USDA Natural Resources
Conservation Service

Ecological site R026XY038NV
LOAMY SLOPE 14+ P.Z.

Last updated: 4/10/2024
Accessed: 03/22/2025

General information

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

MLRA notes

Major Land Resource Area (MLRA): 026X–Carson Basin and Mountains

The area lies within western Nevada and eastern California, with about 69 percent being within Nevada, and 31 percent being within California. Almost all this area is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. Isolated north-south trending mountain ranges are separated by aggraded desert plains. The mountains are uplifted fault blocks with steep side slopes. Most of the valleys are drained by three major rivers flowing east across this MLRA. A narrow strip along the western border of the area is in the Sierra Nevada Section of the Cascade-Sierra Mountains Province of the Pacific Mountain System. The Sierra Nevada Mountains are primarily a large fault block that has been uplifted with a dominant tilt to the west. This structure leaves an impressive wall of mountains directly west of this area. This helps create a rain shadow affect to MLRA 26. Parts of this eastern face, but mostly just the foothills, mark the western boundary of this area. Elevations range from about 3,806 feet (1,160 meters) on the west shore of Pyramid Lake to 11,653 feet (3,552 meters) on the summit of Mount Patterson in the Sweetwater Mountains.

Valley areas are dominantly composed of Quaternary alluvial deposits with Quaternary playa or alluvial flat deposits often occupying the lowest valley bottoms in the internally drained valleys, and river deposited alluvium being dominant in externally drained valleys. Hills and mountains are dominantly Tertiary andesitic flows, breccias, ash flow tuffs, rhyolite tuffs or granodioritic rocks. Quaternary basalt flows are present in lesser amounts, and Jurassic and Triassic limestone and shale, and Precambrian limestone and dolomite are also present in very limited amounts. Also of limited extent are glacial till deposits along the east flank of the Sierra Nevada Mountains, the result of alpine glaciation.

The average annual precipitation in this area is 5 to 36 inches (125 to 915 millimeters), increasing with elevation. Most of the rainfall occurs as high-intensity, convective storms in spring and autumn. Precipitation is mostly snow in winter. Summers are dry. The average annual temperature is 37 to 54 degrees F (3 to 12 degrees C). The freeze-free period averages 115 days and ranges from 40 to 195 days, decreasing in length with elevation.

The dominant soil orders in this MLRA are Aridisols and Mollisols. The soils in the area dominantly have a mesic soil temperature regime, an aridic or xeric soil moisture regime, and mixed or smectitic mineralogy. They generally are well drained, are clayey or loamy and commonly skeletal, and are very shallow to moderately deep.

This area supports shrub-grass vegetation characterized by big sagebrush. Low sagebrush and Lahontan sagebrush occur on some soils. Antelope bitterbrush, squirreltail, desert needlegrass, Thurber needlegrass, and Indian ricegrass are important associated plants. Green ephedra, Sandberg bluegrass, Anderson peachbrush, and several forb species also are common. Juniper-pinyon woodland is typical on mountain slopes. Jeffrey pine, lodgepole pine, white fir, and manzanita grow on the highest mountain slopes. Shadscale is the typical plant in the drier parts of the area. Sedges, rushes, and moisture-loving grasses grow on the wettest parts of the wet flood plains and terraces. Basin wildrye, alkali sacaton, saltgrass, buffaloberry, black greasewood, and rubber rabbitbrush grow on the drier sites that have a high concentration of salts.

Some of the major wildlife species in this area are mule deer, coyote, beaver, muskrat, jackrabbit, cottontail, raptors, pheasant, chukar, blue grouse, mountain quail, and mourning dove. The species of fish in the area include trout and catfish. The Lahontan cutthroat trout in the Truckee River is a threatened and endangered species.

LRU notes

The Sierra Influenced Ranges LRU is characterized by wooded great basin mountains with climatic and biotic affinities to the Sierra Nevada mountain range. The Sierra Influences Ranges LRU receives greater precipitation that the mountain ranges of central NV. Amount of precipitation varies in relation to the local strength of the Sierra NV rain shadow, characterized by pinyon and juniper trees. The White, Sweetwater, Pine Nut, Wassuk, and Virginia ranges of Nevada support varying amounts of Sierra Nevada flora, such as ponderosa pine. Elevations range from 1610 to 2420 meters and slopes range from 5 to 49 percent, with a median value of 22 percent. Frost free days (FFD) ranges from 92 to 163.

Ecological site concept

The Loamy Slope 14+ P.Z. site occurs on smooth to slightly concave mountain sideslopes. Although this community occurs on all aspects, it is usually restricted to northerly aspects at lower elevations. Slopes range from 15 to 75 percent. Elevations are 4500 to 9500. The soils are typically more than 40 inches deep and well drained. The soils have formed in residuum and colluvium from intermediate volcanic and granitic parent materials. The dominant plants are mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and western needlegrass (Achnatherum occidentale).

Associated sites

R026XY028NV	**MOUNTAIN RIDGE**
R026XY039NV	**CLAYPAN 14+ P.Z.**
R026XY084NV	**DEEP LOAMY 14+ P.Z.**

Similar sites

R026XY018NV	**GRANITIC SOUTH SLOPE 10-12 P.Z.** ACTH7-ACOCO codominant
R026XY100NV	**STONY SLOPE 10-12 P.Z.** ACTH7-POFE codominant
R026XY082NV	**MOUNTAIN LOAM 16+ P.Z.** ACPI2-KOMA codominant grasses with ACLE9
R026XY076NV	**MOUNTAIN SHOULDERS 16+ P.Z.** ACLE9 dominant grass; less productive site
R026XY089NV	**SOUTH SLOPE 12-14 P.Z.** LEKI2-ACHNA codominant
R026XY079NV	**GRANITIC SOUTH SLOPE 14+ P.Z.** Soils derived from granitic parent materials
R026XY053NV	**LOAMY 16+ P.Z.** BRMA4 codominant grass
R026XY048NV	**LOAMY SLOPE 12-14 P.Z.** PUTR2 codominant shrub; ACTH7 codominant grass; more productive site
R026XY008NV	**GRANITIC FAN 10-12 P.Z.** HECO26-ACHY codominant grasses
R026XY046NV	**GRANITIC SLOPE 12-14 P.Z.** less productive site
R026XY026NV	**GRANITIC SLOPE 10-12 P.Z.** ACTH7-ACSP12 codominant

