USDA Natural Resources Conservation Service

Ecological site R036XY111CO
Steep Shallow Clay Loam (pinyon-Utah juniper)

Accessed: 05/17/2024

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

Steep Shallow Clay Loam - (Pinyon-Juniper) ecological site is found on canyon walls and hills 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 semi-desert. 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.

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

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).

341Ba-Mancos Shale Lowlands-Grand Valley Subsection <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 Steep Shallow Clay Loam - (Pinyon-Juniper) ecological site was drafted from the existing Steep Shallow Clay Loam - (Pinyon-Juniper) 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 canyon, canyon walls and hills on clayey (very boulder/very stony sandy clay loams and clay loams) textured soils derived from residuum weathered from shale or shale and sandstone and colluvium over residuum weathered from shale and sandstone. It is a Utah Juniper-Pinyon. It has an ustic aridic moisture regime and mesic temperature regime. The effective precipitation ranges from 9 to 12 inches.

Associated sites

R035XY263UT	**Semidesert Very Steep Stony Loam (Two-Needle Pinyon, Utah Juniper)** Semidesert Very Steep Stony Loam (Two-Needle Pinyon, Utah Juniper) is a very steep sloped (30 to 70% slopes). Soil textures range from very channery loams to very stony loamy fine sands. Soils are moderately deep to deep. 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 semidesert zone (8 to 12" of precipitation).
R036XY110CO	**Shallow Clay Loam (pinyon-Utah juniper)** Shallow Clay Loam Pinyon-Juniper is a gentle 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.
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.
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.

Similar sites

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.

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.
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.
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.
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.
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.
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.
R036XY110CO	**Shallow Clay Loam (pinyon-Utah juniper)** Shallow Clay Loam Pinyon-Juniper is a gentle 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.

Table 1. Dominant plant species

Tree	(1) *Juniperus osteosperma* (2) *Pinus edulis*
Shrub	Not specified
Herbaceous	Not specified

Physiographic features

This site occurs on canyons, canyon walls, and hills. Slopes typically range from 25-80%, 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) Hill
Flooding frequency	None
Ponding frequency	None

Elevation	1,646–2,073 m
Slope	25–80%
Aspect	Aspect is not a significant factor

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)	279 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 very boulder/very stony sandy clay loams, clay loams, and very stony loam. The surface layer texture is usually a sandy clay loam with 25-35% clay with boulders and stones on top. The subsoils are clay textured. The subsurface can be sandy clay loam, clay loam, and silty clay loam with approximately 30-40% clay that can have gravels, stones and boulders in it. The most common parent materials are residuum weathered from shale or shale and sandstone and colluvium over residuum weathered from shale and sandstone. The soil moisture and temperature regimes are ustic aridic and mesic respectively.

In the past, Shallow Clay Loam has been used as a catchall for steep sloped 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. Moderately deep and deep skeletal soils need to be evaluated and most likely belong in the Stony Foothills or Cobbly Foothills.

Soils assigned to this site and these soil map units needing to be evaluated for which ESD (ecological site description) they belong to are: Reef, Dolcan, Romberg, Wauquie, and Katzine. Prater is a fine soil assigned to this ESDs, but the Prater soil belongs in the Foothills/Upland zone and not the semidesert zone.

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

Typical soils assigned to this ecological site are:

Clayey - Zyme

Loamy-Skeletal – Crosscan

Table 4. Representative soil features

Parent material	(1) Colluvium–shale (2) Residuum–sandstone and shale
Surface texture	(1) Clay loam (2) Very stony sandy clay loam (3) Very bouldery sandy clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Moderately slow to slow
Soil depth	15–51 cm
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	10–45%
Available water capacity (0-101.6cm)	3.05–7.11 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–2 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)	10–35%
Subsurface fragment volume >3" (Depth not specified)	10–45%

