USDA Natural Resources Conservation Service

Ecological site R026XY050NV
GRAVELLY CLAY 10-12 P.Z.

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Accessed: 04/25/2024

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.

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

GRAVELLY CLAY 10-12 P.Z. is typically found on mountains and hills between 5,000 and 6,000 feet of elevation on moderate to low slopes (4 to 15 percent). The soil is typically shallow to lithic bedrock with an increase in clay with depth. The dominant vegetation is little sagebrush (Artemisia arbuscula ssp. longicaulis) and Thurber's neddlegrass (Achnatherum thurberianum).

Associated sites

F026XY070NV	**Pinus monophylla-Juniperus osteosperma/Artemisia tridentata ssp. wyomingensis/Achnatherum thurberianum-Poa fendleriana**
R026XY010NV	**LOAMY 10-12 P.Z.**
R026XY023NV	**CLAYPAN 10-12 P.Z.**
R026XY091NV	**CHURNING CLAYPAN 10-12 P.Z.**

Similar sites

R026XY091NV	**CHURNING CLAYPAN 10-12 P.Z.** POSE dominant grass; occurs on vertisols
R026XY097NV	**CHURNING CLAYPAN 8-10 P.Z.** More productive site; occurs on vertisols
R026XY033NV	**SANDY CLAYPAN 8-10 P.Z.** ACHY dominant grass; ATCA2 major shrub; sandy surface soil
R026XY088NV	**CLAY SLOPE 10-12 P.Z.** GLSPA major shrub; more productive site
R026XY095NV	**GRANITIC CLAYPAN 8-12 P.Z.** ACSP12 dominant grass
R026XY047NV	**DROUGHTY CLAYPAN 8-10 P.Z.** Less productive site; ATCO and PIDE4 important shrubs on site
R026XY101NV	**SANDY LOAM 8-10 P.Z.** More productive site

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Artemisia arbuscula ssp. longicaulis*
Herbaceous	(1) *Achnatherum thurberianum*

Physiographic features

This site occurs on summits and sideslopes of hills and low mountains. Slopes range from 2 to 50 percent, but slope gradients of 4 to 15 percent are most typical. Elevations are 4150 to 6000 feet.

Table 2. Representative physiographic features

Landforms	(1) Mountain (2) Hill
Elevation	4,150–6,000 ft
Slope	4–15%
Aspect	Aspect is not a significant factor

Climatic features

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 ascends the western slopes of the Sierra Range, the air cools, condensation takes place 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 climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 10 to about 12 inches. Mean annual air temperature is 49 to 51 degrees F. The average growing season is about 90 to 110 days.

Average total precipitation by month at the Stead Climate Station (267820) is as follows: Jan. 1.57, Feb. 1.92, Mar. 1.24, Apr. 0.56, May 0.55, Jun. 0.54, Jul. 0.34, Aug. 0.26, Sep. 0.46, Oct. 0.72, Nov. 0.88, Dec. 1.84. Average annual precipitation is 10.89 inches.

Table 3. Representative climatic features

Frost-free period (characteristic range)	
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	10-12 in
Frost-free period (average)	104 days
Freeze-free period (average)	134 days
Precipitation total (average)	11 in