R026XY005NV	**LOAMY 12-14 P.Z.** More productive site
R026XY052NV	**SHALLOW LOAM 16+ P.Z.** LEKI2 dominant grass
R026XY040NV	**GRAVELLY LOAM 14+ P.Z.** PUTR2 dominant shrub; more productive site
R026XY084NV	**DEEP LOAMY 14+ P.Z.** ACOCO-PONE3 codominant
R026XY010NV	**LOAMY 10-12 P.Z.** ACTH7 dominant grass
R026XY006NV	**GRANITIC LOAM 14+ P.Z.** Less productive site; soils derived from granitic parent materials

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia tridentata ssp. vaseyana*
Herbaceous	(1) *Achnatherum occidentale*

Physiographic features

This site occurs on smooth to slightly concave mountain sideslopes. Although this community occurs on all aspects, it is usually restricted to northerly aspects at lower elevations. Slopes range from 15 to 75 percent. Elevations are 4500 to 9500.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Elevation	4,500–9,500 ft
Slope	15–75%
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is subhumid with cool, dry summers and cold, wet winters. Average annual precipitation is 14 inches to 18 inches. Mean annual air temperature is 36 to 45 degrees F. The average growing season is about 30 to 90 days. Climate data used to support this section were derived from PRISM and is not specifically tied to any dominant climate station.

Nevada's climate is predominantly arid, with large daily ranges of temperature, infrequent severe storms, heavy snowfall in the higher mountains, and great location variations with elevation. Three basic geographical factors largely influence Nevada's climate: continentality, latitude, and elevation. Continentality is the most important factor. The strong continental effect is expressed in the form of both dryness and large temperature variations. Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate of the State. The prevailing winds are from the west, and as the warm moist air from the Pacific Ocean ascend the western slopes of the Sierra Range, the air cools, condensation occurs and most of the moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt not only in the West but throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The temperature regime is also affected by the blocking of the inland-moving maritime air. Nevada sheltered from maritime winds, has a continental climate with well-developed seasons and the terrain responds quickly to changes in solar heating.

Nevada lies within the mid-latitude belt of prevailing westerly winds which occur most of the year. These winds bring frequent changes in weather during the late fall, winter and spring months, when most of the precipitation occurs. To the south of the mid-latitude westerlies, lies a zone of high pressure in subtropical latitudes, with a center over the

Pacific Ocean. In the summer, this high-pressure belt shifts northward over the latitudes of Nevada, blocking storms from the ocean. The resulting weather is mostly clear and dry during the summer and early fall, with scattered thundershowers. The eastern portion of the state receives significant summer thunderstorms generated from monsoonal moisture pushed up from the Gulf of California, known as the North American monsoon. The monsoon system peaks in August and by October the monsoon high over the Western U.S. begins to weaken and the precipitation retreats southward towards the tropics (NOAA 2004).

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	14-18 in
Frost-free period (average)	60 days
Freeze-free period (average)	
Precipitation total (average)	16 in

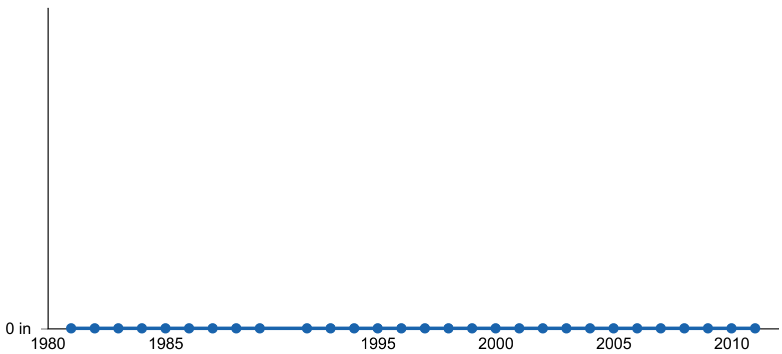


Figure 1. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with the Loamy Slope 14+ P.Z.

Soil features

The soils are typically more than 40 inches deep and well drained. The soils have formed in residuum and colluvium from intermediate volcanic and granitic parent materials. The available water capacity is low. Soil surface layers are typically thick and very dark. Soil series associated with this site are Bullville, Delhew, Glean, Hapgood family, Hartig Variant, Holtle Variant, Katyblay, Kiote, Snopoc, and Squawval.

Table 4. Representative soil features

Parent material	(1) Colluvium–granite (2) Residuum–granite
Surface texture	(1) Very gravelly coarse sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately rapid
Soil depth	40–84 in
Surface fragment cover <=3"	50%
Surface fragment cover >3"	5%

Available water capacity (0-40in)	1.5–2.5 in
Calcium carbonate equivalent (0-40in)	0–1%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	61%
Subsurface fragment volume >3" (Depth not specified)	5%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it has a set of key characteristics that influence a site's resilience to disturbance and resistance to invasion. Key characteristics include 1) climate (precipitation, temperature), 2) topography (aspect, slope, elevation, and landform), 3) hydrology (infiltration, runoff), 4) soils (depth, texture, structure, organic matter), 5) plant communities (functional groups, productivity), and 6) natural disturbance regime (fire, herbivory, etc.) (Caudle et al. 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al 2013).

