USDA Natural Resources Conservation Service

Ecological site R036XY284CO
Loamy Foothills

Last updated: 12/20/2024
Accessed: 05/13/2025

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.

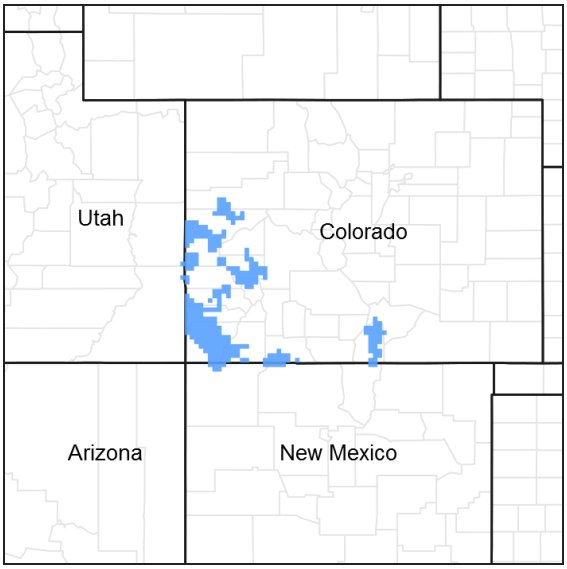

Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 036X–Southwestern Plateaus, Mesas, and Foothills

Loamy Foothills ecological site is found on benches and mesa tops 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 Wyoming big sagebrush.

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:
313Be San Juan Basin North Subsection <313B Navaho Canyonlands Section < 313 Colorado Plateau Semi-Desert (Cleland, et al., 2007).

313Aa-San Juan Basin-Mesa Verde, 313Ab-Canyon of Ancients-Blanding Basin, and 313Ac-Monument Upwarp subsections <313A Grand Canyons Section < 313 Colorado Plateau Semi-Desert (Cleland, et al., 2007).

341Bo-North Uncompahgre Plateau , 341Bp-Uncompahgre Plateau, 341Bg-Northeast Flank, 341Bq-South Uncompahgre Plateau, 341Bk-La Sal Mountains, 341Bd-Salt Anticline Benchlands, and 341Be-Dove Creek-Egnar Plains Subsections <341B Northern Canyonlands Section < 341 Intermountain Semi-desert and Desert (Cleland, et al., 2007).

EPA:
20a Monticello-Cortez Uplands, 20c Semiarid Benchlands and Canyonlands, < 20 Colorado Plateau < 10.l Cold Deserts < 10 North American Deserts (Griffith, 2006).

USGS:
Colorado Plateau Province (Canyonlands and Navajo Section)

Ecological site concept

The 36X Loamy Foothills was drafted from the existing Loamy 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 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.

Associated sites

R035XY413CO	**Alkali Bottom** The site is found on terraces, drainage-ways and alluvial valley floors. This site is in a run-in position on the landscape. Soils are deep from shale and sandstone. Soils are moderate to strongly alkaline. Surface textures are sandy loam, clay loam or silty clay loam. Subsurface textures are silty clay loam. Dominant plants are alkali sacaton, inland saltgrass, basin wildrye, and greasewood.
R036XY141CO	**Shallow Loamy Mesa Top (pinyon-Utah juniper)** This site is found on sloping mesa tops. Soils are shallow and can be very cobbly. The soil textures are sandy loam or loam and are calcareous. Dominant vegetation is muttongrass, Indian ricegrass, two-needle pinyon, and Utah juniper.
R036XY142CO	**Loamy Mesa Top (pinyon-Utah juniper)** This site is found on sloping mesa tops. Soils are moderately deep to deep. The soil textures are loam or silt loam. Soils are formed from calcareous eolian materials and are underlain by sandstone. The subsurface has a strong calcic horizon. Dominant vegetation is muttongrass, Indian ricegrass, two-needle pinyon, and Utah juniper.
R036XY405CO	**Loamy Bottom** This site occurs on drainage-ways, floodplains, and alluvial fans. This site is in a run-in position on the landscape. Soils are deep. Soil textures are generally loams. Dominant vegetation is muttongrass, basin big sagebrush, and western wheatgrass.

