USDA Natural Resources
Conservation Service

Ecological site R036XY110CO
Shallow Clay Loam (pinyon-Utah juniper)

Accessed: 05/19/2024

General information

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

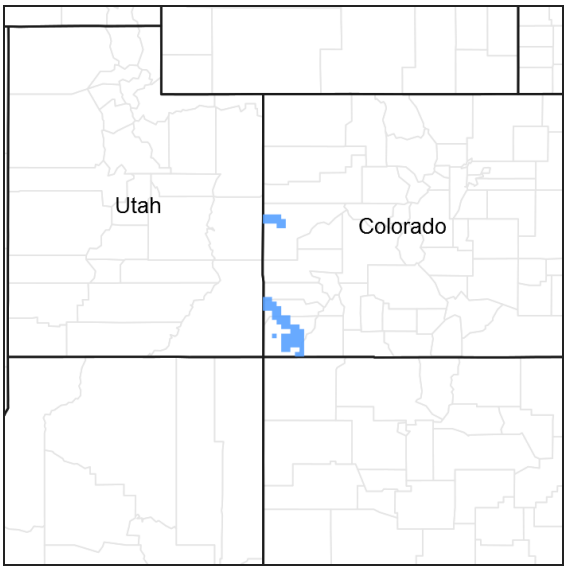

Figure 1. Mapped extent

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

MLRA notes

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

Shallow Clay Loam - (Pinyon-Juniper) ecological site is found on edges of mesas, pediments and dipslopes and in canyons in MLRA 36. 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 semi-desert regions. This zone is 9 to 12 inches of precipitation and has a mesic temperature regime. This site has bimodal precipitation that is dominated by Utah Juniper and pinyon with shrubs and grasses in the understory.

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

313Bc Chuska Valley Cold Desert Shrubland subsection <313B Navaho Canyonlands Section < 313 Colorado Plateau Semi-Desert (Cleland, et al., 2007).

341Bg-Northeast Flank and 341Ba-Mancos Shale Lowlands-Grand Valley subsections <341B Northern Canyonlands Section < 341 Intermountain Semi-desert and Desert (Cleland, et al., 2007).

EPA:
20a Monticello-Cortez Uplands, 20b Shale Deserts and Sedimentary Basins, and 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 Shallow Clay Loam PJ ecological site was drafted from the existing Shallow Clay Loam PJ Range Site 34X, (NRCS, March, 1996). 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 edges of mesas, pediments and dipslopes and in canyons on shallow clayey soils derived residuum weathered from sandstone and shale and/or colluvium over residuum weathered from shale. It is a Utah Juniper and Pinyon community. It has an ustic aridic moisture regime and mesic temperature regime. The effective precipitation ranges from 9 to 12 inches.

Associated sites

R036XY111CO	**Steep Shallow Clay Loam (pinyon-Utah juniper)** Steep Shallow Clay Loam Pinyon-Juniper is a very steep sloped (> 25% slopes) site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory. This site is in the 8 to 12 inch precipitation zone of semidesert.
R036XY113CO	**Semidesert Juniper Loam** Semidesert Juniper Loam is a gentle sloped (<25-30% slope) site with shallow soils that are loamy in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory. This site is in the 8 to 12 inch precipitation zone of semidesert.
R036XY325CO	**Semidesert Loam** Semidesert Loam are loamy texture soils. Particle control section is fine-loamy. Clay content is higher in these soils than those found in Semidesert Sandy Loam. Both are a Wyoming big sagebrush dominated site. Indian Ricegrass and galleta are the dominant grass on this site. The soils on this site are moderately deep to very deep. This site is in the 8 to 12 inch precipitation zone of semidesert.
R036XY328CO	**Semidesert Clay Loam** Semidesert Clay Loam is on clayey texture soils. Clay content is higher in these soils than those found in Semidesert Loam. Both are a Wyoming big sagebrush dominated site. Western wheatgrass/thickspike wheatgrass is the dominant grass on this site. The soils on this site are moderately deep to very deep. This site is in the 8 to 12 inch precipitation zone of semidesert.

Similar sites

R036XY111CO	**Steep Shallow Clay Loam (pinyon-Utah juniper)** Steep Shallow Clay Loam Pinyon-Juniper is a very steep sloped (> 25% slopes) site with shallow soils that are clayey in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory.
R036XY445CO	**Steep Colluvial Slopes** Steep Colluvial Slopes is a very steep (>25% slope) sloped site with very shallow to shallow soils that are clayey in texture. This site is dominated by Utah Juniper and pinyon. This site may have Wyoming big sagebrush in the understory. This site has higher precipitation (12 to 16") than Semidesert Loam (8 to 12"). The temperature is slightly cooler than the semidesert site. Foothill site will be found at elevations above the semidesert site. The soils are similar in nature.
R036XY346CO	**Cobbly Foothills** Cobbly Foothill is a gentle sloped (<20% slope) site with moderately deep to deep soils that are loamy-skeletal in texture. Common surface textures are cobbly or gravelly loam. This site is dominated by Big sagebrush, western wheatgrass, Pinyon, and Utah Juniper. This site is in the 12 to 16 inch precipitation zone of foothills/upland.

R036XY141CO	**Shallow Loamy Mesa Top (pinyon-Utah juniper)** Shallow Loamy Mesa Top is a gentle sloped (<25% slope) site with very shallow and shallow soils that are loamy in texture. This site is dominated by Pinyon, Utah Juniper, muttongrass and Indian ricegrass. This site is in the 15 to 18 inch precipitation zone of foothills/upland.
R036XY142CO	**Loamy Mesa Top (pinyon-Utah juniper)** Loamy Mesa Top is a gentle sloped (<15% slope) site with moderately deep to deep soils that are coarse loamy in texture. This site is shallow to calcic horizon. The typical profile is border-line skeletal which reduces the water holding capacity of this site. It is dominated by Pinyon, Utah Juniper, muttongrass and Indian ricegrass. This site is in the 15 to 18 inch precipitation zone of foothills/upland.
R036XY446CO	**Southwestern Mountain (pinyon-Utah juniper)** Southwestern Mountain (Pinyon-Juniper) is a gentle sloped (<25% slope) site with very shallow and shallow soils that are loamy or loamy-skeletal in texture. This site is dominated by Pinyon, Utah Juniper, Wyoming big sagebrush, muttongrass and Indian ricegrass. This site may have oakbrush in the understory. This site is in the 12 to 16 inch precipitation zone of foothills/upland.
R036XY114CO	**Mountain Pinyon** Mountain Pinyon is a gentle sloped (<25% slope) site with very shallow and shallow soils that are loamy 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.
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.
R036XY113CO	**Semidesert Juniper Loam** Semidesert Juniper Loam is a gentle sloped (<25-30% slope) site with shallow soils that are loamy in texture. This site is dominated by Utah Juniper and scattered pinyon. This site may have Wyoming big sagebrush in the understory.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

This site occurs on canyon walls, sideslopes and edges of mesas, pediments and dipslopes. Slopes typically range from 3-25%, and elevations are generally 5400-6800 ft., but it can go down to 5200 on north and easterly slopes and up to 7000 on south and westerly slopes.