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

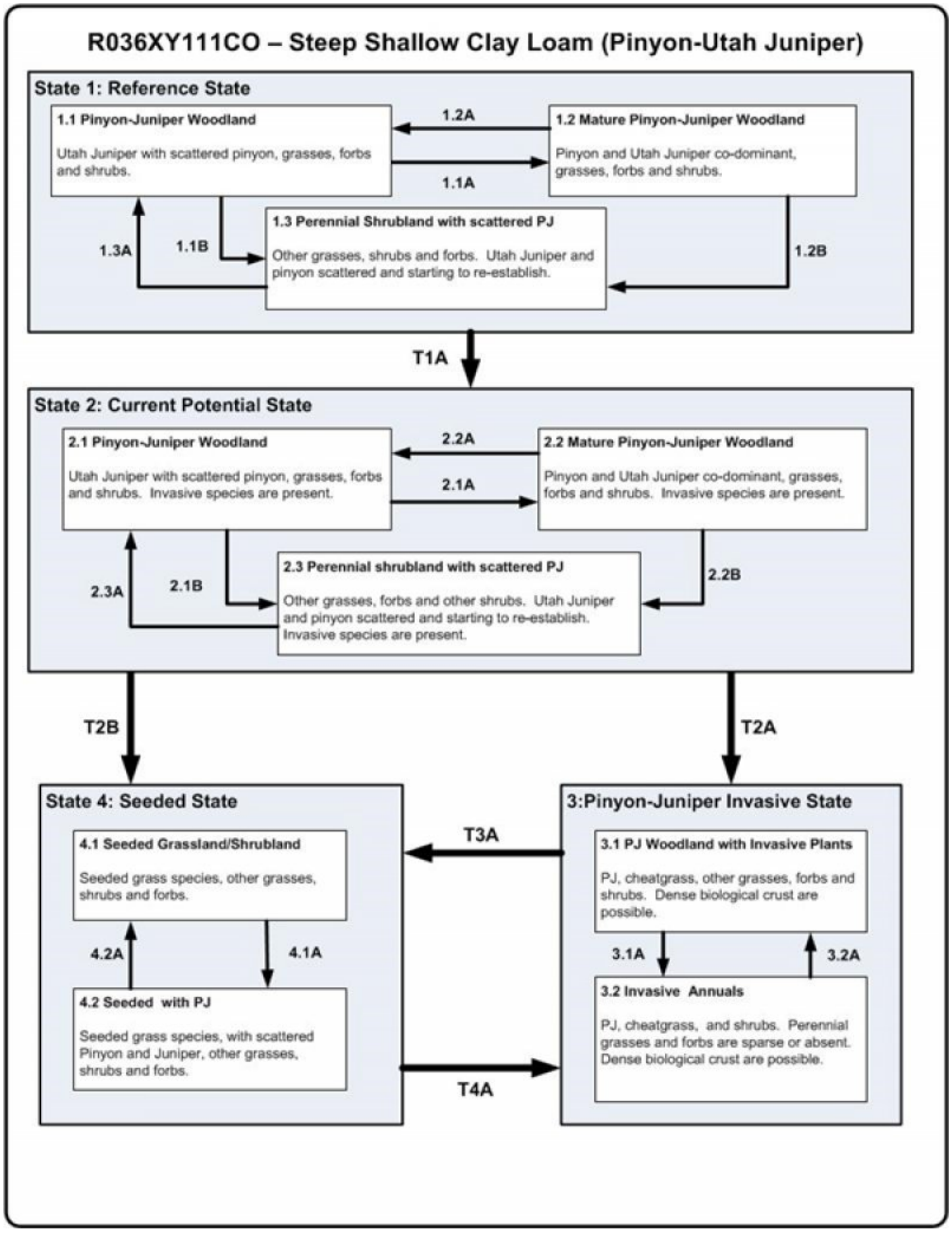
R036XY111CO – Steep Shallow Clay Loam (Pinyon-Utah Juniper)
State 1: Reference State
1.1 Pinyon-Juniper Woodland
Utah Juniper with scattered pinyon, grasses, forbs and shrubs.
1.2A
1.1A
1.2 Mature Pinyon-Juniper Woodland
Pinyon and Utah Juniper co-dominant, grasses, forbs and shrubs.
1.3A
1.1B
1.3 Perennial Shrubland with scattered PJ
Other grasses, shrubs and forbs. Utah Juniper and pinyon scattered and starting to re-establish.
1.2B
T1A
State 2: Current Potential State
2.1 Pinyon-Juniper Woodland
Utah Juniper with scattered pinyon, grasses, forbs and shrubs. Invasive species are present.
2.2A
2.1A
2.2 Mature Pinyon-Juniper Woodland
Pinyon and Utah Juniper co-dominant, grasses, forbs and shrubs. Invasive species are present.
2.3A
2.1B
2.3 Perennial shrubland with scattered PJ
Other grasses, forbs and other shrubs. Utah Juniper and pinyon scattered and starting to re-establish. Invasive species are present.
2.2B
T2B
T2A
State 4: Seeded State
4.1 Seeded Grassland/Shrubland
Seeded grass species, other grasses, shrubs and forbs.
4.2A
4.1A
4.2 Seeded with PJ
Seeded grass species, with scattered Pinyon and Juniper, other grasses, shrubs and forbs.
T3A
T4A
3:Pinyon-Juniper Invasive State
3.1 PJ Woodland with Invasive Plants
PJ, cheatgrass, other grasses, forbs and shrubs. Dense biological crust are possible.
3.1A
3.2A
3.2 Invasive Annuals
PJ, cheatgrass, and shrubs. Perennial grasses and forbs are sparse or absent. Dense biological crust are possible.