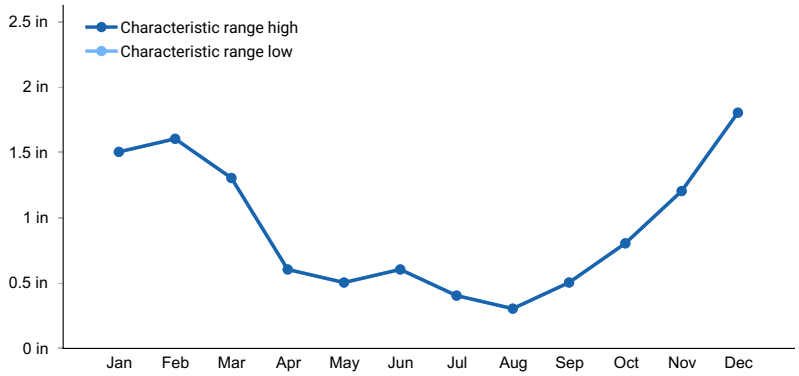


Figure 1. Monthly precipitation range

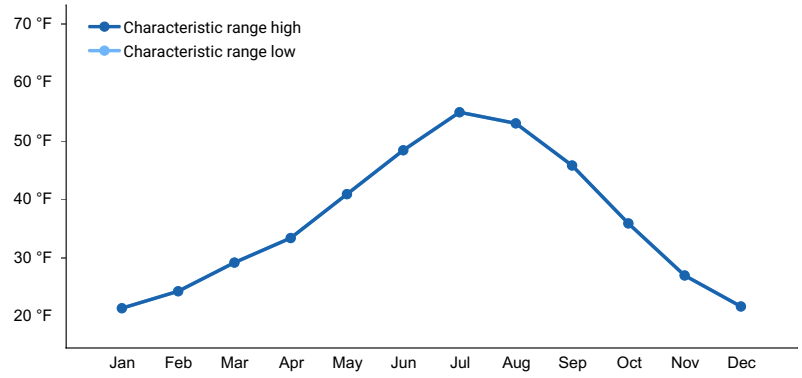


Figure 2. Monthly minimum temperature range

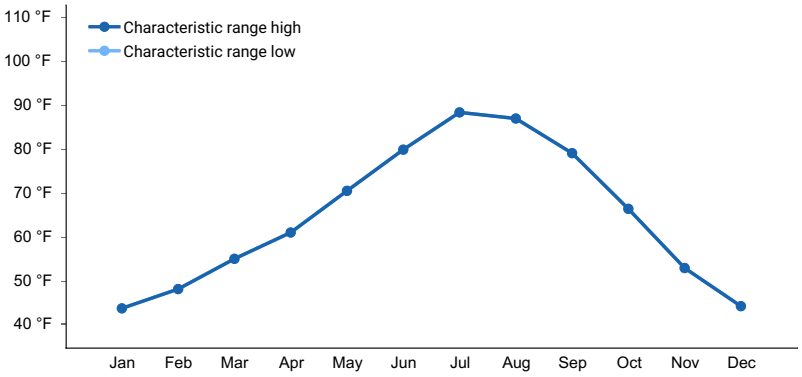


Figure 3. Monthly maximum temperature range

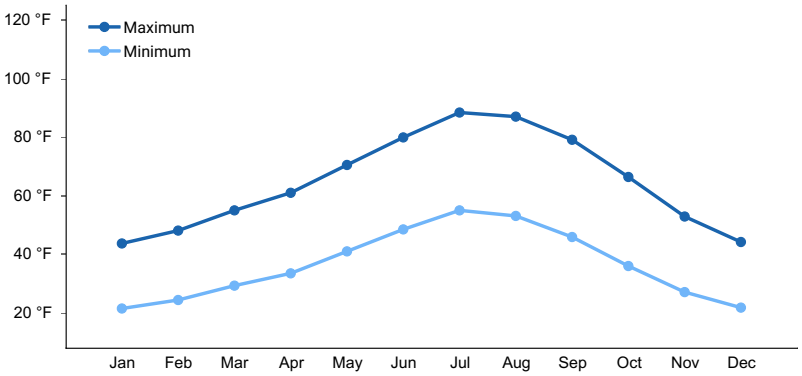


Figure 4. Monthly average minimum and maximum temperature

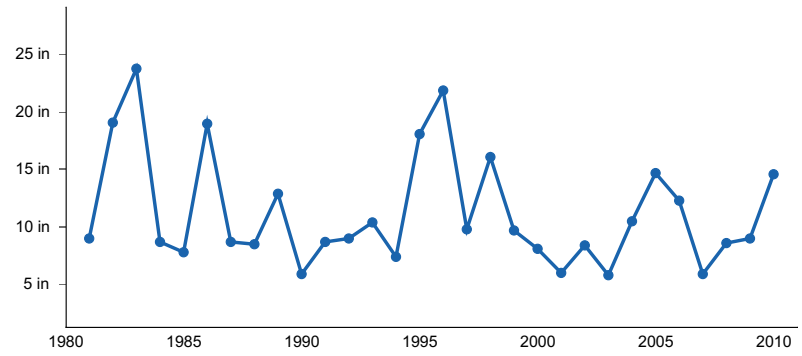


Figure 5. Annual precipitation pattern

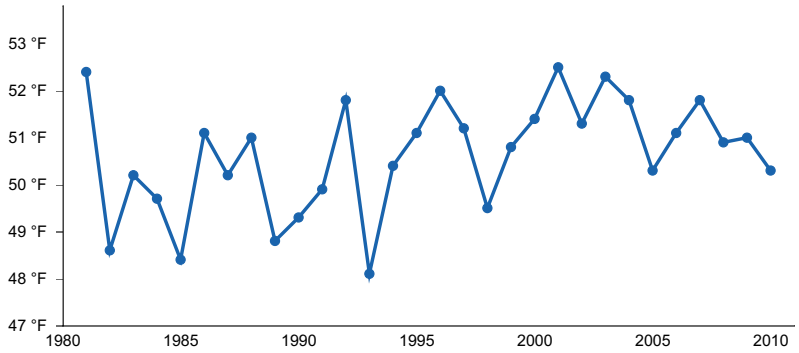


Figure 6. Annual average temperature pattern

Climate stations used

- (1) STEAD [USC00267820], Reno, NV

Influencing water features

There are no influencing water features associated with this site.

Soil features

Associated soils are typically shallow and are formed in residuum from andesite, tuff, or sedimentary rock parent material. The soil surface is medium in texture over a fine-textured subsoil, forming an argillic horizon. Permeability is moderate and the soils are well drained. Available water capacity is very low. Infiltration is restricted once these soils are wetted then they are subject to water loss by runoff. The soils commonly have over 40 percent gravels, cobbles and stones on the surface which provide a stabilizing affect on surface erosion conditions. Associated soil series are , Ceejay, Doorkiss, Xman, Acrelane, and Chalco.

Table 4. Representative soil features

Parent material	(1) Residuum–andesite (2) Residuum–tuff (3) Residuum–sedimentary rock
Surface texture	(1) Very gravelly sandy loam (2) Very gravelly loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Moderate