Table 2. Representative physiographic features

Landforms	(1) Canyon (2) Pediment (3) Dip slope
Flooding frequency	None
Ponding frequency	None
Elevation	1,646–2,073 m
Slope	3–25%

Climatic features

Average annual precipitation is about 9 to 12 inches. This area is located where there is winter precipitation and summer monsoonal rains meet. Of this, 45-50% falls as snow, and 50-55% falls as rain. Snow usually falls from November to March. Rains are falls April 1 thru October 31. The driest period is usually May to June. Plant growth begins late March and early April. Cool-season plants start a dormancy period during June. Summer thundershowers are common in July to September. The summer moisture will favor growth from the warm season

plants. When late summer and fall rains occur, warm-season plants accelerate growth, and some regrowth occurs on cool-season species. Shrub species continue growth through the entire growing season. The average annual total snowfall is 17.8 inches. The highest winter snowfall record in this area is 44.8 inches which occurred in 1972-1973. The lowest snowfall record is zero inches during the 1999-2000 winter. The highest yearly precipitation recorded was 19.02 in 2015 and the lowest was 5.17 in 1989. Mean daily annual air temperature is about 50ºF to 54ºF, averaging about 33ºF for the winter and 61ºF through the growing season, March through October. Summer temperatures of 100ºF or more are not unusual. The frost-free period typically ranges from 125 to 165 days at Hovenweep NM (national monument). The last spring frost is the first part of May to the end of May. The first fall frost is the end of September to the middle of October. Mean annual temperature ranges from 55 to 49ºF. Average annual temperature is 51.9ºF. The coldest winter temperature recorded was -24ºF on December 24, 1990 and the coldest summer temperature recorded was 26ºF on June 12, 1970. The hottest day on record is 106 ºF on July 15, 1998. Wide yearly and seasonal fluctuations are common for this climatic zone. Data taken from Western Regional Climate Center (2017) for Hovenweep NM, Utah Climate Station. Hovenweep NM is on the Western edge of the MLRA. Hovenweep NM is the only station occurring in the MLRA in this zone. It is on the upper end of precipitation. There is a need for climate date in the zone.

Typical warm dry weather in late spring and early summer puts warm season plants at a distinct disadvantage compared to plants that grow earlier on stored winter moisture and spring rains. Deep storage of winter moisture allows sagebrush and small trees to compete strongly with shallower rooted grasses during this dry period where other factors encourage their spread.

Table 3. Representative climatic features

Frost-free period (average)	131 days
Freeze-free period (average)	146 days
Precipitation total (average)	305 mm

Climate stations used

- (1) HOVENWEEP NM [USC00424100], Monticello, UT

Influencing water features

None.

Soil features

Soils are very shallow to shallow in depth (4-20 inches). The surface soils of this site are sandy clay loams, clay loams, and silty clay loams with boulders on the surface. The surface layer texture is usually a sandy clay loam with 20-40% clay. The subsoils are clay textured. The subsurface can be sandy clay loam, clay loam, and silty clay loam with approximately 25-35% clay. The most common parent materials are residuum weathered from sandstone and shale and colluvium over residuum weathered from shale.

The soil moisture and temperature regimes are ustic aridic and mesic respectively. The microbiotic crust is an important part of this site. It helps hold the soil and nutrients in place.

Shallow Clay Loam has been used as a catchall for PJ sites that don’t fit other ecological sites in this climatic zone. Some soils have been miscorrelated to this site that should be assigned to a different site. The soils that need to be investigated are in shallow loam soils family and should probably be assigned to the semi-desert juniper loams ecological site. The moderately deep and deep skeletal soils need to be evaluated and most likely belong in the Stony Foothills or Cobbly Foothills as the majority of them have greater than 12" of precipitation.

Soils assigned to this site and these soil map units needing to be evaluated for which ESD (ecological site description) they belong to are: Rizno, Dolcan, Romberg and Wauquie.

This ecological site has been used in the following Soil Surveys: CO671 (Cortez Area), CO670 (Ute Mountain Area),

and CO677 (Ridgeway Area).

Typical soils assigned to this ecological site are:

Clayey - Zyme

Loamy-Skeletal – Crosscan

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone and shale (2) Colluvium–shale
Surface texture	(1) Silty clay loam (2) Very bouldery sandy clay loam (3) Very stony loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow to moderately slow
Soil depth	10–51 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	20–40%
Available water capacity (0-101.6cm)	3.05–7.37 cm
Calcium carbonate equivalent (0-101.6cm)	1–15%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	10–25%
Subsurface fragment volume >3" (Depth not specified)	10–30%

Ecological dynamics

This area has a long history of past prehistoric human use for thousands of years. They used pinyon-juniper woodlands for hunting, fuelwood, for food, such as pinon nuts. MLRA 36 have archaeological evidence indicating 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 is characterize by broken topography, and lack of perennial water sources. Most pinyon-juniper Northern half of MLRA 36 (Colorado and Utah) can be describe as a persistent woodland type. There is a winter-summer bimodal precipitation pattern on 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 so 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. The precipitation and climate of MLRA 36 are conducive to producing Pinyon/juniper, and sagebrush complexes.

Pinyon-Juniper expansion began during the late 1800s into deeper well drained soils. (Tausch et al. 1981, Miller and Tausch, 2001). The causes of woodland expansion are often attributed to an reduction in fires, introduction of livestock grazing, shifts in climate, and increases in atmospheric CO2 (Miller and Rose 1999). Prior to European settlement, PJ woodland species were primarily found on shallow soils and rocky ridges. Few fire history studies and pinyon-juniper chronologies have been done in the southwest. It appears that woodland on the Colorado

Plateau are more susceptible to die off from severe drought (Miller and Tausch, 2001). Historically, fires before European settlement in the southwest occurred late spring to mid-summer (Miller and Tausch, 2001).

