additional information and data is required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 36 must be further investigated.

Field testing of the information contained in this Provisional ESD is required. As this ESD is moved to the Approved ESD level, reviews from the technical team, quality control, quality assurance, and peers will be conducted.

Site Authors

Suzanne Mayne Kinney

Certifications

NRCS Science and Technology Certified by Rachel Murph (9/18/2017)

Quality Assurance

Provisional Status Verified by Scott Woodall (12/21/2017)

Reference Sheet

Certification: Reference Sheet Certified by Rachel Murph (9/18/2017)

Author(s)/participant(s): Suzanne Mayne-Kinney

Contact for lead author:

Date: 3/10/2017 **MLRA:** 036X **Ecological Site:** Sandy Foothills R036XY310CO This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: X Annual Production, Foliar Cover, Biomass

Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural disturbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

1. **Number and extent of rills:** None to very rare. Any rills present should be short in length (less than 6 feet long) and only occur where increased runoff occurs on lower part of steeper slopes and areas below exposed bedrock. Old rills should be weathered and muted in appearance. An increase in rill formation may be seen after disturbance events such as recent fire or thunderstorms.

2. **Presence of water flow patterns:** None to Slight. If present, short (less than 6-8 feet long) and usually disconnected with numerous debris dams. They are stable. Flow patterns typically flow around perennial plant bases and show no evidence of erosion. They are more evident after recent thunderstorms.

3. **Number and height of erosional pedestals or terracettes:** None. Plants should show no signs of pedestalling. Terracettes occur very rarely.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, standing dead, lichen, moss, plant canopy are not bare ground):** In the reference state bare ground ranges from 15 to 30%. Areas with well-developed biological soil crust should not be counted as bare ground. Areas with poorly developed biological soils crust that are interpreted as functioning as bare ground (therefore they would be susceptible to raindrop splash erosion) should be recorded as bare ground.

5. **Number of gullies and erosion associated with gullies:** None to very rare. Any gullies present are sparsely located across the landscape and are usually caused by run-in water from adjacent sites that are dominated by exposed bed rock or dissected slopes. If present gullies have been re-stabilized by perennial vegetation.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Minor evidence of wind generated soil movement, slight deposition at the base of shrubs is acceptable; however blowouts or excessive deposition should not occur.

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- 7. Amount of litter movement (describe size and distance expected to travel):** Most litter resides in place with some redistribution caused by water and wind movement. Fine litter (<¼ inch in diameter) may be moved up to <1 ft. with deposition occurring at obstruction. The majority of litter accumulates at the base of plants or in soil depression adjacent to the plant. Woody stems (those greater than ¼ inch in diameter) are not likely to move under normal conditions.
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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):** Soil surface textures are loamy sand to fine sandy loam. Soil stability values are 1-3 with no canopy cover and 2-4 under canopy. There is little water erosion and light to moderate wind erosion with the reference plant community in place.
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- 9. Soil surface structure and SOM content (include type and strength of structure, and A-horizon color and thickness):** Surface texture is generally a loamy fine sand, fine sandy loam or a very fine sandy loam. Soil surface depth varies from 3 to 12 inches and structure is typically weak fine granular to weak medium platy structure. There is little difference in the soils under the plants when compared to soils in the interspaces.
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- 10. Effect on plant community composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Bare spaces are small, rounded in shape, and are unconnected. The diverse grass, forb, shrub functional/ structural groups and any well-developed biological soil crusts (moss, pinnacled lichen, and light cyanobacteria) (when present), reduce raindrop impact and slows overland flow providing increased time for infiltration.
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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):** none
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- 12. Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
 Dominant: Perennial grasses (needle-and-thread, Indian ricegrass) > Perennial Native Forbs >
 Sub-dominant: non-sprouting shrubs (Wyoming big sagebrush)>= Native Warm Season Rhizomatous Grasses (blue grama, galleta)
 Other:
 Additional: Factors contributing to temporal variability include wildlife use, drought, and insects. Factors contributing to special variability include soil texture, depth, rock fragments, slope, aspect, and micro-topography. These groups are based on community phase 1.1 of the reference community which is generally considered the reference plant community for this ecological site.
- Perennial and annual forbs can be expected to vary widely in their expression in the plant community based upon departures from average growing conditions. Biological crusts (lichen, moss, and cyanobacteria) should be present but are variable based on plant community and state.
- Functional/structural groups may appropriately contain non-native species if their ecological function is the same as the native species in the reference state.
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- 13. Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
 Typical minimal. During years with average to above average precipitation, there should be very little recent mortality or decadence apparent in either the shrubs or grasses. Some mortality of bunchgrass and other shrubs may occur during very severe (long term) droughts.
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- 14. Average percent litter cover (15-25%) and depth (.25inches):** Litter cover (including under plants) ranges from 15-25%, nearly all of which should be fine litter. Depth is generally 1 leaf thickness in the interspaces and up to ¼ inch under plant canopies. Litter can be variability due to the herbaceous production differences from one year to the next with climatic fluctuations. Litter can increase immediate following leaf drop or after favorable conditions increase native annual forb production. Litter will also decline during and following extended drought.
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- 15. Expected annual production (this is TOTAL above-ground production, not just forage production):** 600 lbs. /ac. low precipitation years, 1000 lbs. /ac. average precipitation years, 1200 lbs. /ac. above average precipitation years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 400 - 600 lbs. /ac. or more.
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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 indicator, we are describing**

what is NOT expected in the reference state for the ecological site: Known invasive species include cheatgrass (*Bromus tectorum*), broom snakeweed (*Gutierrezia sarothrae*), tansy mustard (*Descurainia pinnata*), Russian thistle (*Salsola tragus*), twoneedle pinyon (*Pinus edulis*), and Utah juniper (*Juniperus osteosperma*)

- 17. Perennial plant reproductive capability:** The only limitations are weather-related, wildfire, natural disease, inter-species competition, wildlife, and insects that may temporarily reduce reproductive capability.
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Reference Sheet Approval

Approval

Rachel Murph, State Rangeland Management Spec., USDA NRCS Colorado

Date

9/18/2017