Soil depth	14–20 in
Surface fragment cover <=3"	19–38%
Surface fragment cover >3"	5–8%
Available water capacity (0-40in)	1.1–2.4 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0–4 mmhos/cm
Sodium adsorption ratio (0-40in)	0–5
Soil reaction (1:1 water) (0-40in)	6.8–7.4

Subsurface fragment volume <=3" (Depth not specified)	16–35%
Subsurface fragment volume >3" (Depth not specified)	12–13%

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 invasives. 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 2013). Biotic factors that 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 to over 3.0 m (Dobrowolski et al. 1990). Root length of mature sagebrush plants was measured to a depth of 2 meters in alluvial soils in Utah (Richards and Caldwell 1987). However, community types with low sagebrush as the dominant shrub were found to have soil depths and thus available rooting depths of 71 to 81 cm in a study in northeast Nevada (Jensen 1990). These shrubs have a flexible generalized root system with development of both deep taproots and laterals near the surface (Comstock and Ehleringer 1992).

Periodic drought regularly influences sagebrush ecosystems and drought duration and severity has increased throughout the 20th century in much of the Intermountain West. Major shifts away from historical precipitation patterns have the greatest potential to alter ecosystem function and productivity. Species composition and productivity can be altered by the timing of precipitation and water availability with the soil profile (Bates et al. 2006).