The ecological sites in this DRG are dominated by deep-rooted, cool season perennial bunchgrasses and long-lived shrubs (50+ years) with high root to shoot ratios. The dominant shrubs usually root to the full depth of the winter-spring soil moisture recharge, which ranges from 1.0 and over 3.0 m. (Comstock and Ehleringer 1992). Root length of mature sagebrush plants was measured to a depth of two meters in alluvial soils in Utah (Richards and Caldwell 1987). Tap roots of antelope bitterbrush have been documented from 4.5 to 5.4 m in length (McConnell 1961). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).

The dominant perennial bunchgrass is western needlegrass. This species generally has somewhat shallower root systems than the shrubs, but root densities are often as high as or higher than those of shrubs in the upper 0.5 m of the soil profile. General differences in root depth distributions between grasses and shrubs results in resource partitioning in these shrub/grass systems.

Mountain big sagebrush and antelope bitterbrush are generally long-lived; therefore, it is not necessary for new individuals to recruit every year for perpetuation of the stand. Infrequent large recruitment events and simultaneous low, continuous recruitment is the foundation of population maintenance (Noy-Meir 1973). Survival of the seedlings is dependent on adequate moisture conditions.

The perennial bunchgrasses that are co-dominant with the shrubs include western needlegrass, Letterman's needlegrass, sedges (Carex spp.), and spike fescue (*Leucopoa kingii*). These species generally have somewhat shallower root systems than the shrubs, but bunchgrass root densities are often as high as or higher than those of shrubs in the upper 0.5 m but taper off more rapidly than shrubs. General differences in root depth distributions between grasses and shrubs result in resource partitioning in these shrub/grass systems.

The Great Basin sagebrush communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during the winter. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource uptake by the decomposition of dead plant material following disturbance. The invasion of sagebrush communities by cheatgrass (*Bromus tectorum*) has been linked to disturbances (fire, abusive grazing) that have resulted in fluctuations in resources (Chambers et al 2007). Sites in this group were not found to be influenced by cheatgrass invasions. Access to some areas where this site is mapped was limited due to landownership constraints.

Western needlegrass is a strongly tufted perennial grass that grows up to 4 dm in height (Cronquist et al. 1994). It grows in dry, well-drained soils from upper foothills up into the higher areas of the mountains in the western United States (USDA Forest Service 1988). The roots of this grass are deep, fibrous and spreading, which allows it to be more resistant to trampling and drought (USDA Forest Service 1988).

Letterman needlegrass is an erect, densely-tufted perennial bunchgrass that forms large clumps. It is found on dry soils in a variety of vegetation communities, including, high elevation meadows, subalpine grasslands, open areas underneath aspen, and in sagebrush communities (Tisdale and Hironaka 1981). It grows best on loamy soils that are greater than 20 cm deep (Dittberner and Olson 1983).

Basin wildrye is a large, cool-season perennial bunchgrass with an extensive deep coarse fibrous root system (Reynolds and Fraley 1989). Clumps may reach up to 2 meters in height (Cronquist et al. 1994). Basin wildrye does not tolerate long periods of inundation; it prefers cycles of wet winters and dry summers and is most commonly found in deep soils with high water holding capacities or seasonally high water tables (Cronquist et al. 1994, Perryman and Skinner 2007).

The ecological sites in this DRG have high resilience to disturbance and resistance to invasion. Resilience increases with elevation, aspect, increased precipitation and increased nutrient availability. Long-term disturbance response may be influenced by small differences in landscape topography. Concave areas receive run-in from adjacent landscapes and consequently retain more moisture to support the growth of deep-rooted perennial grasses (i.e. basin wildrye) whereas convex areas where runoff occurs are slightly less resilient and may have more shallow-rooted perennial grasses (i.e. bluegrasses (Poa spp.) and prairie junegrass (*Koeleria macrantha*)). North slopes are also more resilient than south slopes because lower soil surface temperatures keep moisture content higher on northern exposures. Three possible alternative stable states have been identified for this DRG.

Fire Ecology:

Fire is believed to be the dominant disturbance force in big sagebrush communities. Several authors suggest pre-settlement fire return intervals in mountain big sagebrush communities varied from 15 to 25 years (Burkhardt and Tisdale 1969, Houston 1973, and Miller et al. 2000). Kitchen and McArthur (2007) suggest a mean fire return interval of 40 to 80 years for mountain big sagebrush communities. The range from 15 to 80 years is probably more accurate and reflects the differences in elevation and precipitation where mountain big sagebrush communities occur. On a landscape scale, multiple seral stages were represented in a mosaic, reflecting periodic reoccurrence of fire and other disturbances (Crawford et al 2004). Post-fire hydrologic recovery and resilience is primarily influenced by pre-fire site conditions, fire severity, and post-fire weather and land use that relate to vegetation recovery. Fire adaptation by herbaceous species is generally superior to the dominant shrubs, which are typically killed by fire. Sites with low abundances of native perennial grasses and forbs typically have reduced resiliency following disturbance and are less resistant to invasion or increases in cheatgrass (Miller et al 2013). If fire frequency decreases, sagebrush will increase and with inappropriate grazing management, the perennial bunchgrasses and forbs may be reduced.

Mountain big sagebrush is killed by fire (Neunschwander 1980, Blaisdell et al. 1982) and does not resprout (Blaisdell 1953). Post-fire regeneration occurs from seed and will vary depending on site characteristics, seed source, and fire characteristics. Mountain big sagebrush seedlings can grow rapidly and may reach reproductive maturity within 3 to 5 years (Bunting et al. 1987). Mountain big sagebrush may return to pre-burn density and cover within 15 to 20 years following fire, but establishment after severe fires may proceed more slowly (Bunting et al. 1987).