Similar sites

R036XY310CO	**Sandy Foothills** Site occurs on rolling uplands on mesas. Soils are deep sandy loams to loamy sands. Dominant plants are needle-and-thread, western wheatgrass, Wyoming big sagebrush, and balsamroot.
R036XY287CO	**Stony Foothills** 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.

R036XY289CO	**Clayey Foothills** Site 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.
R036XY347CO	**Foothill Valley** 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.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata subsp. wyomingensis*
Herbaceous	(1) *Poa fendleriana* (2) *Pascopyrum smithii*

Physiographic features

This site occurs on hills, mesas, structural benches, alluvial fans and old terraces. Slopes typically range from 1-15%, and elevations are generally 5800-7200 ft., but it can go down to 5500 on north and easterly slopes and up to 7500 on south and westerly slopes. This site is rather typical of the "bean country" of southwestern Colorado and southeastern Utah.

Table 2. Representative physiographic features

Landforms	(1) Mesa (2) Structural bench (3) Alluvial fan
Flooding frequency	None
Ponding frequency	None
Elevation	1,768–2,195 m
Slope	1–15%
Aspect	Aspect is not a significant factor

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 48ºF to 52ºF, averaging about 31ºF for the winter and 60ºF through the growing season, March through October. Summer temperatures of 100ºF 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 37ºF. The coldest winter temperature recorded was -23ºF on February 8, 1933 and the coldest summer temperature recorded was 28ºF on June 3, 1908. The hottest day on record is 110 ºF 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.

Table 3. Representative climatic features

Frost-free period (average)	118 days
Freeze-free period (average)	145 days
Precipitation total (average)	356 mm

Climate stations used

- (1) CORTEZ [USC00051886], Cortez, CO
- (2) NORTHDALE [USC00055970], Dove Creek, CO
- (3) BLANDING [USC00420738], Blanding, UT
- (4) PAONIA 1 SW [USC00056306], Hotchkiss, CO
- (5) LA SAL 1SW [USC00424947], Monticello, UT
- (6) URAVAN [USC00058560], Naturita, CO
- (7) YELLOW JACKET 2 W [USC00059275], Yellow Jacket, CO

Influencing water features

There are no water features on this site.

Soil features

Soils are moderately deep (20-40 inches) to deep (60+ inches) with very few rock fragments. The surface layer texture is usually a loam with 12-24% clay. The subsurface can be loam, silt loam, sandy clay loam or clay loam with approximately 22-35% clay. The soil has an argillic horizon. The most common parent materials are eolian deposits derived from sandstone, and alluvium and/or colluvium derived from sandstone and shale. The soils assigned to the ESD range from 4 to 8 inches of water holding capacity. But, generally there is a well- developed textural B horizon which contributes to a water-holding capacity of approximately 6 inches of water in the upper 40 inches of soil. They generally have secondary carbonates or a calcic horizon in the lower B or C horizon. The microbiotic crust is an important part of this site. It helps hold the soil and nutrients in place.

Loamy Foothills has been used as a catchall for sites that don’t fit other ecological sites in this climatic zone. Some soils have been mis-correlated to this site that should be assigned to a different site. The soils that need to be investigated are in fine soils family and should probably be assigned to the clayey foothills ecological site. The fine soils include: Collide, Agua Fria, Callan, Gurley, Iles and Pino. Also, there are soils that are frigid and/or higher than 16” assigned to this site and these soil map units need to be evaluated for which ESD (ecological site description) they belong to: Frigid and higher precipitation soils include: Beje, Evanston, Jemez, Maudlin, Mitch, Callan, Gurley, Iles and Pino.