Figure 6. STM

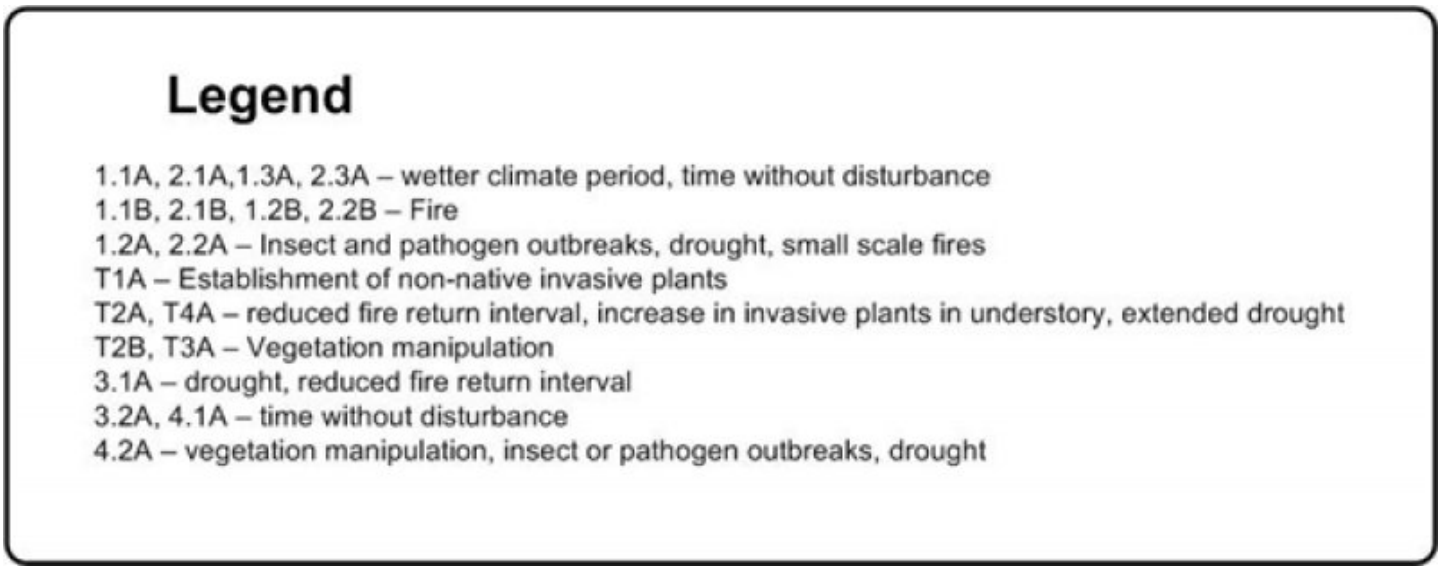

Figure 7. Legend

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. The appearance of this site when the tree canopy cover is low (about 0 to 15%), is a shrub-grass community. Plants common to the site with this tree canopy cover include Salina wildrye, western wheatgrass, galleta, Indian ricegrass, black sagebrush, true mountain mahogany, Utah serviceberry, and Wyoming big sagebrush with only an occasional Utah juniper tree. When the tree canopy cover increases to 15 percent or more, the same plants are present, however, the amounts of grasses and shrubs decrease while Utah juniper trees increases. The tree size and density is directly correlated to precipitation. A few invader species such as mustards, Russian thistle, and kochia have been established on the site at this level of tree cover.

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 20 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	185	207	230
Grass/Grasslike	56	101	157
Shrub/Vine	34	67	90
Forb	6	17	28
Total	**281**	**392**	**505**

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.

Figure 10. 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. Ground cover and structure: Tree canopy 0 to 15% - Ground cover and structure: % Canopy cover vertical view Grasses 15 Forbs 1 Shrubs 2 Trees 5 Average height (FT) Grasses 1.0 Forbs 0.5 Shrubs 3.5 Trees 5.0 %Basal Cover Grasses 10 Forbs 1 Shrubs 1 Trees <1 Total annual production: In an average year, the approximate total annual production (air-dry) is as follows: Tree canopy cover 0-15% 275 to 500 lbs/Ac

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	123	179	207
Shrub/Vine	129	168	207
Tree	39	67	95
Forb	17	34	50
Total	**308**	**448**	**559**

Figure 12. 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 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		

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 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 2.3
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 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		

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 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		

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 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		

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 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		

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 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		

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 7. 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*	67–135	–
	James' galleta	PLJA	*Pleuraphis jamesii*	0–45	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	17–45	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–22	–
	western wheatgrass	PASM	*Pascopyrum smithii*	6–22	–