Historic fire return intervals (300-1000 years) are long, possibly indicating that fire did not play a frequent role in community dynamics. Pinyon and Juniper communities near Mesa Verde were established before European settlement with a fire return interval approximately 400 years (Floyd et al., 2000). Shinneman and Baker (2009) estimated the FRI on the Uncompahgre Plateau to be 400 to 600 years. Mesa Verde (Floyd et al., 2000) and Uncompahgre (Shinneman and Baker, 2009) are in the foothills/upland zone (12 to 16 inches annual precipitation) in MLRA 36. One other known study in the Colorado National Monument on the north eastern part of the Uncompahgre Plateau suggest that lower ecological site zone (semi-desert) (9 to 12 inches of annual precipitation) have a fire return interval of 300 to 1,000 years (Kennard and Moore, 2013). One other difference is that in the semi-desert zone smaller fire of only a few trees maybe more common than the infrequent larger fires found in other studies.

In lower elevations and lower precipitation areas, Utah Juniper maybe dominant over Pinyon. As the precipitation increase and effect moisture increase so will pinyon. The lower end of the pinyon-juniper woodland would be almost entirely Utah Juniper with the reverse happening and pinyon being dominant in the upper end of the pinyon-juniper belt.

The driving factors in Pinyon Juniper woodlands seem to be weather patterns. Drought and insects outbreaks appear to be the main driving factors for mortality in many of the Pinyon/Juniper communities. (Shinneman and Baker, 2009, Floyd et al., 2004) Wet periods seem to enhance and promote pinyon and juniper establishment. Betancourt (1993), noted that Pinyon and Juniper woodlands in the southwest appear to be more susceptible to large die offs during droughts, than in other locations. As severe droughts persist, the Pinyon trees, being more susceptible to drought and insects, seem to die out, while the Utah juniper trees survive. This action could open the canopy for a few years and with sufficient moisture, grasses and forbs would be expected to respond favorably. Two studies illustrated this on the Uncompahgre Plateau found that pinyon began increasing in the 1700s, during a wet period that followed a long dry period. So, tree infill and expansion began before European settlement. Associated fire reduction and livestock grazing effect of European settlers can after the trees started the current expansion. Since the 1900s there has been 2 very wet period in the southwest, during 1900s to 1920s and 1970s to 1990s. These periods saw an increase in Pinon establishment. During the drought of the 1950s and the drought mid-1990s to early 2000s, Pinyon mortality was extensive. (Romme, et al. 2009)

Disturbances such as improper grazing (continuous season long grazing, heavy stocking rates, etc.), recreation activities, etc., can remove herbaceous vegetation and compact the soils. The unpredictability of the annual growing conditions make these communities susceptible to the loss of understory and the resulting accelerated erosion. This ecological site has been grazed by domestic livestock since they were introduced into the area, though grazing has been light due to the lack of water and difficult terrain. The introduction of domestic livestock and the use of fencing and reliable water sources have influenced the disturbance regime of this site. As of this date, invasive annual grasslands that are so common in the Great Basin after a severe disturbance are not as prevalent in MLRA 36, potentially due to the remote location, the climate, and/or the soils.

PJ fire intervals can be influences by the landscape it occurs on. PJ that is complexed with sagebrush site would burn more frequently do to the fine fuels in the sagebrush sites to start the fires. So, the more rough broken terrain would burn less frequently than the gentler and broader landscapes. PJ sites on the Colorado Plateau generally don’t have enough fine fuels to start large scale fires. The exception would be several wet years in a row that would create the fine fuels necessary for a fire to start.

As vegetation communities respond to changes in management or natural occurrences, thresholds can be crossed, which usually means that a return to the previous state may not be possible without major energy inputs. The amount of energy input needed to affect vegetative shifts depends on the present biotic and abiotic features and the desired results.

Pinyon-juniper sites were treated as one vegetation dynamic type when developing the provision ecological site initiative for MLRA 36. These sites will need to be altered as more data and knowledge in the future becomes available. 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 model