Ackmen and Simpatico are in run-in positons on the landscape and need to be evaluated for this ESD, also. This site needs to be further evaluated to see if the fine-silty and fine-loamy soils are one ESD or two ESDs.

This ecological site has been used in the following Soil Surveys: CO679 (Paonia Area), CO671 (Cortez Area), CO668 (Archuleta County), CO675 (San Miguel Area), CO670 (Ute Mountain Area), CO677 (Ridgeway Area), and CO672 (Animas-Dolores Area).

Typical soils assigned to this ecological site are:

Fine- Loamy – Ascalon, Brumley, Potts, Progresso, and Scholle

Fine-Silty – Cahona, Monogram, Monticello, Pulpit, Sharps, Wetherill, and Witt

Table 4. Representative soil features

Parent material	(1) Eolian deposits–sandstone (2) Alluvium–sandstone and shale
Surface texture	(1) Loam

Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate to moderately slow
Soil depth	51 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	10.16–20.32 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–15%
Subsurface fragment volume >3" (Depth not specified)	0–10%

Ecological dynamics

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 characterize 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 where modified by prehistoric humans and not pristine and thus where 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 Wyoming 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). 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 Wyoming 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. This is the interpretive plant community and is considered to be the Reference Plant Community State.

State and transition model

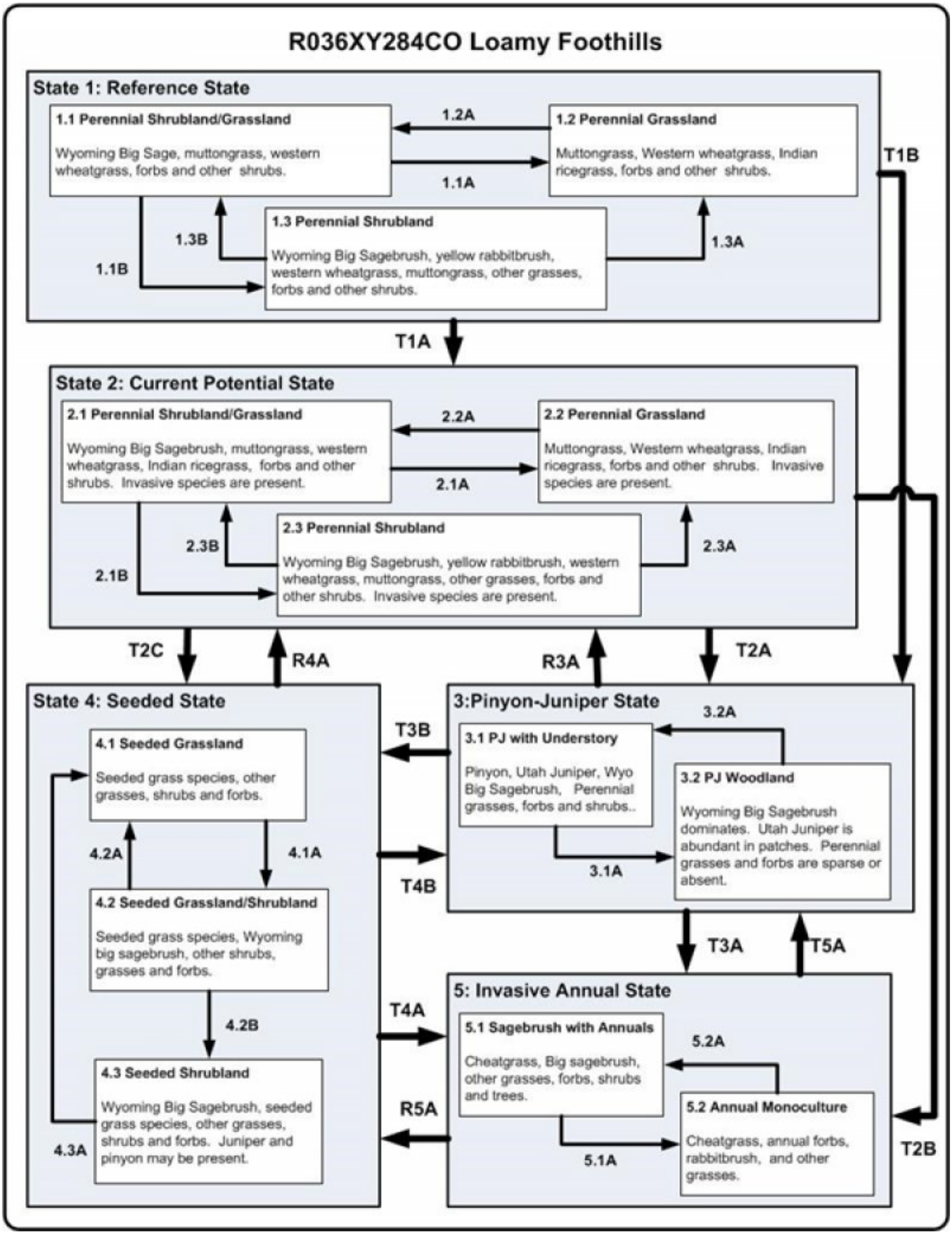

Figure 6. 284CO STM

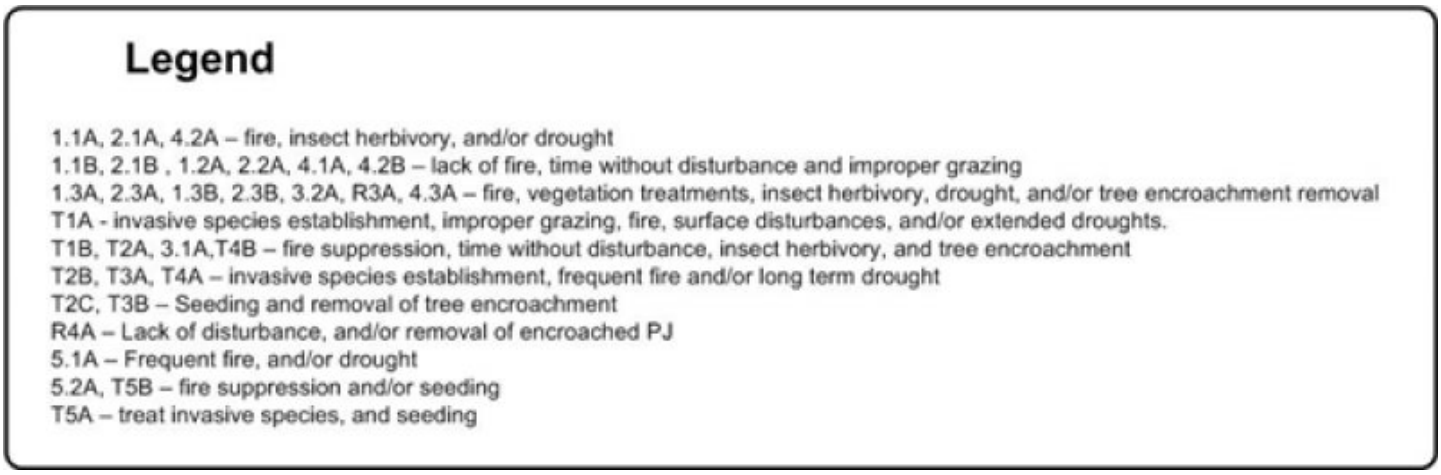

Figure 7. STM Legend

State 1
Reference

The reference state represents the plant communities and ecological dynamics of the Loamy Foothills site. 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 Wyoming Big Sagebrush Communities. The reference state is generally dominated by Wyoming big sagebrush, western wheatgrass, and muttongrass. 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. 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 1.1
Perennial Shrubland and Grassland