With fire, sprouting shrubs may become dominant in the community for a period of time before sagebrush is able to recolonize the site. Pre-fire condition and fire severity influences the growth of most of these species. Douglas' rabbitbrush (*Chrysothamnus viscidiflorus*) and rubber rabbitbrush (*Ericameria nauseosa*) are both top-killed by fire, but can resprout after fire and can also quickly re-establish from seed (Young 1983, Kuntz 1982, Akinsoji 1988). Snowberry has been noted to regenerate from rhizomes and can exceed pre-burn biomass in the third season after a fire (Merrill et al. 1982, Noste and Bushey 1987). Spineless horsebrush readily sprouts and survives after being top-killed by fire (Evans and Young 1978, Pyle and Crawford 1996, Ellsworth and Kauffman 2017).

Antelope bitterbrush is moderately fire tolerant (McConnell and Smith 1977). It regenerates by seed and resprouting (Blaisdell and Mueggler 1956, Clements and Young 2002), however sprouting ability is highly variable and has been attributed to genetics, plant age, phenology, soil moisture and texture and fire severity (Blaisdell and Mueggler 1956, Blaisdell et al. 1982, Clark et al. 1982, Cook et al. 1994). Bitterbrush sprouts from a region on the stem approximately 1.5 inches above and below the soil surface; the plant rarely sprouts if the root crown is killed by fire (Blaisdell and Mueggler 1956). Low intensity fires may allow for bitterbrush to sprout; however, community response also depends on soil moisture levels at time of fire (Murray 1983). Lower soil moisture allows more charring of the stem below ground level (Blaisdell and Mueggler 1956), thus sprouting will usually be more successful after a spring fire than after a fire in summer or fall (Murray 1983, Busse et al. 2000, Kerns et al. 2006). Similarly, currant (Ribes spp.) can increase after fire but this result is not guaranteed (Young and Bailey 1975).

The effect of fire on bunchgrasses relates to culm density, culm-leaf morphology, and the size of the plant. The initial condition of bunchgrasses within the site along with seasonality and intensity of the fire all factor into the individual species response. For most forbs and grasses the growing points are located at or below the soil surface providing relative protection from disturbances which decrease above ground biomass, such as grazing or fire. Thus, fire mortality is more correlated to duration and intensity of heat which is related to culm density, culm-leaf morphology, size of plant and abundance of old growth (Young 1983, Wright 1971).

Broad-leaved grasses like western needlegrass are relatively tolerant of fire (Blaisdell 1953; Wright and Klemmedson 1965, Wright 1971, Bunting et al. 1987). Western needlegrass decreased the first year after an August wildfire in northeastern California, but increased by the third post-fire year, nearly doubling in basal area (Countryman and Cornelius 1957). Emergence of western needlegrass seeds was shown to significantly improve with additions of smoke and burned soil (Blank and Young 1996).

Basin wildrye is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Miller et al. (2013) reported increased total shoot and reproductive shoot densities in the first year following fire, although by year two there was little difference between burned and control treatments.

If fire-tolerant species such as balsamroot (Balsamorhiza spp.), lupine (Lupinus spp.), mule-ears (*Wyethia amplexicaulis*) and phlox (Phlox spp.) are common before fire, these forbs will increase after fire. The increase in species such as silvery lupine in mountain big sagebrush communities has been attributed to both resprouting and reproduction from seed (Goergen and Chambers 2009). Because these species are relatively unpalatable, they may also increase with heavy grazing.

Wildlife/Livestock Grazing Interpretations:

This site is suitable for grazing. Grazing management considerations include timing, duration, frequency, and intensity of grazing. Overgrazing leads to an increase in mountain big sagebrush and a decline in deep-rooted perennial bunchgrasses. Shallow-rooted bluegrasses will increase with further degradation. Reduced bunchgrass vigor or density provides an opportunity for expansion of bluegrass species in interspaces. Sandberg bluegrass and similar low-growing grasses increase under grazing pressure (Tisdale and Hironaka 1981). A combination of overgrazing and prolonged drought may lead to soil redistribution, increased bare ground and a loss in plant production.

Despite low palatability, mountain big sagebrush is eaten by sheep, cattle, goats, and horses. Chemical analysis indicates that the leaves of big sagebrush equal alfalfa meal in protein, have a higher carbohydrate content, and yield twelvefold more fat (USDA 1988). Many wildlife species are dependent on the sagebrush ecosystem including the greater sage grouse, sage sparrow, pygmy rabbit and the sagebrush vole. Dobkin and Sauder (2004) identified 61 species, including 24 mammals and 37 birds, associated with the shrub-steppe habitats of the Intermountain West. Antelope bitterbrush is an important shrub species to a variety of animals, such as domestic livestock, antelope, deer, and elk. Bitterbrush is critical browse for mule deer, as well as domestic livestock, antelope, and elk (Wood 1995, Clements and Young 2002). Antelope bitterbrush is most commonly found on soils that provide minimal restriction to deep root penetration such as coarse textured soil, or finer textured soil with high stone content (Driscoll 1964). Grazing tolerance of antelope bitterbrush is dependent on site conditions (Garrison 1953).

Western needlegrass is slow to mature and remains green through most of the growing season. Since it can remain green into fall, it is higher quality forage compared to other species that have senesced by then (USDA Forest Service 1988). For livestock, this grass has good forage value, and it has fair forage value for wildlife (Stubbendieck et al. 1992). Seeds of this grass are avoided by grazing animals but are not necessarily injurious. Since seeds are avoided by grazing animals, a large amount of the seed produced grows to maturity (USDA Forest Service 1988).