Lahontan sagebrush is fairly drought tolerant but also tolerates periodic wetness during some portion of the growing season. Low sagebrush is also susceptible to the sagebrush defoliator, Aroga moth. Aroga moth can partially or entirely kill individual plants or entire stands of big sagebrush (Furniss and Barr 1975), but the research is inconclusive of the damage sustained by Lahontan sagebrush populations.

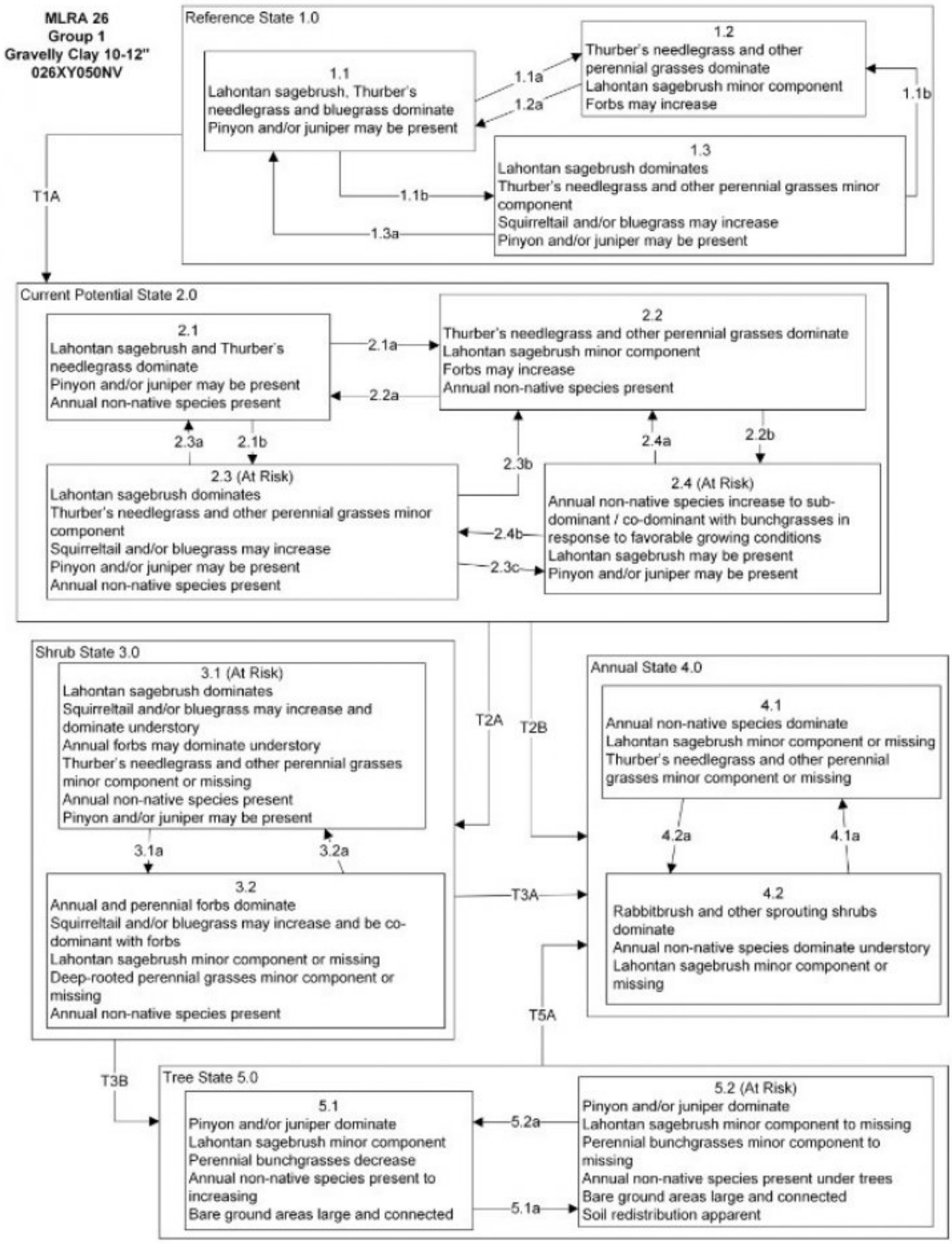
The Great Basin sagebrush communities have high spatial and temporal variability in precipitation both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The invasibility of plant communities is often 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 pools 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).
This ecological site has low to moderate resilience to disturbance and resistance to invasion. Increased resilience increases with elevation, aspect, increased precipitation and increased nutrient availability.