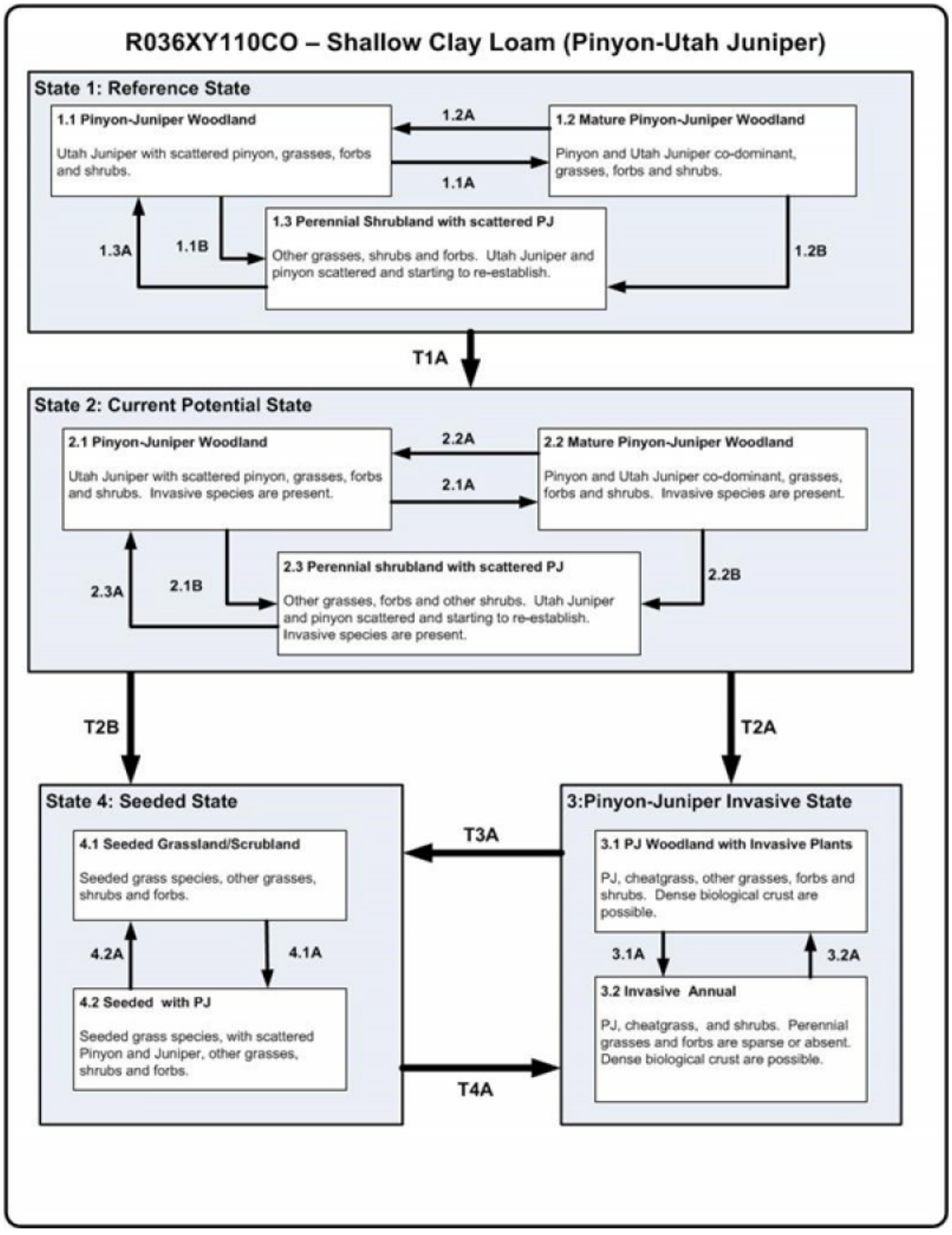

Figure 6. STM 110CO

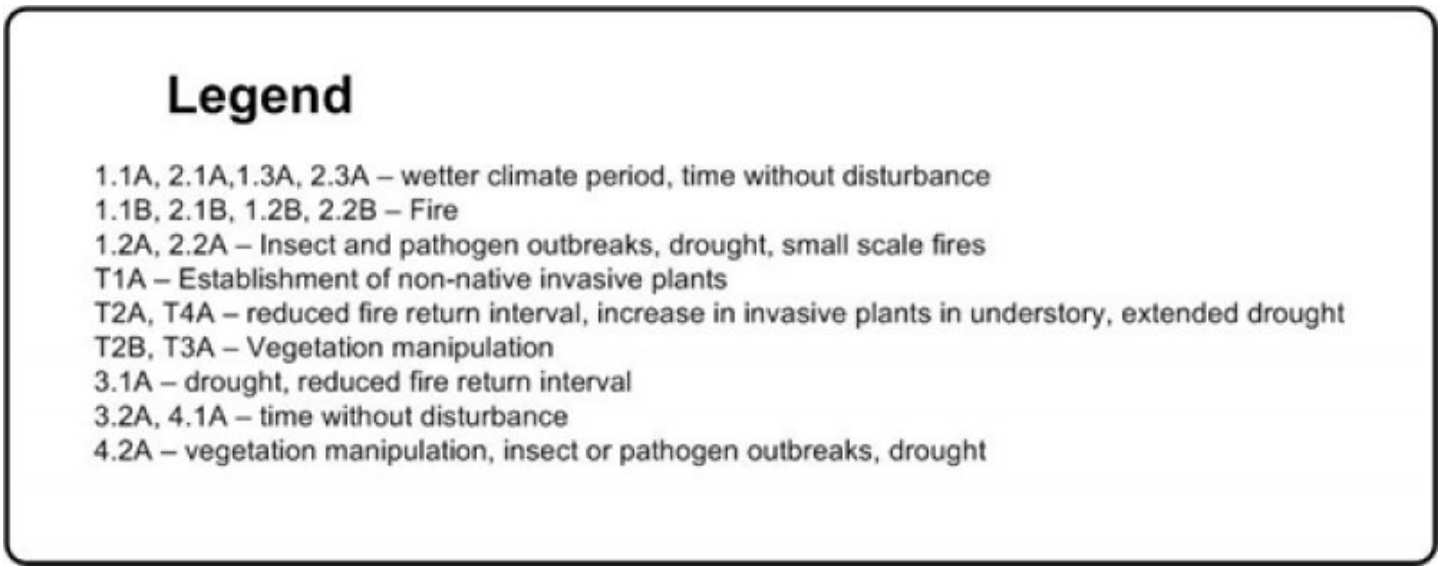

Figure 7. legend

State 1
Reference State

This state represents the natural variability and dynamics of this site that occurred naturally. This state includes the dominant biotic communities that would have occurred on this ecological site prior to European Settlement. The dominant aspect of this site is Pinyon and Utah Juniper with an understory of shrubs and associated grasses. Fluctuations in species compositions and relative production may change from year to year dependent upon abnormal precipitation or other climatic factors. The primary disturbance mechanisms for this site in reference condition include drought, insects, and infrequent fire. Because catastrophic disturbances like a crown fire or drought happen with long intervals, these communities have long periods of succession, (i.e. long periods of dense Pinyon and Juniper)—300-600 years in upland/foothills ecological site zone and 300 to 1,000 in semi-desert ecological site zone. According to Shinneman (2006), the pinon-juniper zone on the Uncompahgre Plateau typically burns in high-intensity, stand-replacing fires with a 400–600 years rotation (Shinneman, 2006). In the semi-arid environment of this ecological site, fine fuels are typically not continuous, reducing the likelihood of short fire return intervals. Typically, fires occurred in late spring through mid-summer following several wet years that allowed the fine fuels to become more contiguous (Baisan and Swetnam, 1990, and Swetnam and Baisan, 1996). The higher in elevation and higher precipitation area would burn more frequently as they would have more fine fuels in the understory. The timing of drought, and fire, coupled with surface disturbance can dictate whether the community can stay within the reference state or if the community transitions into another state.

Community 1.1
Pinyon-Juniper Woodland

A well-developed understory with a canopy of younger Pinyon and Utah juniper. At this stage Utah juniper may be dominant over Pinyon. Pinyon trees are more susceptible to drought, insects, and disease than Utah Juniper trees. In fact, it is difficult to identify methods beside fire that naturally reduce Utah juniper. After long periods of drought weaken the Pinyon trees, beetle kills can become quite extensive, especially after the droughts. Drought periods can also weaken and reduce the understory. Plant establishment is mainly limited by the available moisture. Biological crusts can be highly developed and diversified in the large interspaces between trees. The following is from the 1996 Range Site: Tree canopy 15 to 30% - Ground cover and structure: % Canopy cover vertical view Grasses 8 Forbs 1 Shrubs 1 Trees 25 Average height (FT) Grasses 1.0 Forbs 0.5 Shrubs 2.0 Trees 8.0 %Basal Cover Grasses 5 Forbs 1 Shrubs 1 Trees 3 Total annual production: In an average year, the approximate total annual production (air-dry) is as follows: Tree canopy cover 15 to 30% 250 to 450 lbs/Ac.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	163	185	207
Grass/Grasslike	45	101	168
Shrub/Vine	62	78	90
Forb	11	28	39
Total	**281**	**392**	**504**

Figure 9. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 1.2
Mature Pinyon-Juniper Woodland