The early growth and abundant production of basin wildrye make it a valuable source of forage for livestock. It is important forage for cattle and is readily grazed by cattle and horses in early spring and fall. Though coarse-textured during the winter, basin wildrye may be utilized more frequently by livestock and wildlife when snow has covered low shrubs and other grasses. Basin wildrye is used often as a winter feed for livestock and wildlife; not only providing roughage above the snow but also cover in the early spring months (Majerus 1992). Inadequate rest and recovery from defoliation causes a decrease in basin wildrye and an increase in sagebrush and rubber rabbitbrush (Young et al. 1976, Roundy 1985). Spring defoliation of basin wildrye and/or consistent, heavy grazing during the growing season has been found to significantly reduce basin wildrye production and density (Krall et al. 1971). Additionally, basin wildrye suffers from low seed viability and low seedling vigor (Young and Evans 1981). Roundy (1985) found that although basin wildrye is adapted to seasonally dry soils, high and frequent spring precipitation is necessary to establish it from seed. This suggests that establishment of basin wildrye seedlings occurs only during years of unusually high precipitation.

Long-term disturbance response may be influenced by small differences in landscape topography. Concave areas receive and hold more moisture and may retain deep-rooted perennial grasses whereas convex areas are slightly less resilient and may lose deep-rooted perennial grasses more rapidly.

State and Transition Model Narrative Group 13
This is a text description of the states, phases, transitions, and community pathways possible in the State and Transition model for the MLRA 26 Disturbance Response Group 13. Other sites included in this DRG are: R026XY108NV, R026XY075NV, R026XY056NV, R026XY052NV, R026XY076NV, R026XY109NV, R026XY112NV, R026XY110NV, R026XF059CA, R026XF058CA.

Reference State 1.0:
The Reference State 1.0 represents the natural range of variability under pristine conditions. The reference state has three general community phases: a shrub-grass dominant phase, a perennial grass dominant phase and a shrub dominant phase. State dynamics are maintained by interactions between climatic patterns and disturbance regimes. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, fine fuel loads, and retention of organic matter and nutrients. Plant community phase changes are primarily driven by fire, periodic drought and/or insect or disease attack.

Community Phase 1.1:
Mountain big sagebrush and perennial bunchgrasses co-dominate. Western needlegrass is the dominant grass species, however there may be several grass species present. Grass, shrub, and forb diversity is high.

Community Phase Pathway 1.1a, from phase 1.1 to 1.2:
Fire would decrease or eliminate the overstory of sagebrush and allow perennial bunchgrasses and forbs to dominate the site. Fires are small, high-severity, stand replacement fires that typically occur from April through October. Patchy fires create a sagebrush/grass mosaic. High severity fire significantly reduces sagebrush cover and leads to an early- to mid-seral community, dominated by grasses and forbs.

Community Phase Pathway 1.1b, from phase 1.1 to 1.3:
Time and lack of disturbance such as fire or drought allow for an increase in mountain big sagebrush. Excessive herbivory and/or long-term drought may also reduce perennial understory.

Community Phase 1.2:
This community phase is characteristic of a post-disturbance, early- to mid-seral community. Western needlegrass, bluegrass and other perennial grasses dominate. Sprouting shrubs such as green rabbitbrush (*Chrysothamnus viscidiflorus*), snowberry (*Symphoricarpos oreophilus*), green ephedra (*Ephedra viridis*), spineless horsebrush (*Tetradymia canescens*) may be a significant component. Mountain big sagebrush is a minor component. Forbs may be a significant component.

Community Phase Pathway 1.2a, from phase 1.2 to 1.1:
Time and lack of disturbance allows sagebrush to reestablish.

Community Phase 1.3:
Mountain big sagebrush becomes dominant in the absence of disturbance. Western needlegrass and other perennial grasses are reduced. Bluegrass may increase. Singleleaf pinyon and/or Utah juniper may be present.

Community Phase Pathway 1.3a, from phase 1.3 to 1.1:
Low severity fire kills some sagebrush and results in a patchwork of shrubs and grasses.

Community Phase Pathway 1.3b, from phase 1.3 to 1.2:
High severity fire significantly reduces sagebrush cover, leading to early- to mid-seral community.

T1A: Transition from Reference State 1.0 to Current Potential State 2.0:
Trigger: This transition is caused by the introduction of non-native annual weeds, such as cheatgrass, mustard and Russian thistle (Salsola spp.).

Slow variables: Over time, the annual non-native plants will increase within the community decreasing organic matter inputs from deep-rooted perennial bunchgrasses resulting in reductions in soil water availability for perennial bunchgrasses.

Threshold: Any amount of introduced non-native species causes an immediate decrease in the resilience of the site. Annual non-native species cannot be easily removed from the system and have the potential to significantly alter disturbance regimes from their historic range of variation.

T2A: Transition from Reference State 1.0 to Shrub State 3.0:
Trigger: Inappropriately managed, long-term grazing of perennial bunchgrasses during the growing season would favor shrubs and initiate transition to Community Phase 3.1. Fire would cause a transition to Community Phase 3.2.

Slow variables: Long-term decrease in deep-rooted perennial grass density resulting in a decrease in organic matter inputs and subsequent soil water decline.

Threshold: Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and nutrient redistribution and reduces soil organic matter.

Current Potential State 2.0:
This state is similar to the Reference State 1.0. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. This state has the same three general community phases. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These include the presence of all structural and functional groups, fine fuel loads and retention of organic matter and nutrients. Positive feedbacks decrease ecosystem resilience and stability of the state. These include the non-natives high seed output, persistent seed bank, rapid growth rate, ability to cross pollinate and adaptations for seed dispersal. Additionally, the presence of highly flammable, non-native species reduces State resilience because these species can promote fire where historically fire has been infrequent leading to positive feedbacks that further the degradation of the system.

Community Phase 2.1:
Mountain big sagebrush and perennial bunchgrasses co-dominate. Western needlegrass is the dominant grass species; however, there may be several grass species present. Grass, shrub, and forb diversity is high. Annual non-native species present.