As ecological condition declines, Lahontan sagebrush, rabbitbrush, bottlebrush squirreltail, and Sandberg's bluegrass increase as Thurber's needlegrass and other perennial bunchgrasses decrease. Cheatgrass is the species most likely to invade this site. Crown-sprouting shrubs (rabbitbrush, snakeweed, ephedra) and fire tolerant plants (spiny hopsage) significantly increase following wildfire.

Fire Ecology:
The mean fire return intervals for Lahontan sagebrush communities have been estimated to be from 35 to over 100 years. Fire most often occurs during wet years with high forage production. Lahontan sagebrush is very susceptible to fire damage. Lahontan sagebrush is usually killed by fire and does not re-sprout. The recovery in burned areas is usually via small, light, wind-dispersed seed for all low sagebrush subspecies. Partially injured Lahontan sagebrush may re-grow from living branches, but sprouting does not occur. Thurber's needlegrass is classified as moderately resistant, but depending on season of burn, phenology, and fire severity, this perennial bunchgrass is moderately to severely damaged by fire. Burning has been found to decrease the vegetation and reproductive vigor. Early season

burning is more damaging to this needlegrass than late season burning. Sandberg’s bluegrass, a minor component of this ecological site, has been found to increase following fire likely due to its low stature and productivity (Daubenmire 1975) and may retard reestablishment of deeper rooted bunchgrasses. Sandberg's bluegrass is generally unharmed by fire. It produces small amounts of litter and is usually dormant when fires do occur. Squirreltail is considered one of the most fire resistant native bunchgrasses. Older plants contain minor amounts of litter so hot, quick fires do little damage to the root crown.

State and transition model


MLRA 26
Group 1
Gravelly Clay 10-12"
026XY050NV
Reference State 1.0
1.1
Lahontan sagebrush, Thurber's needlegrass and bluegrass dominate
Pinyon and/or juniper may be present
1.2
Thurber's needlegrass and other perennial grasses dominate
Lahontan sagebrush minor component
Forbs may increase
1.3
Lahontan sagebrush dominates
Thurber's needlegrass and other perennial grasses minor component
Squirreltail and/or bluegrass may increase
Pinyon and/or juniper may be present
1.1a
1.2a
1.1b
1.1b
1.3a
T1A
Current Potential State 2.0
2.1
Lahontan sagebrush and Thurber's needlegrass dominate
Pinyon and/or juniper may be present
Annual non-native species present
2.2
Thurber's needlegrass and other perennial grasses dominate
Lahontan sagebrush minor component
Forbs may increase
Annual non-native species present
2.1a
2.2a
2.3a
2.1b
2.3b
2.4a
2.2b
2.3 (At Risk)
Lahontan sagebrush dominates
Thurber's needlegrass and other perennial grasses minor component
Squirreltail and/or bluegrass may increase
Pinyon and/or juniper may be present
Annual non-native species present
2.4 (At Risk)
Annual non-native species increase to sub-dominant / co-dominant with bunchgrasses in response to favorable growing conditions
Lahontan sagebrush may be present
Pinyon and/or juniper may be present
2.4b
2.3c
Shrub State 3.0
3.1 (At Risk)
Lahontan sagebrush dominates
Squirreltail and/or bluegrass may increase and dominate understory
Annual forbs may dominate understory
Thurber's needlegrass and other perennial grasses minor component or missing
Annual non-native species present
Pinyon and/or juniper may be present
3.1a
3.2a
3.2
Annual and perennial forbs dominate
Squirreltail and/or bluegrass may increase and be co-dominant with forbs
Lahontan sagebrush minor component or missing
Deep-rooted perennial grasses minor component or missing
Annual non-native species present
T2A
T2B
T3A
Annual State 4.0
4.1
Annual non-native species dominate
Lahontan sagebrush minor component or missing
Thurber's needlegrass and other perennial grasses minor component or missing
4.2a
4.1a
4.2
Rabbitbrush and other sprouting shrubs dominate
Annual non-native species dominate understory
Lahontan sagebrush minor component or missing
T5A
T3B
Tree State 5.0
5.1
Pinyon and/or juniper dominate
Lahontan sagebrush minor component
Perennial bunchgrasses decrease
Annual non-native species present to increasing
Bare ground areas large and connected
5.2 (At Risk)
Pinyon and/or juniper dominate
Lahontan sagebrush minor component to missing
Perennial bunchgrasses minor component to missing
Annual non-native species present under trees
Bare ground areas large and connected
Soil redistribution apparent
5.2a
5.1a