Mature pinyon and Utah juniper woodland characterized this community phase. When weather patterns favor an increase of pinyon and Utah juniper canopy with the associated understory of shrubs, grasses and forbs. Depending on the timing of precipitation, cool season grasses, like Indian ricegrass or warm season grasses like galleta could be dominant. Interspaces supporting highly developed biological crusts are common. The following is from the 1996 Range Site: Tree canopy 30%+ - Ground cover and structure: % Canopy cover vertical view Grasses 1 Forbs 0 Shrubs 1 Trees 35 Average height (FT) Grasses 1 Forbs 0.5 Shrubs 1.5 Trees 12.0 %Basal Cover Grasses 1 Forbs <1 Shrubs <1 Trees 5 Total annual production: In an average year, the approximate total annual production (air-dry) is as follows: Tree canopy cover 15 to 30% 200 to 400 lbs/Ac.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	196	269	342
Grass/Grasslike	11	34	56
Shrub/Vine	11	22	34
Forb	6	11	17
Total	**224**	**336**	**449**

Figure 11. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 1.3
Perennial Shrubland with Scattered PJ

The overall aspect of this community phase is grasses and shrubs with scattered pinyon and Utah juniper. The herbaceous understory has a mix of grasses and forbs. This community phase is a result of a crown fire or sufficiently large and hot ground fire that will kill many of the trees, combined with sufficient seed-banks and moisture for reestablishment of grasses and forbs. It is common that after a crown fire many patches of trees will remain unburned, because of fire’s unpredictability and broken topography. This leaves a seed bank for the burned areas. This community phase is very short lived in comparison to the other community phases in this state. The following is from the 1996 Range Site: This community is characterized by a Wyoming big sagebrush shrub canopy, where few perennial grasses may be present. Commonly seen grasses include salina wildrye, western wheatgrass, and Indian ricegrass. Tree canopy 15 to 30% - Ground cover and structure: % Canopy cover vertical view Grasses 20 Forbs 1 Shrubs 2 Trees 2 Average height (FT) Grasses 1 Forbs 0.5 Shrubs 3.5 Trees 5.0 %Basal Cover

Grasses 5 Forbs 1 Shrubs 1 Trees 3 Total annual production: In an average year, the approximate total annual production (air-dry) is as follows: Tree canopy cover 0-15% 325 to 550 lbs/Ac

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	168	213	252
Shrub/Vine	129	168	207
Tree	39	67	95
Forb	28	45	62
Total	**364**	**493**	**616**

Figure 13. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 1.1A
Community 1.1 to 1.2

This pathway occurs when events create a wetter climate cycle, favor pinyon and perennial bunch grass establishment. Following several favorable precipitation years and lack of surface disturbances, native perennial plants will reestablish.

Pathway 1.1B
Community 1.1 to 1.3

This pathway is very unlikely, but can occur when a fire is able to move through the community. Two situations can make this occur: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires.

Pathway 1.2A
Community 1.2 to 1.1

This pathway occurs during and after events such as drought or insect/pathogen outbreaks. Droughts and insects can kill the trees, increasing nutrient availability in the system. Due to the natural conditions of drought, grasses typically do not take up the extra nutrients in the long term. In the short term, grasses and forbs may increase for a few years until juniper and pinyon recover.

Pathway 1.2B
Community 1.2 to 1.3

This pathway is very unlikely but can occur when a fire is able to move through the community phase. Two situations can make this occur: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires.

Pathway 1.3A
Community 1.3 to 1.1

This pathway occurs when the climate favors the establishment and growth of trees. More energy is taken-up and stored in the trees as the length between fires and droughts increase. In addition, when shrubs establish on the site they can provide safe-sites for tree establishment furthering the presence of trees.

State 2
Current Potential State

This state is very similar to the reference state, except that non-native grasses and/or forbs are now present in all community phases. The current potential state may include introduced (seeded) or invasive nonnative species. The invasive plants are present in sparse amounts in this state. Natural disturbance are still drought, insects, and infrequent fires still influence the community shifts. The human caused disturbance drivers (i.e. domestic livestock grazing, vegetation manipulation, and recreational activities (i.e. OHV use)) are now present. This shift in species composition could affect nutrient cycling, hydrology and soil stability. At this time there is no known way to effectively remove the non-native plants from the site once they have become established. State 2 is in jeopardy of moving to State 3 (Pinyon-Juniper Invasive State) when remaining native understory plants are stressed and invasive species have increased till they are dominant.

Community 2.1
Pinyon-Juniper Woodland

A well-developed understory with a canopy of younger Pinyon and Utah juniper. At this stage Utah juniper may be dominant over Pinyon. Pinyon trees are more susceptible to drought, insects, and disease than Utah Juniper trees. In fact, it is difficult to identify methods beside fire that naturally reduce Utah juniper. After long periods of drought weaken the Pinyon trees, beetle kills can become quite extensive, especially after the droughts. Drought periods can also weaken and reduce the understory. Plant establishment is mainly limited by the available moisture. Biological crusts can be highly developed and diversified in the large interspaces between trees. Sparse invasive introduced plants species would be present in this phase.

Figure 14. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 2.2
Mature Pinyon-Juniper Woodland

Mature pinyon and Utah juniper woodland with a well-developed understory would characterized this community phase. This phase supports a diverse understory of grasses, forbs and shrubs. Depending on the timing of precipitation, cool season grasses, like Indian ricegrass or warm season grasses like galleta could be dominant. Interspaces supporting highly developed biological crusts are common. Sparse invasive introduced plants species would be present in this phase.

Figure 15. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 2.3
Perennial Shrubland with scattered PJ

The overall aspect of this community phase is grassland with scattered pinyon and Utah juniper. The herbaceous understory has a mix of grasses and forbs. This community phase is a result of a crown fire or sufficiently large and hot ground fire that will kill many of the trees, combined with sufficient seed-banks and moisture for reestablishment of grasses and forbs. It is common that after a crown fire many patches of trees will remain unburned, because of fire’s unpredictability and broken topography. This leaves a seed bank for the burned areas. This community phase is very short lived in comparison to the other community phases in this state. Sparse invasive introduced plants species would be present in this phase.

Figure 16. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 2.1A
Community 2.1 to 2.2

This pathway occurs when events create a wetter climate cycle, favor Pinyon and perennial bunch grass establishment. Following several favorable precipitation years and lack of surface disturbances, native perennial bunch grasses and forbs will reestablish.

Pathway 2.1B
Community 2.1 to 2.3

This pathway is very unlikely, but can occur when a fire or vegetation manipulation happens to the trees. Two situations can make this occur: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires. Seeding after the tree removal may be necessary to help facilitate the return of understory species. Seeding depending on the species may take this community phase into state 4 (Seeded State).

Pathway 2.2A
Community 2.2 to 2.1

This pathway occurs during and after events such as drought or beetle infestations. Droughts and insects can kill pinyon trees, increasing nutrient availability in the system. Due to the natural conditions of drought, grasses typically do not take up the extra nutrients in the long term. In the short term, grasses and forbs may increase for a few years until Juniper recover. Utah Juniper are more able to compete for these nutrients and became the dominant overstory tree over time.