Community Phase Pathway 2.1a, from phase 2.1 to 2.2:
Fire would decrease or eliminate the overstory of sagebrush and allow perennial bunchgrasses and forbs to dominate the site. Fires would typically be small, high-severity, stand replacing, and patchy due to fine fuel loads. Patchy fires create a sagebrush/grass mosaic. High severity fire significantly reduces sagebrush cover and leads to an early- to mid-seral community, dominated by grasses and forbs.

Community Phase Pathway 2.1b, from phase 2.1 to 2.3:
Time, long-term drought, grazing management that favors shrubs or combinations of these allows the sagebrush overstory to increase and dominate the site, causing a reduction in perennial bunchgrasses.

Community Phase 2.2:
This community phase is characteristic of a post-disturbance, early- to mid-seral community. Western needlegrass, bluegrass and other perennial grasses dominate. Sprouting shrubs such as green rabbitbrush (*Chrysothamnus viscidiflorus*), snowberry (*Symphoricarpos oreophilus*), green ephedra (*Ephedra viridis*), spineless horsebrush (*Tetradymia canescens*) may be a significant component. Mountain big sagebrush is a minor component. Forbs may be a significant component. Annual non-native species are present.

Community Phase Pathway 2.2a, from phase 2.2 to 2.1:
Absence of disturbance over time allows the sagebrush to recover. This may be combined with grazing management that favors shrubs.

Community Phase 2.3:
Mountain big sagebrush increases and the perennial understory is reduced. Squirreltail and bluegrasses may increase. Annual non-native species are present.

Community Phase Pathway 2.3a, from phase 2.3 to 2.1:
Low severity fire kills some sagebrush and results in a patchwork of shrubs and grasses. Other disturbances/practices include brush management with minimal soil disturbance to reduce sagebrush cover.

Community Phase Pathway 2.3b, from phase 2.3 to 2.2
High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

T2A: Transition from Current Potential State 2.0 to Shrub State 3.0:
Trigger: Inappropriately managed, long-term grazing of perennial bunchgrasses during the growing season would favor shrubs and initiate transition to Community Phase 3.1. Fire would cause a transition to Community Phase 3.2.

Slow variables: Long-term decrease in deep-rooted perennial grass density resulting in a decrease in organic matter inputs and subsequent soil water decline.

Threshold: Loss of deep-rooted perennial bunchgrasses changes spatial and temporal nutrient cycling and nutrient redistribution, and reduces soil organic matter.

Shrub State 3.0:
This state has two community phases: a mountain big sagebrush dominated phase and a rabbitbrush dominated phase. This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Squirreltail and bluegrasses will increase with a reduction in deep-rooted perennial bunchgrass competition and become the dominant grass. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush canopy cover is high and sagebrush may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory and shallow-rooted understory dominate site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community Phase 3.1:
Mountain big sagebrush dominates the overstory. Western needlegrass and other deep-rooted perennial grasses are reduced or missing. Bluegrasses may dominate the understory. Bare ground may be significant. Annual non-native species are present.

Community Phase Pathway 3.1a, from phase 3.1 to 3.2:
Fire reduces or eliminates the overstory of sagebrush.

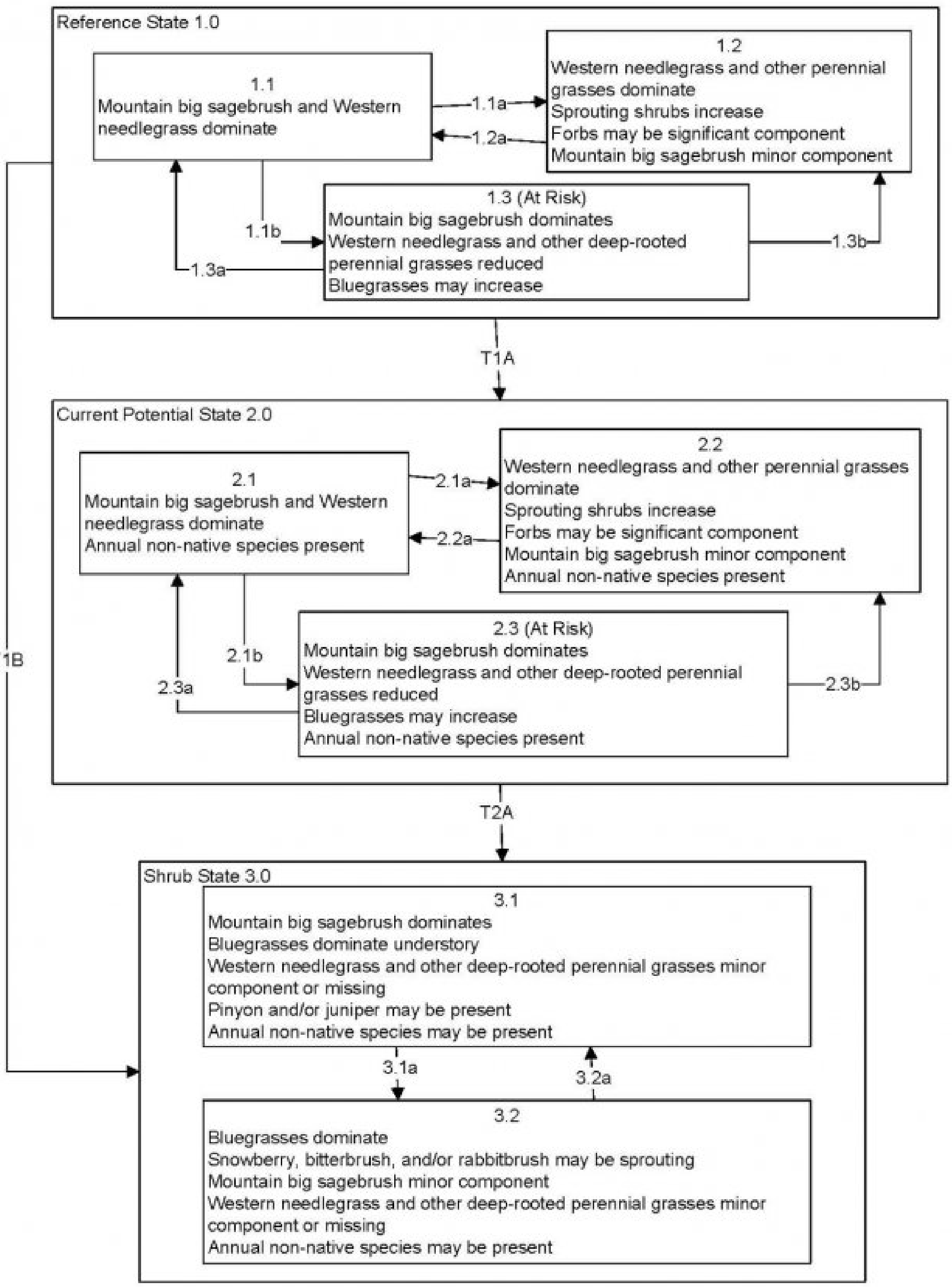
Community Phase 3.2:
Bluegrasses dominate the site. Rabbitbrush, bitterbrush, horsebrush, ephedra, and/or snowberry may be sprouting. Mountain big sagebrush is a minor component. Annual non-native species increasing and may be co-dominant in