Figure 8. Wyoming Big Sagebrush-Muttongrass

Figure 9. Loamy Foothills Close Up View

The dominant plants on this site are Wyoming big sagebrush, muttongrass and western wheatgrass. The sagebrush will be a mixed age stand. Other common grasses are Junegrass, needle-and-thread, Indian ricegrass, and bottlebrush squirreltail. Rock goldenrod, lupine, paintbrush, buckwheats, phlox, and Penstemon are common forbs. 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. Small amounts of low woody and semi-woody plants such as yellow rabbitbrush, Parry's rabbitbrush, and broom snakeweed are common. Other lower frequency shrubs that occur are antelope bitterbrush, Utah serviceberry, and true mountain mahogany. Also, occurring sometimes are squaw-apple (wild crab apple), and spineless horsebrush. On the upper (higher elevations) and where moisture is favorable, Gambel's oak may be found in small quantities.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	504	729	1009
Shrub/Vine	308	364	476
Forb	84	140	196
Total	**896**	**1233**	**1681**

Table 6. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	15-35%
Grass/grasslike foliar cover	25-40%
Forb foliar cover	1-10%
Non-vascular plants	0-1%
Biological crusts	1-5%
Litter	30-40%
Surface fragments >0.25" and <=3"	1-15%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	5-15%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	1-10%	10-20%	1-4%
>0.15 <= 0.3	–	1-10%	0-10%	1-4%
>0.3 <= 0.6	–	5-20%	0-10%	–
>0.6 <= 1.4	–	1-15%	–	–
>1.4 <= 4	–	0-5%	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Figure 11. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 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 5-10 years 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.

Figure 12. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 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.

Figure 13. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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

Pathway 1.1A
Community 1.1 to 1.2

This transition is caused by naturally occurring fires and/or drought. With a mature sagebrush community, this pathway can be caused by high intensity fire that burns hot enough to remove Wyoming 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).

Pathway 1.1B
Community 1.1 to 1.3

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.

Pathway 1.2A
Community 1.2 to 1.1

This pathway favors shrub establishment. Events that cause this pathway are cause by time without disturbance (i.e. lack of fire). Sagebrush can become established in 5-10 years following a fire, if there is seed available and the climate conditions are right for it to germinate and grow.

Pathway 1.3B
Community 1.3 to 1.1

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.

Pathway 1.3A
Community 1.3 to 1.2

This pathway is caused by naturally occurring fires, drought 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.

State 2
Current Potential

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 2.1
Perennial Shrubland and Grassland

This community phase is dominated by Wyoming big sagebrush, Muttongrass, western wheatgrass, and Indian ricegrass. 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.

Figure 14. Plant community growth curve (percent production by month).
CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 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.

Figure 15. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 2.3
Perennial Shrubland

Figure 16. 2.3

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.

Figure 17. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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

Pathway 2.1A
Community 2.1 to 2.2

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.

Pathway 2.1B
Community 2.1 to 2.3

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

Pathway 2.2A
Community 2.2 to 2.1

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

Pathway 2.3B
Community 2.3 to 2.1

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.

Pathway 2.3A
Community 2.3 to 2.2

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.

State 3
Pinyon-Juniper

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 3.1
Pinyon-Juniper 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.

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

CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 3.2
Pinyon-Juniper Woodland

Figure 19. 3.2

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.

Figure 20. Plant community growth curve (percent production by month).
CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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

Pathway 3.1A
Community 3.1 to 3.2

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

Pathway 3.2A
Community 3.2 to 3.1

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

State 4
Seeded

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 4.1
Seeded Grassland

Figure 21. Seeded grassland during severe drought

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.

Figure 22. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 4.2
Seeded Grassland and Shrubland

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

Figure 23. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 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.

Figure 24. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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

Pathway 4.1A

Community 4.1 to 4.2

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.

Pathway 4.2A
Community 4.2 to 4.1

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.

Pathway 4.2B
Community 4.2 to 4.3

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.

Pathway 4.3A
Community 4.3 to 4.1

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.

State 5
Invasive Annual

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 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.