Pathway 2.2B
Community 2.2 to 2.3

This pathway is very unlikely to occur naturally with fire. But, vegetation manipulation can be used to remove trees. Two situations occur naturally: 1) a fire can carry in the understory after several wet years allow fine fuels to accumulate, or 2) as the woodland approaches the later stages of development where canopies become dense and crown sizes have increased, and thus community phase becomes susceptible to crown fires. Seeding after the tree removal may be necessary to help facilitate the return of understory species. Seeding depending on the species may take this community phase into state 4 (Seeded State).

Pathway 2.3A
Community 2.3 to 2.1

This pathway occurs when the climate favors the establishment and growth of trees. More energy is taken-up and stored in the trees as the length between fires and droughts increase. In addition, when shrubs establish on the site they can provide safe-sites for tree establishment furthering the presence of trees.

State 3
Pinyon-Juniper Invasive State

This state occurs when there is an absence of natural disturbance (i.e. insects and drought and/or fire) over long time frames (Zlatnik, 1999). Also, management actions could have allowed trees to become very mature and have effectively closed out the understory. Invasive plants have increased in abundance. This state has the lowest resiliency and resistance of any state in this model. There may be no practicable way back to the Current Potential State (State 2), due to the large amounts of energy and monetary inputs that are needed. Seeding, with either natural disturbance and/or vegetation management to transition it to State 3 (Seeded State) may be the best long term option for this site.

Community 3.1
PJ Woodland with Invasive Plants

A lack of understory with a canopy of older Pinyon and Juniper, where plant interspaces very large and connected. This community phase occurs when natural or management actions allow for the increase in Pinyon and Utah juniper and a decrease in the grass and forb understory. Invasive introduced plants species would be present in this phase and are increasing.

Figure 17. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 3.2
Invasive Annuals

This state is characterized by annual grasses like cheatgrass, annual wheatgrass dominating the understory. Also, invasive forbs like storkbill, halogeton and others may be present. This community phase has active erosion under the pinyon and Utah juniper canopy. Utah Juniper has allelopathic effects on some plant (i.e. Sandberg bluegrass, blue grama), which cheatgrass does not appear to suffer this effect when growing under juniper canopies (Zlatnik, 1999).

Figure 18. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 3.1A
Community 3.1 to 3.2

This pathway occurs when events such as frequent fire or drought remove the trees and shrubs, and facilitate the continued establishment of cheatgrass or other invasive annuals. Cheatgrass will typically invade/increase in tree/shrub interspaces when PJ communities are degraded. Once the cheatgrass establishes the amount and continuity of fine fuels increases. This can reduce the fire return interval and shorten the time between fires. When fire eliminates the tree/shrub/native grass component, it completes the conversion to annual dominant community phase. Cheatgrass and other invasive annuals can persist for long periods of time. Once a fire or a drought removes the trees/shrubs, it is difficult to reestablish because, not only has the fire return interval been shortened to a time that will not allow seedling establish, the soil and other abiotic factors have been altered.

Pathway 3.2A
Community 3.2 to 3.1

This pathway is when there is a lack of fire and/or disturbance. The fire return interval lengthens. This could be done by having firebreaks and/or fire suppression which will allow the perennial species a chance to establish with natural processes or with vegetation manipulation.

State 4
Seeded State

This state is a result seeding plants species. Vegetation manipulation may or may not have been done depending on disturbance history of the location. The trees were removed and adapted grasses, forbs and shrubs are established. Plants can be native or introduced depending on the desired management goals. If grazing tolerant species were established these communities can better withstand grazing and other disturbances. Due to the shallow or rocky soils and unpredictable precipitations patterns, it is difficult to establish grasses from seed, so this state may be hard to achieve and require large energy inputs.

Community 4.1
Seeded Grassland/Shrubland

This community phase appears as a grassland with scattered shrubs and trees. The vegetative production is typically higher than in the current potential state, depending on grass species seeded; however the grass is still sparse due to the low water holding capacity of soils associated with pinyon and juniper.

Figure 19. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Community 4.2
Seeded with PJ

This community phase has a dense under story of introduced grasses and forbs, but a canopy of pinyon and Utah juniper are establishing. Native perennial grasses, forbs, and shrubs may also be starting to establish. Interspaces are filled with biological crusts and herbaceous plants.

Figure 20. Plant community growth curve (percent production by month). CO0102, Semidesert Sites.

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

Pathway 4.1A
Community 4.1 to 4.2

This pathway occurs when events favor the establishment of shrubs and trees, including long periods without disturbances.

Pathway 4.2A
Community 4.2 to 4.1

This pathway occurs as trees and shrubs are removed from the community, either naturally through insect herbivory or through vegetation manipulation by man.

Transition T1A
State 1 to 2

This transition from the native perennial bunchgrass and shrub understory in the reference state to a state that has been invaded by naturalized species such as crested wheatgrass (blown in or seeded), cheatgrass, annual wheatgrass and other introduced or exotic plants. This transition occurs as natural and/or management actions favor an increase in non-native grasses and forbs, especially annuals. Possible events include the presence of invasive species, improper livestock grazing, extended droughts, and fire combined with an available seed source of non-native species.

Transition T2A
State 2 to 3

When this transition to state 3 occurs the site has lost much of its expected resistance and resilience. At this point natural and/or management actions have decreased the understory to a point where erosion increases. Reduced influence from fire, insects, and drought could cause the tree canopy to close, effectively reducing the herbaceous understory thus facilitating the transition. Improper grazing and or increase surface disturbance combined with periods of drought can facilitate this transition because soil stability is lost and susceptibility to soil loss increases.

Transition T2B
State 2 to 4

This transition is from tree canopy reduction and re-establishment of grasses and forbs. If the community is approaching state 3 (pinyon-juniper invasive state), due to a loss of understory and increase invasive plants this pathway of seeding could be preferable to doing nothing. This pathway may facilitate the recovery of the soils. The infrequent naturally occurring fires could also cause this transition. Reseeding after a fire may be the only way to successfully restore the ecological dynamics to a site. Either way this pathway involves large energy and monetary inputs by man.

Transition T3A
State 3 to 4

Vegetation treatment can transition it to a seeded state. Because of the soils (shallow and/or rocky) and the unpredictable precipitation, this pathway should be used cautiously. This pathway involves large energy and monetary inputs by man.

Transition T4A
State 4 to 3

This transition occurs when events favor the establishment and dominance of invasive annuals. Events may include an extended drought, surface disturbance such as off road vehicle use, and/or a shortened fire return interval, all of which can stress the native perennial bunchgrasses.