the understory.

Community Phase Pathway 3.2a, from phase 3.2 to 3.1:
Absence of disturbance over time allows sagebrush and other shrubs to recover.

State and transition model

MLRA 26
Group 13
Loamy Slope 14+"
026XY038NV



MLRA 26
Group 13
Loamy Slope 14+"
026XY038NV
KEY

Reference State 1.0 Community Phase Pathways
1.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community, dominated by grasses and forbs.
1.1b: Time and lack of disturbance such as fire or drought. Excessive herbivory and/or long-term drought may also reduce perennial understory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: Low severity fire creates sagebrush/grass mosaic.
1.3b: High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T1A: Introduction of non-native annual species.
Transition T2B: Inappropriate grazing management (from 1.3 to 3.1).

Current Potential State 2.0 Community Phase Pathways
2.1a: Low severity fire creates sagebrush/grass mosaic; high severity fire significantly reduces sagebrush cover and leads to early/mid-seral community dominated by grasses and forbs; non-native annual species present.
2.1b: Time and lack of disturbance. Inappropriate grazing management and/or long-term drought may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for regeneration of sagebrush.
2.3a: Low severity fire creates sagebrush/grass mosaic.
2.3b: High severity fire significantly reduces sagebrush cover leading to early/mid-seral community.

Transition T2A: Inappropriate grazing management (to 3.1), or high severity fire (from 2.3 to 3.2).

Shrub State 3.0 Community Phase Pathways
3.1a: Fire.
3.2a: Time and lack of disturbance.

State 1
Reference Plant community

Community 1.1

Reference Plant community

The representative plant community is dominated by western needlegrass, and mountain big sagebrush. Potential vegetative composition is about 65% grasses and grass-like plants, 10% forbs and 25% shrubs. Approximate ground cover (basal and crown) is 30 to 45 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	455	585	715
Shrub/Vine	175	225	275
Forb	70	90	110
Total	**700**	**900**	**1100**

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Primary Perennial Grasses**			423–675	
	western needlegrass	ACOCO	*Achnatherum occidentale ssp. occidentale*	360–450	–
	Letterman's needlegrass	ACLE9	*Achnatherum lettermanii*	18–90	–
	basin wildrye	LECI4	*Leymus cinereus*	0–45	–
	wood bluegrass	PONE	*Poa nemoralis*	12–23	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	11–22	–
	muttongrass	POFE	*Poa fendleriana*	11–22	–
2	**Secondary Perennial Grasses**			45–135	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	5–27	–
	pine needlegrass	ACPI2	*Achnatherum pinetorum*	5–27	–
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	5–27	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	5–27	–
	spike fescue	LEKI2	*Leucopoa kingii*	5–27	–
	Sandberg bluegrass	POSE	*Poa secunda*	5–27	–
Forb					
3	**Perennial**			45–135	
	spike fescue	LEKI2	*Leucopoa kingii*	5–27	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	5–27	–
	lupine	LUPIN	*Lupinus*	5–27	–
Shrub/Vine					
4	**Primary Shrubs**			135–265	
	mountain big sagebrush	ARTRV	*Artemisia tridentata ssp. vaseyana*	135–225	–
	Forb, annual	2FA	*Forb, annual*	35–81	–
	buckwheat	ERIOG	*Eriogonum*	0–45	–
	tapertip hawksbeard	CRAC2	*Crepis acuminata*	5–27	–
	lupine	LUPIN	*Lupinus*	5–27	