MLRA 26
Group 1
Gravelly Clay 10-12"
026XY050NV
KEY

Reference State 1.0 Community Phase Pathways
1.1a: 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. 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 would create 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.

Current Potential State 2.0 Community Phase Pathways
2.1a: 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.
2.2b: Fall and spring growing season conditions that favors the germination and production of non-native annual grasses. 2.4 may be a transitory plant community.
2.3a: Low severity fire creates sagebrush/grass mosaic, herbivory or combinations. Brush management with minimal soil disturbance reduces sagebrush.
2.3b: High severity fire significantly reduces sagebrush cover leading to early mid-seral community. Brush management with minimal soil disturbance reduces sagebrush.
2.3c: Fall and spring growing season conditions that favors the germination and production of non-native annual grasses. 2.4 may be a transitory plant community.
2.4a: Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.
2.4b: Growing season conditions favoring perennial bunchgrass production and reduced cheatgrass production.

Transition T2A: Time and lack of disturbance and/or inappropriate grazing management (to 3.1).
Transition T2B: Fire or brush management causing severe soil disturbance.

Shrub State 3.0 Community Phase Pathways
3.1a: Fire.
3.2a: Time and lack of disturbance (unlikely/may take many years).

Transition T3A: Catastrophic fire and/or treatments that disturb the existing plant community.
Transition T3B: Time and lack of disturbance allows for maturation of the tree community.

Annual State 4.0 Community Phase Pathways
4.1a: Time and lack of disturbance.
4.2a: Fire.

Tree State 5.0 Community Phase Pathways
5.1a: Time and lack of disturbance allows for maturation of tree community.
5.2a: Tree thinning treatment (typically for fuels management).

Transition T5A: Catastrophic fire.

State 1
Reference State

The Reference State 1.0 is a representative of 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, low 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 1.1
Community Phase 1.1

This community phase is dominated by Lahontan sagebrush and Thurber's needlegrass. Other perennial grasses on site include deep-rooted, cool season bunchgrasses such as Indian ricegrass, Webber's ricegrass, and desert needlegrass. Shallow-rooted, cool season bunchgrasses include Sandberg's bluegrass and squirreltail. A variety of

perennial forbs occur on this site including biscuit root, Hooker's balsamroot, big-headed clover, onion, and phlox. Potential vegetative composition is about 40% grasses, 10% forbs and 50% shrubs and trees. Aprroximate ground cover (basal and crown) is approximately 15 to 25 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	94	161	282
Grass/Grasslike	80	144	240
Forb	20	35	60
Tree	6	10	18
Total	**200**	**350**	**600**

Community 1.2
Thurber's neddlegrass/Lahontan sagebrush/Forbs

This community phase is characteristic of a post-disturbance, early/mid-seral community. Thurber’s needlegrass, squirreltail, and other perennial bunchgrasses dominate. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush and other sprouting shrubs may be sprouting. Perennial forbs may be a significant component for a number of years following fire.