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	**Grasses**			56–140	
	saline wildrye	LESAS	*Leymus salinus ssp. salinus*	45–112	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–39	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	22–39	–
	Grass, perennial	2GP	*Grass, perennial*	0–28	–
	western wheatgrass	PASM	*Pascopyrum smithii*	6–22	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
Forb					
2	**Forbs**			17–56	
	Forb, perennial	2FP	*Forb, perennial*	0–28	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–11	–
	sanddune cryptantha	CRFE3	*Cryptantha fendleri*	0–6	–
	Crandall's beardtongue	PECR5	*Penstemon crandallii*	0–6	–
	threadleaf ragwort	SEFLF	*Senecio flaccidus var. flaccidus*	0–6	–
Shrub/Vine					
3	**Shrubs**			67–112	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	17–45	–
	black sagebrush	ARNO4	*Artemisia nova*	6–17	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–11	–
	mormon tea	EPVI	*Ephedra viridis*	0–6	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–6	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	0–6	–
Tree					
4	**Trees**			135–280	
	Utah juniper	JUOS	*Juniperus osteosperma*	135–247	–
	twoneedle pinyon	PIED	*Pinus edulis*	22–45	–

Table 9. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			28–84	
	saline wildrye	LESAS	*Leymus salinus ssp. salinus*	17–34	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	6–11	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–6	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–6	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–6	–
Forb					
2	**Forbs**			1–22	
	sanddune cryptantha	CRFE3	*Cryptantha fendleri*	0–6	–
	Crandall's beardtongue	PECR5	*Penstemon crandallii*	0–6	–
	threadleaf ragwort	SEFLF	*Senecio flaccidus var. flaccidus*	0–6	–
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–6	–
Shrub/Vine					
3	**Shrubs**			6–39	
	Utah serviceberry	AMUT	*Amelanchier utahensis*	0–6	–
	black sagebrush	ARNO4	*Artemisia nova*	0–6	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	0–6	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–6	–
	mormon tea	EPVI	*Ephedra viridis*	0–6	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–6	–
Tree					
4	**Tree**			168–336	
	Utah juniper	JUOS	*Juniperus osteosperma*	202–303	–
	twoneedle pinyon	PIED	*Pinus edulis*	34–56	–

Table 10. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			112–336	
	saline wildrye	LESAS	*Leymus salinus ssp. salinus*	112–179	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–45	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	22–45	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–28	–
	western wheatgrass	PASM	*Pascopyrum smithii*	6–22	–
Forb					
2	**Forbs**			22–45	
	stemless mock goldenweed	STAC	*Stenotus acaulis*	0–17	–
	sanddune cryptantha	CRFE3	*Cryptantha fendleri*	0–6	–
	Crandall's beardtongue	PECR5	*Penstemon crandallii*	0–6	–
	threadleaf ragwort	SEFLF	*Senecio flaccidus var. flaccidus*	0–6	–
Shrub/Vine					
3	**Shrubs**			135–202	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	45–90	–
	black sagebrush	ARNO4	*Artemisia nova*	22–45	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	6–22	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–17	–
	mormon tea	EPVI	*Ephedra viridis*	0–6	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–6	–
Tree					
4	**Trees**			45–112	
	Utah juniper	JUOS	*Juniperus osteosperma*	6–67	–
	twoneedle pinyon	PIED	*Pinus edulis*	0–22	–

Animal community

The following is from 1996 Range Site:

Wildlife Interpretation--

Harvesting, chaining, and burning of juniper trees and shrubs can improve big game forage. Some blocks of juniper should be left undisturbed to provide big game habitat and for other species. In large areas where sagebrush and other shrubs become dominant, manipulation that restores a mix of grasses and forbs is beneficial for many wildlife species. Areas of sagebrush along drainages and south and west facing slopes should be left undisturbed to provide critical winter forage for mule deer. Water developments for livestock and wildlife can be a useful management tool on this site.

--Grazing Interpretations--

This site may be of low value for cattle grazing when the canopy cover is in the 0 - 15% range. When grazed by sheep, the grazing value is only moderate due to low production. When the site has 15 - 30% tree canopy cover the grazing value for cattle and sheep is slightly lower. When the site is dominated by trees, the site is of little grazing value. Over grazing of the site by any animals, including big game, will ultimately increase tree production and

decrease grass and forb production on the site. With or without grazing, trees will, over time, dominate the site. To maintain understory production, periodic fire, or other thinning methods must be used on an average of every 40 to 80 years.

The plant community is primarily Utah Juniper, Wyoming big sagebrush, and pinyon. The shrubs provide good winter browse for cattle, sheep, goats, pronghorn antelope, elk, mule deer, and bighorn sheep. Grasses include Indian ricegrass, and galleta, and when present provide good grazing conditions for all classes of livestock and wildlife. Utah juniper and pinyon pine provide good cover for livestock and wildlife; mule deer, pronghorn antelope, and goats may also graze these trees. 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 must 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

Clayey Soils

Zyme - D

Loamy-Skeletal Soils

Crosscan - D

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

The following is from 1996 Range Site:

This site provides cover for wildlife and mat e a good area for hunting big game during the fall. Other recreational pursuits, such as hiking, and sight-seeing, are available on this site.

Wood products

The following is from 1996 Range Site:

This site does not produce trees for lumber. There is a potential for use of the trees as fence posts, firewood, and Christmas trees when the site is producing enough trees to be in the 15% canopy class. Usually, if the canopy class is greater than 30%, there are few young trees which are better for Christmas trees. When the canopy class is 0 - 15%, there are very few trees that are large enough for fence posts, however, there will be a few trees that are of value for firewood and some of which can be used for Christmas trees.

Other information

The following is from 1996 Range Site:

--Poisonous and Toxic Plant Communities--

Toxic plants that may be associated with this site include woolly locoweed and broom snakeweed. Woolly locoweed is toxic to all classes of livestock and wildlife. Locoweed is palatable and has similar nutrient value to alfalfa, which may cause animals to consume it even when other forage is available. Locoweed contains swainsonine (indolizdine alkaloid) and is poisonous at all stages of growth. Poisoning will become evident after 2-3 weeks of continuous grazing and is associated with 4 major symptoms: 1) neurological damage, 2) emaciation, 3) reproductive failure and abortion, and 4) congestive heart failure linked with high mountain disease. 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 generally will only graze broom snakeweed when other forage is unavailable, typically in winter when toxicity levels are at their lowest (Knight and Walter, 2001).

Potentially toxic plants associated with this site include four-wing saltbush and some buckwheat species, which may accumulate selenium, but only when growing on selenium enriched soils. These plants, when consumed will cause alkali disease or chronic selenosis, which affects all classes of livestock (excluding goats). Typically animals consuming 5-50 ppm selenium will develop chronic selenosis and animals consuming greater than 50 ppm selenium will develop acute selenosis. Clinical signs include lameness, soughing of the hoof, hair loss, blindness, and aimless wandering. Horses tend to develop what is called a bob tail or roached main due to breakage of the long hairs.