	lupine	LUPIN	*Lupinus*	5–27	–
5	**Secondary Shrubs**			45–135	
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	5–27	–
	mormon tea	EPVI	*Ephedra viridis*	5–27	–
	rockspirea	HODU	*Holodiscus dumosus*	5–27	–
	mountain monardella	MOOD	*Monardella odoratissima*	5–27	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	5–27	–
	currant	RIBES	*Ribes*	5–27	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	5–27	–
Tree					
6	**Evergreen**			10–36	
	buckwheat	ERIOG	*Eriogonum*	1–45	–
	rockspirea	HODU	*Holodiscus dumosus*	5–27	–
	mountain monardella	MOOD	*Monardella odoratissima*	5–27	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	5–27	–
	currant	RIBES	*Ribes*	5–27	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	5–27	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	5–27	–
	Utah juniper	JUOS	*Juniperus osteosperma*	5–18	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	5–18	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Grazing management should be keyed to western needlegrass and all other perennial grass production. Western needlegrass has a spreading and deeply penetrating root system, which makes it resistant to trampling. Letterman’s needlegrass begins growth early in the year and remains green throughout the relatively long growing season, thus, making it valuable forage for livestock. Cusick's bluegrass makes up only a small proportion of the biomass of the sagebrush communities in which it lives, but it is often taken preferentially by cattle, especially early in the season. Muttongrass is excellent forage for domestic livestock especially in the early spring. Muttongrass begins growth in late winter and early spring, which makes it available before many other forage plants. Nevada bluegrass is a widespread forage grass. It is one of the earliest grasses in the spring and is sought by domestic livestock and several wildlife species. Canby's bluegrass is a palatable species for several livestock species. Nevada bluegrass is a palatable species, but its production is closely tied to weather conditions. It produces little forage in drought years, making it a less dependable food source than other perennial bunchgrasses.
The early growth and abundant production of basin wildrye make it a valuable source of forage for livestock. It is important forage for cattle and is readily grazed by cattle and horses in early spring and fall. Though coarse-textured during the winter, basin wildrye may be utilized more frequently by livestock and wildlife when snow has covered low shrubs and other grasses. Mountain big sagebrush is eaten by domestic livestock but has long been considered to be of low palatability, and a competitor to more desirable species.

Stocking rates vary over time depending upon season of use, climate variations, site, and previous and current management goals. A safe starting stocking rate is an estimated stocking rate that is fine tuned by the client by adaptive management through the year and from year to year.

Wildlife Interpretations:
Mountain big sagebrush is highly preferred and nutritious winter forage for mule deer and elk. Western needlegrass provides valuable forage for many species of wildlife. Letterman's needlegrass provides valuable forage for many species of wildlife. It is consumed by mule deer and is most palatable early in the season before the foliage becomes coarse and wiry. Deer, elk, and mountain goat also use Cusick's bluegrass early in the season. The value of Cusick's bluegrass as cover for small animals has been rated as poor to fair. Deer and elk make heavy use of

muttongrass, especially in early spring when other green forage is scarce. Depending upon availability of other nutritious forage, deer may use mutton grass in all seasons. Mutton grass cures well and is an important fall and winter deer food in some areas. Canby's and Nevada bluegrass are important forage speceis for several wildlife species. Basin wildrye provides winter forage for mule deer, though use is often low compared to other native grasses. Basin wildrye provides summer forage for black-tailed jackrabbits. Because basin wildrye remains green throughout early summer, it remains available for small mammal forage for longer time than other grasses.

Hydrological functions

Runoff is very high. Permeability is moderate.

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition and the colorful flowering of wild flowers and shrubs during the spring and early summer. This site offers rewarding opportunities to photographers and for nature study. This site is used for camping and hiking and has potential for upland and big game hunting.

Other products

Native peoples used big sagebrush leaves and branches for medicinal teas, and the leaves as a fumigant. Bark was woven into mats, bags and clothing. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

Other information

Mountain big sagebrush is easily propagated from seed under greenhouse, nursery, and common garden conditions and has been successfully seeded directly into field sites. Mountain big sagebrush has also been successfully planted in field sites using nursery-grown bareroot and containerized stock. Letterman’s needlegrass has been used successfully in revegetating mine spoils. This species also has good potential for erosion control. Basin wildrye is useful in mine reclamation, fire rehabilitation and stabilizing disturbed areas. Its usefulness in range seeding, however, may be limited by initially weak stand establishment.

Type locality

Location 1: Mineral County, NV	
Township/Range/Section	T7N R28E S13
Latitude	38° 28′ 20″
Longitude	118° 48′ 40″
General legal description	About two miles southwest of Mount Grant peak, Wassuk Range, Hawthorne Army Depot, Mineral County, Nevada. This site also occurs in Carson City, Douglas, Lyon, Storey and Washoe Counties, Nevada.

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Approval

Kendra Moseley, 4/10/2024

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)	Patti Novak-Echenique
Contact for lead author	State Rangeland Management Specialist
Date	11/08/2011
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are typically none to rare. A few may occur on steeper slopes after summer convection storms.

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2. **Presence of water flow patterns:** Water flow patterns are typically non-existent. Water flow patterns may rarely be observed on steeper slopes in areas recently subjected to summer convection storms or rapid spring snowmelt.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a "normal" condition.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground 10-20% depending on amount of surface rock fragments

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5. **Number of gullies and erosion associated with gullies:** None

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None

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7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 3 to 6 on most soil textures found on this site. (To be field tested.)

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically medium granular or weak, subangular blocky. Soil surface colors are grayish brown and soils are typified by a mollic epipedon. Organic matter of the surface 2 to 4 inches is typically 1.25 to 3 percent. Organic matter content can be more or less depending on micro-topography.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Reference Plant Community: Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., needlegrasses) slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Subangular blocky structure or subsoil argillic horizons are not to be interpreted as compaction.

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: Deep-rooted, cool season, perennial bunchgrasses >> tall shrubs (big sagebrush, ephedra, antelope bitterbrush)

    Sub-dominant: associated shrubs > deep-rooted, cool season, perennial forbs >> shallow-rooted, cool season, perennial grasses > fibrous, shallow-rooted, cool season, perennial and annual forbs

    Other: evergreen trees

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs may be common with standing dead shrub canopy material as much as 25% of total woody canopy; some of the mature bunchgrasses (<10%) have dead centers.

14. **Average percent litter cover (%) and depth (in):** Between plant interspaces and under canopy as much as 60% and litter depth is ± ¼ inch.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** For normal or average growing season (through mid-June) ± 900 lbs/ac; =700 lbs/ac on unfavorable and = 1100 lbs/ac on exceptional years. Spring moisture significantly affects total production

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:** Potential invaders on this site include cheatgrass, annual mustards, and knapweeds. Singleleaf pinyon and Utah juniper will increase on this site and may become dominant.

17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years. Reduced growth and reproduction occur during extreme or extended drought periods.