Figure 25. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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 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.

Figure 26. Plant community growth curve (percent production by month). CO0103, MLRA 36 - Foothills Mesic. MLRA 36.

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

Pathway 5.1A
Community 5.1 to 5.2

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.

Pathway 5.2A
Community 5.2 to 5.1

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.

Transition T1A
State 1 to 2

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
State 1 to 3

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.

Transition T2A
State 2 to 3

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 T2C
State 2 to 4

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.

Transition T2B
State 2 to 5

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.

Restoration pathway R3A
State 3 to 2

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.

Transition T3B
State 3 to 4

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.

Transition T3A
State 3 to 5

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).

Restoration pathway R4A
State 4 to 2

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.

Transition T4B
State 4 to 3

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.

Transition T4A
State 4 to 5

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 T5A
State 5 to 3

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
State 5 to 4

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.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Native Cool Season Bunchgrasses**			448–785	
	muttongrass	POFE	*Poa fendleriana*	448–673	–
	needle and thread	HECO26	*Hesperostipa comata*	11–112	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	11–112	–
	squirreltail	ELEL5	*Elymus elymoides*	6–56	–
	Grass, perennial	2GP	*Grass, perennial*	0–56	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–22	–
2	**Native Cool Season Rhizomatous Grasses**			168–504	
	western wheatgrass	PASM	*Pascopyrum smithii*	168–504	–
3	**Native Warm Season Rhizomatous Grasses**			0–28	
	blue grama	BOGR2	*Bouteloua gracilis*	0–17	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–17	–
Forb					
4	**Perennial Native Forbs**			56–168	
	lupine	LUPIN	*Lupinus*	6–39	–
	fleabane	ERIGE2	*Erigeron*	6–39	–
	redroot buckwheat	ERRA3	*Eriogonum racemosum*	6–28	–
	milkvetch	ASTRA	*Astragalus*	6–28	–
	Indian paintbrush	CASTI2	*Castilleja*	6–28	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	6–28	–
	beardtongue	PENST	*Penstemon*	6–22	–
	Forb, perennial	2FP	*Forb, perennial*	0–22	–
	onion	ALLIU	*Allium*	0–17	–
	aster	ASTER	*Aster*	0–17	–

	bastard toadflax	COUM	*Comandra umbellata*	0–17	–
	rubberweed	HYMEN7	*Hymenoxys*	0–17	–
	rock goldenrod	PEPU7	*Petradoria pumila*	0–17	–
	ragwort	SENEC	*Senecio*	0–17	–
	spiny phlox	PHHO	*Phlox hoodii*	0–11	–
	buckwheat	ERIOG	*Eriogonum*	0–11	–
Shrub/Vine					
5	**Native non-sprouting Shrubs**			168–504	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	140–308	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	11–56	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	6–39	–
	wild crab apple	PERA4	*Peraphyllum ramosissimum*	0–11	–
	spineless horsebrush	TECA2	*Tetradymia canescens*	0–11	–
	Parry's rabbitbrush	ERPAP10	*Ericameria parryi var. parryi*	0–11	–
6	**Native Sprouting Shrubs**			11–56	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–28	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	0–28	–
	Gambel oak	QUGA	*Quercus gambelii*	0–17	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–11	–

Animal community

Interpretations for Wildlife (Written by Ed Neilson, Area 1 Wildlife Biologist (2015))

This site provides both food and cover for wildlife. Mule deer, pronghorn and elk are large ungulates that use the site depending on the state. Pinion Juniper states provide cover for both mule deer and elk and the other states provide forage to varying degrees. Coyote, red and gray fox, badger, bobcat, mountain lion, long-tailed weasel and an occasional black bear are the most common mammalian predators found on this site. Pronghorn prefer the grass and sagebrush dominated areas. Other common wildlife mammal species that occur on this site depending on the state are: desert cottontail, Nuttall's cottontail, white-tailed and black-tailed jackrabbit, Gunnison's and white-tailed prairie dog, Least chipmunk, Colorado chipmunk, golden-mantled ground squirrel, valley and northern pocket gopher, deer mouse, Western harvest mouse, pinyon mouse, Mexican woodrat, desert woodrat, ringtail, and porcupine.