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. (Knight and Walter, 2001)

--Invasive Plant Communities--
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. Of particular concern in semi-arid environments are the annual invaders including cheatgrass, Russian thistle, kochia, halogeton, and annual mustards. 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. On well-developed Utah juniper and pinyon pine communities soils are complete occupied by lateral roots, which inhibit an herbaceous understory as well as annual invasions. However once these sites are disturbed and pinyon-juniper communities begin to decline invasion is possible.

--Fire Ecology--

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.

In most ecological sites dominated by Utah juniper, fire is not an ecological driver. However, the common occurrence of Wyoming big sagebrush in this site indicates that fire regularly contributes to the dynamics of this ecological site. The old age of the trees indicates that fires are often low intensity flash fires that primarily burn the understory without damaging the large trees. When the plant community is burned, shrubs decrease while perennial and annual grasses increase. 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.

Type locality

Location 1: Montezuma County, CO	
Township/Range/Section	T15S R99W S29
General legal description	2,000 feet west, 1,800 feet south of the NE corner of section 29.

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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 (1/24/2005). Revised by Jake Owens (3/23/2007) Owens copied R035XY221UT reference sheet and revised it to match this site. The R035XY221UT reference sheet was originally written by Robert Stager (BLM), F.E. Busby (USU), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS) Revised and Updated by Suzanne Mayne-Kinney on 5/18/2017
Contact for lead author	
Date	05/18/2017
Approved by	Rachel Murph, State Rangeland Management Spec., USDA NRCS Colorado
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** On more gentle slopes (< 15 %): Common and occur throughout site. Rills may be 10 or more feet in length. Sides of rills may be up to 4 inches high. Rills are most likely to form below adjacent exposed bedrock or water flow patterns where sufficient water accumulates to cause erosion. B. On steep slopes (> 15 %): Frequent. Occur throughout the site. Rills may extend down entire slope.

2. **Presence of water flow patterns:** Flow paths are expected and frequent. They are disconnected with debris dams, As slope increases, flow paths become more prominent and connected.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are rare and may form at the base of plants that occur on the edge of flow paths. Terracettes are rare to few, forming behind debris dams of small to medium sized litter (up to 2 inches in diameter) may form in water flow patterns. These debris dams may accumulate smaller litter (leaves, grass and forb stems) and sediment. Terracettes or debris dams are more obvious following intense rainfall events.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 20-30% bare ground. (Soil surface is typically covered 20 to 45 percent surface fragments). Most bare ground is associated with water flow patterns, rills, and gullies. Areas with well-developed biological soil crusts should not be counted as bare ground. Poorly developed biological soil crusts that are interpreted as functioning as bare ground (therefore they would be susceptible to raindrop splash erosion) should be recorded as bare ground. Ground cover is based on first raindrop impact, and bare ground is the opposite of ground cover. Ground cover + bare ground = 100%.

5. **Number of gullies and erosion associated with gullies:** None to few on gentle slopes (< 15 %). On steep slopes and areas below adjacent exposed bedrock, gullies are more prone to occur. Length often extends from exposed bedrock until gully reaches a stream or an area where water and sediment accumulate. Gullies may remove soil from base of plants exposing roots. Gullies may show slightly more erosion as slope increases, or as the site occurs adjacent to steep sites with concentrated flow patterns.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to very few. Trees break the wind and reduce the potential for wind erosion. The surface fragments armor the soil surface and help to reduce the potential for wind erosion.

7. **Amount of litter movement (describe size and distance expected to travel):** Most litter accumulates at base of plants. Woody stems from trees are not moved unless present in water flow patterns, rills, or gullies.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** This site should have an erosion rating of 3 to 5 under the plant canopies, and a rating of 2 to 4 in the interspaces. The average should be a 4. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion. This site can have cryptogamic crusts which help to stabilize the soil surface.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil organic matter content ranges from 0.5-2%. Soils are very shallow and shallow in depth. The surface soils of this site range from sandy clay loam, silty clay loam and clay loam, Soils are often cobbly, channery or stone filled. Structure is moderate medium granular structure parting and/or weak fine granular structure. The soil surface (A horizon) ranges from 2 to 6 inches in depth. Refer to soil survey for more detailed information about your specific site.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial**

distribution on infiltration and runoff: The presence of trees, perennial grasses and forbs, and shrubs will breakup raindrop impact and splash erosion. The spatial distribution of the plants, biological crusts and interspaces will provide small pockets for water storage and surface roughness that slows down runoff, allowing time for infiltration. The tree and shrub canopy is effective in intercepting rain drops and preventing splash erosion on the reference state. But, with increased tree canopy, understory canopy is reduced, increased bare soil and litter accumulates under trees, it can forms micro-topography that can help water accumulate which can cause more rapid runoff.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None, although bedrock is found within 20 inches of soil surface. In addition, there may be layers of calcium carbonate or other naturally occurring hard layers found in the soil subsurface. These should not be considered to be compaction layers.

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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: Trees (pinyon, Utah Juniper) >

    Sub-dominant: cool season bunchgrasses (Muttongrass, Indian ricegrass, prairie junegrass, squirreltail) > shrubs (Black sagebrush, Wyoming big sagebrush, Utah serviceberry, mountain mahogany) > forbs (Buckwheat, locoweeds, cryptantha, penstemons, asters, daisy, threadleaf groundsel, stemless goldenweed)

    Other: cool season rhizomatous (Western wheatgrass) = warm season short bunchgrass (Galleta, blue grama) > cryptogams

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** A mix of young, middle aged and old pinyon and Utah juniper are expected to be found on this site. In years with average or above average precipitation, shrubs, grasses and forbs should have little mortality or decadence. Tree mortality, especially pinyon, can be expected under severe and/or extended drought and subsequent insect infestations. Under a dense tree canopy, understory has increased decadence and mortality.

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14. **Average percent litter cover (%) and depth (in):** Litter cover ranges from 15-30% at a depth of 0.5 to 2.0 inches. Most litter is at the base and under the canopy of the plants.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Tree canopy cover 0-15%: 325-550 lbs./ac.; Tree canopy cover 15-30%: 250-450 lbs./ac.; Tree canopy cover > 30%: 200-400 lbs./ac. Production figures are for total annual vegetation.

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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:** Few invasives capable of dominating this site. Cheatgrass, Broom snakeweed, and Mustard

may invade the community.

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17. **Perennial plant reproductive capability:** All plants have the ability to reproduce in most years. Limitations are weather related, wildfire, natural disease, inter-species competition, and insects may temporarily reduce reproductive capability. Increased tree canopy will result in decreased understory reproductive capability.