Community 1.3
Lahontan sagebrush/Thurber's needlegrass

Sagebrush increases in the absence of disturbance. Decadent sagebrush dominates the overstory and the deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs and/or from herbivory.

Pathway 1.1a
Community 1.1 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires will typically be low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring may be more severe and reduce sagebrush cover to trace amounts.

Pathway 1.1b
Community 1.1 to 1.3

Time and lack of disturbance such as fire allows for sagebrush to increase and become decadent. Long-term drought, herbivory, or combinations of these will cause a decline in perennial bunchgrasses and fine fuels leading to a reduced fire frequency and allowing sagebrush to dominate the site.

Pathway 1.2a
Community 1.2 to 1.1

Time and lack of disturbance will allow sagebrush to increase.

Pathway 1.3a
Community 1.3 to 1.1

A low severity fire, herbivory or combinations will reduce the sagebrush overstory and create a sagebrush/grass mosaic.

Pathway 1.3b

Community 1.3 to 1.2

Fire will decrease or eliminate the overstory of sagebrush and allow for the perennial bunchgrasses to dominate the site. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community.

State 2
Current Potential State

The Current Potential 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. These non-native species can be highly flammable, and promote fire where historically fire had been infrequent. Negative feedbacks enhance ecosystem resilience and contribute to the stability of the state. These feedbacks include the presence of all structural and functional groups, low 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.

Community 2.1
Lahontan sagebrush-Thurber's needlegrass/annual non-native species

Figure 8. Minor amounts of cheatgrass

Community Phase 2.1 is similar to the Reference State Community Phase 1.1, with the presence of non-native species in trace amounts. Lahontan sagebrush and Thurber's needlegrass dominate the site. Forbs and other shrubs and grasses make up smaller components of this site. There are minor amounts of cheatgrass, annual mustards, medusahead, and/or red-stem filaree.

Community 2.2
Thurber's needlegrass/forbs/annual non-native species

Community Phase 2.2 is characteristic of a post-disturbance, early to mid-seral community where annual non-native species are present. Sagebrush is present in trace amounts; perennial bunchgrasses dominate the site. Depending on fire severity patches of intact sagebrush may remain. Rabbitbrush maybe sprouting or dominant in the community. Perennial forbs may be a significant component for a number of years following fire. Annual non-native species are stable or increasing within the community.

Community 2.3
Lahontan sagebrush (At Risk)

Community Phase 2.3 is at risk of crossing a threshold to another state. Sagebrush dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing, or from both. Rabbitbrush may be a significant component. Squirreltail or Sandberg bluegrass may increase and become dominant. Annual non-native species may be stable or increasing due to lack of competition with perennial bunchgrasses. The site is susceptible to further degradation from grazing, drought, and fire.

Community 2.4
Native bunchgrasses-annual non-native species (At Risk)

Community Phase 2.4 is at risk of crossing into an annual state. Native bunchgrasses dominate; however, annual non-native species such as cheatgrass may be sub or co-dominant in the understory. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. Seeded species may be present. Sagebrush is a minor component. This site is susceptible to further degradation from grazing, drought, and fire.

Pathway 2.1a
Community 2.1 to 2.2

Fire reduces the shrub overstory and allows for perennial bunchgrasses to dominate the site. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring or a change in management favoring an increase in fine fuels may be more severe and reduce sagebrush cover to trace amounts. Annual non-native species are likely to increase after fire.