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	**Shrub**			34–101	
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	17–45	–
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	0–17	–
	black sagebrush	ARNO4	*Artemisia nova*	6–17	–
	Utah serviceberry	AMUT	*Amelanchier utahensis*	0–11	–
	mormon tea	EPVI	*Ephedra viridis*	0–6	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–6	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–6	–
Tree					
4	**Trees**			168–280	
	Utah juniper	JUOS	*Juniperus osteosperma*	123–247	–
	twoneedle pinyon	PIED	*Pinus edulis*	17–67	–

Table 8. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grasses**			112–202	
	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*	0–22	–
	western wheatgrass	PASM	*Pascopyrum smithii*	6–22	–
Forb					
2	**Forbs**			22–45	
	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*	0–6	–
	mormon tea	EPVI	*Ephedra viridis*	0–6	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–6	–
Tree					
4	**Trees**			45–90	
	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 prescribed burning of juniper trees and shrubs can improve big game forage. Some blocks of juniper should be left undisturbed to provide cover for 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.

Wildlife species that use the site include mule deer, coyote, cottontail, bushy tailed rat, golden eagle, sage grouse, pinyon jay, rock wren, Rocky Mountain elk, mountain lion, white tailed jackrabbit, side blotched lizard, red-tailed hawk, ash-throated flycatcher, western blue bird, hairy woodpecker, bobcat, rock squirrel, gopher snake, sagebrush lizard, chuckar, mourning dove, and plain titmouse.

The following is from 1996 Range Site:

--Grazing Interpretations—

This site is of low grazing value for cattle when canopy cover is in the 0 to 15% range. The reason is low production and steep slopes. When grazed by sheep, the grazing value is only moderate due to low production. When the site is dominated by trees, the site is of lower value. Over grazing of the site by any animals including big game will ultimately increase the proportion of tree production and reduce 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 infrequent basis such as 40 to 80 year intervals.

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
Reef - D

Loamy Soils

Rizno - 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:

The site provides cover for wildlife and may be 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 and fire wood when the site is producing enough trees to be in the 15% canopy class. There may be a few trees (when in this canopy class that may be used as Christmas trees. When the canopy class is 0 to 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 had 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).

--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 completely 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.