Avian species common to the site depending on the state are: in state 1 and 2, Brewer's sparrow, vesper sparrow, green-tailed towhee, Western meadowlark, lark sparrow, sage thrasher, mourning dove, Gunnison's sage grouse, American kestrel, red-tailed hawk, northern harrier and golden eagle. In state 5; mountain bluebird, pinyon jay, chipping sparrow, mourning dove, blue-gray gnatcatcher, juniper titmouse, common nighthawk, ash-throated flycatcher, bushtit, gray flycatcher, Bewick's wren, spotted towhee, Western screech owl, Northern saw-whet owl and red-tailed hawk.

This site is valuable for existing and potential habitat for the threatened Gunnison's sage grouse. Both conversion to a seeded state and encroachment of pinyon/juniper can make the site less valuable for sage grouse.

Amphibians and reptiles that may be found on this site depending on the state include: Great Basin and New Mexico spadefoot, collared lizard, short-horned lizard, side-blotched lizard, plateau striped whiptail, striped whipsnake, bull snake, Western terrestrial garter snake and Western rattlesnake.

--Grazing Interpretations--
This site provides good grazing conditions for livestock and wildlife due to the high availability of nutritious forage.

Yet, this site often lacks natural perennial water sources, which can influence the suitability for livestock and wildlife grazing. The suitability for re-seeding or restoring this site is fair due to the extreme temperatures and variability in time and amount of precipitation. This site may occur in desert bighorn sheep, elk, mule deer and pronghorn antelope ranges, and are important wintering areas for these wildlife species. However, in many places the populations will be small and have little grazing impact on the site.

The plant community is primarily grasses, with a majority of the cover coming from muttongrass, and Indian ricegrass. These grasses provide good grazing conditions for horses, cattle, sheep, elk, and bighorn sheep. The presence of shrubs, primarily Wyoming big sagebrush, and rabbitbrush provide year round browse for all classes of livestock and wildlife. Wyoming sagebrush provides good wintering browse due to its high protein content; however sagebrush is used sparingly by livestock when other herbaceous forages are available. Forb composition and annual production depends primarily on precipitation amounts and thus is challenging to use in livestock grazing management decisions. However, forb composition should be monitored for species diversity, as well as poisonous or injurious plant communities which may be detrimental to livestock if grazed. Before making specific grazing management recommendations, an onsite evaluation should be made.

Hydrological 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

Fine-Loamy Soils
Ascalon B
Brumley C
Potts C
Progresso C
Scholle C

Fine-Silty Soils

Cahona C
Monogram C
Monticello B
Pulpit C
Sharps C
Wetherill B or C

Witt B

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, 2015).

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, 2015).

Recreational uses

Recreational activities include aesthetic value and good opportunities for hiking, horseback riding, and off-road vehicle use.

Wood products

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

Other products

None

Other information

--Poisonous and Toxic Plant Communities--
Toxic plants that may be associated with this site include broom snakeweed, tailcup lupine, and two lobe larkspur. Broom snakeweed contains steroids, terpenoids, saponins, and flavones that can cause abortions or reproductive failure in sheep and cattle, however cattle are most susceptible. These toxins are most abundant during active growth and leafing stage. Cattle and sheep will typically only graze broom snakeweed when other forage is unavailable and generally in winter when toxicity levels are at their lowest.

Tail cup lupine contains quinolizidine and piperlizidine alkaloids, which are found in all part of the plants, during all phases. Lupine poisoning primarily affects cattle and is associated with 2 syndromes: 1) crooked calf disease and 2) neurological disease. Crooked calf disease is characterized by calves being born with skeletal deformities and caused by cows consuming toxic levels of lupines between 40 and 70 days gestation. The neurological diseases effects may include muscle tremors, labored breathing, coma, and death. This can be caused by grazing lupines at any time.