Fire is an important aspect of Wyoming big sagebrush dominated ecological sites. Fire intervals are historically 10-70 years 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.

ENDANGERED PLANTS AND ANIMALS:
Bald eagles may be found on this site during the winter season.

COUNTIES IN WHICH THIS SITE IS LOCATED:
Mesa, Garfield, Rio Blanco, Montrose, San Miguel, Route, Moffat, Ouray, and Eagle.

Major poisonous plants to livestock:
Utah juniper can only be poisonous to cattle when desirable forage is not available. Death losses from this species is rare. Stock may be poisoned if large quantities of berries are eaten.

Type locality

Location 1: Mesa County, CO	
Township/Range/Section	T16 RT13S SR97W
General legal description	1000’W & 800’S of NE corner Sec 16, T13S, R97W Mesa County.
Location 2: Mesa County, CO	
Township/Range/Section	T29 RT15S SR100W
General legal description	2000’W & 1800’S of NE corner Sec 29, T15S R100W Mesa County.
Location 3: Mesa County, CO	
Township/Range/Section	T15 RT14S ST100W
General legal description	100’E & 1500’S of NW corner Sec 15, T14S T100W Mesa County.

Other references

Baisan, C. H. and T. W. Swetnam. 1990. Fire history on a desert mountain range: Rincon Mountain Wilderness, Arizona, USA. Canadian Journal of Forest Research. 20:1559-1569.

Betancourt, J. L., E. A. Pierson, K. A. Rylander, J. A. Fairchild-Parks, and J. S. Dean. 1993. Influence of history and climate on New Mexico pinyon-juniper woodlands. In: Gen. Tech. RM-236 - Managing Pinon-Juniper Ecosystems for Sustainability and Social Needs.

Cartledge, T. R., and J. G. Propper. 1993. Pinon-Juniper Ecosystems through Time: Information and Insights from the Past. In Gen. Tech. RM-236 - Managing Pinon-Juniper Ecosystems for Sustainability and Social Needs.

Floyd, M.L., W.H. Romme, and D.D. Hanna. 2000. Fire History and vegetation pattern in Mesa Verde National Park, Colorado, USA. Ecological Applications. 10:1666-1680.

Floyd, M. L., D. D. Hanna, W. H. Romme. 2004. Historical and recent fire regimes in pinyon-juniper woodlands on Mesa Verde, Colorado, USA. Forest Ecology and Management. 198:269-289.

Kennard, D.K. and A.J. Moore. 2013. Fire history, woodland structure, and mortality in pinon-juniper woodland in

the Colorado National Monument. Natural Areas Journal. 33:296-306.

Miller, R. F. and R. J. Tausch. 2001. The role of fire in juniper and pinyon woodlands: a descriptive analysis. In: Galley, K.E.M.; Wilson. T.P., [EDs]. Proceedings of the invasive species workshop: the role of fire in the control and spread on invasive species. Fire conference 2000. Tallahassee, Fl: Tall Timbers Research Station: Miscellaneous publication 11:15-30.

Miller, R. F. and J. A. Rose. 1999. Fire history and western juniper encroachment in sagebrush steppe. Journal of Range Management. 52:550-559.

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

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

Natural Resources Conservation Service (NRCS). March 1996. Range Site Description for Steep Shallow Clay Loam PJ #111: USDA, Denver Colorado.

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

Romme, W. H., C.D. Allen, J.D. Bailey, W.L. Baker, B.T. Bestelmeyer, P.M. Brown, K.S. Eisenhart, M.L. Floyd, D.W. Huffman, B.F. Jacobs, R.F. Miller, E.H. Muldavin, T.W. Swetnam, R.J. Tausch, and P.J. Weisberg. 2009. Historical and Modern Disturbance Regimes, Stand Structures, and Landscape Dynamics in Pinon-Juniper Vegetation of the Western United States. Rangeland Ecology and Management 62:203-222.

Shinneman, D. J. and W. L, Baker. 2009. Historical fir and multidecadal drought as context for pinon-juniper woodland restoration in western Colorado. Ecological Applications 19: 1231-1245.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/. Accessed [5/3/2017].