Two lobe larkspur affects cattle only—sheep and goats have been used a biological control mechanism to reduce larkspur communities. This plant contains many diterpenoid alkaloids which can cause sudden death, uneasiness, increased excitability, muscle weakness, staggering, and stiffness. Larkspur toxicity levels are highest during the

vegetative state when the plants are less palatable, and as the plants mature, toxicity decreases, but palatability increases. This creates a toxic window during the flowering stage in which cattle are most susceptible to poisoning. During this time plants are palatable and toxic enough to have a detrimental effect.

Potentially toxic plants associated with this site include Wyoming big sagebrush. Wyoming big sagebrush contains sesquiterpene lactones and monoterpenes which have been suspected of being toxic to sheep. An experimental dosage of ¾ lbs of big sagebrush fed to sheep for three days was found to be lethal.

Russian thistle is an invasive toxic plant, causing nitrate and to a lesser extent oxalate poisoning, which affects all classes of livestock. The buildup of nitrates in these plants is highly dependent upon environmental factors, such as after a rain storm, during a drought, cool/cloudy days, and soils high in nitrogen and low in sulfur and phosphorus, all which cause increased nitrate accumulation. Nitrate collects in the stems and can persist throughout the growing season. Clinical signs of nitrate poisoning include drowsiness, weakness, muscular tremors, increased heart and respiratory rates, staggering gait, and death. Conversely, oxalate poisoning causes kidney failure; clinical signs include muscle tremors, tetany, weakness, and depression. Poisoning generally occurs when livestock consume and are not accustomed to grazing oxalate-containing plants. Animals with prior exposure to oxalates have increased numbers of oxalate-degrading rumen microflora and thus are able to degrade the toxin before clinical poisoning can occur.

Type locality

Location 1: Montezuma County, CO	
General legal description	Chapin Mesa and Wetherill Mesa in Mesa Verde National Park. (These areas are good examples of a protected mature pinyon-juniper community, except where recently burned, and detailed soil-vegetation studies have been made on them.)

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--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.

Rangeland health reference sheet

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

Author(s)/participant(s)	Original written by Steve Myers and Scott Woodall (12/15/2004). Revised by Jake Owens (2/17/2010) Owens copied R036XY306UT reference sheet and revised it to match this site. Revised and Updated by Suzanne Mayne-Kinney on 8/21/2015
Contact for lead author	
Date	08/21/2015
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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.

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2. **Presence of water flow patterns:** None to Slight. If present, short (less than 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.

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

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** In the reference state bare ground ranges from 5 to 15%. 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. This site can have up to 6% surface rock cover. Ground cover is based on first raindrop impact, and bare ground is the opposite of ground cover. Ground cover + bare ground = 100%. Extended drought can cause bareground to

increase.

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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.

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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):** Stability class rating is 2 to 4 in the interspaces at the soil surface. With cover the expected values are 4 to 6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface texture is generally a loam. Soil surface depth varies from 3 to 7 inches and structure is typically thick platy parting to weak fine granular or medium granular. The dry surface color is reddish brown to brown. There is little difference in the soils under the plants when compared to soils in the interspaces.

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10. **Effect of community phase 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 annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Native Cool Season Bunchgrasses >>> Native Cool Season Rhizomatous Grasses >=

    Sub-dominant: Perennial Native Forbs >= Native non-sprouting Shrubs >>>

    Other: Native Sprouting Shrubs >> Native Warm Season Rhizomatous Grasses

    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 (%) and depth (in):** Litter cover (including under plants) ranges from 30-40%, 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 up to 20% 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 annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 800 lbs. /ac. low precipitation years, 1100 lbs. /ac. average precipitation years, 1500 lbs. /ac. above average precipitation years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 400 - 650 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 indicators, 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)

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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.