Swetnam, T. and Baisan, C. 1996. Historical fire regime patterns in the southwestern United States since AD 1700. In: CD Allen (ed.) Fire Effects in Southwestern Forest: Proceedings of the 2nd La Mesa Fire Symposium, pp. 11-32. USDA Forest Service, Rocky Mountain Research Station, General Technical Report RM-GTR-286.

Tausch, R. J., N. E. West, and A. A. Nabi. 1981. Tree age and dominance patterns in Great Basin pinyon-juniper woodlands. Journal of Rangeland Management 34:259-264.

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

Zlatnik, E. 1999. Juniperus osteosperma. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). http://www.fs.fed.us/database/feis/. Accessed March 27, 2017.

Contributors

Suzanne Mayne Kinney
Jake Owens

Acknowledgments

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

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

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

--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)	This is a copy of the R035XY240UT reference sheet revised to match this site. Original written by Steve Myers (1/24/2005). Revised by Jake Owens (3/23/2007) Owens copied R035XY240UT reference sheet and revised it to match this site. The R035XY240UT reference sheet was originally written by Robert Stager (BLM), Dana Truman (NRCS), Paul Curtis (BLM), Shane A. Green (NRCS), and Randy Beckstrand (BLM). 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:** Frequent due to the steepness of the site. The surface rock fragments on this site. The overall stony to bouldery surface is expected to be resistant to rill formation and accelerated erosion in general. Where rills occur, they may extend down entire slope.

2. **Presence of water flow patterns:** Due to the steep slopes, Flow paths are expected. They are prominent and connected. They tend to wind around rock fragments and perennial plant bases. disconnected with debris dams, Runoff is rapid. They show some evidence of erosion with fines and litter depositing against the uphill side of gravel, rocks and plants. During episodic precipitation events e.g. thunderstorms, these sites are expected to shed large volumes of water to adjacent ecological sites.

---

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):** 30-50% bare ground. (Soil surface is typically covered 20 to 65 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:** Gullies are present with the inherent steep slopes of this site. Length often extends from exposed bedrock until gully reaches a stream or an area where water and sediment accumulate, but they may be wide and shallow and armored with very large rocks. Gullies may remove soil from base of trees exposing roots.

---

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):** Movement is expected due to steepness of slope (>25%). Deposition would likely occur at points of obstruction such as the uphill side of gravel, rocks and plants, especially following major storm events. Fine litter is moved with even moderate precipitation events and spring runoff. Woody stems may be washed from site. Distance varies from 2-5 feet; following intense rainfall events up to 15 feet or more depending on water concentrations. Gullies may remove accumulated litter from under trees.

---

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 a soil stability rating of 4 or 5 under the plant canopies using the soil stability kit test, and a rating of 3 to 4 in the interspaces. The average should be a 4. Surface texture is silty clay loam to very channery loam to gravelly loam. Vegetation cover, litter, biological soil crusts and surface rock reduce erosion.

---

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** SOM ranges from 0.5-1%. Surface soils are very shallow to shallow. Surface texture ranges from very stony/very boulder sandy clay loam to clay loam. The soil surface can have stone, boulders and cobbles in it. The A-horizon (soil surface) ranges from 1-4 inches in depth. Soil structure is moderate medium granular structure parts to weak fine granular

structure. The A horizon is expected to be more developed under the plant canopies. Use the specific information for the soil you are assessing in the published soil survey to supplement this description.

---

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.

---

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.

---

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 Pine, Utah Juniper) >

    Sub-dominant: cool season bunchgrass (Muttongrass, Indian ricegrass, prairie junegrass, squirreltail, salina wildrye) > 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 grass (western wheatgrass) = warm season short bunchgrass (galleta, blue grama)> cryptogams

    Additional:

---

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.

---

14. **Average percent litter cover (%) and depth (in):** Litter cover ranges from 10-20% at a depth of 0.5 to 2.5 inches. Most litter is at the base and under the canopy of the plants.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Tree canopy cover 0-15%: 275-500 lbs./ac.; Tree canopy cover 15+: 250-450 lbs./ac. Production figures are for total annual vegetation.

---

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

---

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.