Pathway 2.1b
Community 2.1 to 2.3

Time and lack of disturbance allows for sagebrush to increase and become decadent. Long-term drought reduces fine fuels and leads to a reduced fire frequency, allowing sagebrush to dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely Sandberg bluegrass may increase in the understory depending on grazing management.

Pathway 2.2a
Community 2.2 to 2.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low sagebrush can take many years.

Pathway 2.2b
Community 2.2 to 2.4

Higher than normal spring precipitation favors annual non-native species such as cheatgrass. Non-native annual species will increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Pathway 2.3a
Community 2.3 to 2.1

A change in grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall or winter grazing may cause mechanical damage and subsequent death to sagebrush, facilitating an increase in the herbaceous understory. Low and Lahontan sagebrush are palatable shrub species and can decrease with increased grazing pressure. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. A low severity fire would decrease the overstory of sagebrush and allow for the understory perennial grasses to increase. Due to low fuel loads in this state, fires will likely be small creating a mosaic pattern. Annual non-native species are present and may increase in the community.

Pathway 2.3b
Community 2.3 to 2.2

Fire eliminates/reduces the overstory of sagebrush and allows for the understory perennial grasses to increase. Fires may be high severity in this community phase due to the dominance of sagebrush resulting in removal of overstory shrub community. Annual non-native species respond well to fire and may increase post burn.

Pathway 2.3c
Community 2.3 to 2.4

Fall, winter, and spring precipitation and temperatures mediate the ability for annual grasses and perennial grasses to germinate and/or survive. Higher than normal spring precipitation creates high annual production of annual grasses (Bradley et al. 2016). Higher than normal spring precipitation favors annual non-native species such as cheatgrass. Non-native annual species increase in production and density throughout the site. Perennial bunchgrasses may also increase in production.

Pathway 2.4a
Community 2.4 to 2.2

Fall, winter, and spring precipitation and temperatures mediate the ability for annual grasses and perennial grasses to germinate and/or survive. Depending on temperatures and precipitation in winter and spring, annual grass production may be reduced in favor of perennial bunchgrasses.

Pathway 2.4b
Community 2.4 to 2.3

Rainfall patterns favoring perennial bunchgrasses. Less than normal spring precipitation followed by higher than normal summer precipitation will increase perennial bunchgrass production.

State 3
Shrub State

The Shrub State is characterized by dominance of Lahontan sagebrush and rabbitbrush. The deep-rooted perennial bunchgrass component is missing and the understory is dominated by bluegrass and/or annual non-native species. Nutrient cycling and energy cycling have been truncated by the lack of deep-rooted bunchgrasses. Bluegrass is pedestalling and bare ground has increased along with surface movement of water.

Community 3.1
Lahontan sagebrush/Squirreltail-bluegrass/annual non-native species

Decadent sagebrush dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses are present in trace amounts and may be absent from the community. Squirreltail, bluegrass species, and/or annual forbs dominate the understory. Bare ground may be significant. Pinyon and/or juniper may be encroaching but are not yet affecting understory vegetation.

Community 3.2
Annual and perennial forbs/Squirreltail-bluegrass

Annual and perennial forbs dominate the site (i.e. redstem stork's bill (*Erodium cicutarium*), Hooker's balsamroot (*Balsamorhiza hookeri*) and tapertip hawksbeard (*Crepis acuminata*)). Squirreltail and/or Sandberg bluegrass may increase and be co-dominant with forbs. Deep-rooted perennial bunchgrasses are a minor component or missing. Annual non-native species may be present but are not dominant. Trace amounts of sagebrush or rabbitbrush may be present.

Pathway 3.1a
Community 3.1 to 3.2

Fire, heavy fall grazing causing mechanical damage to shrubs, and/or brush treatments with minimal soil disturbance, will greatly reduce the overstory shrubs to trace amounts and allow for Sandberg bluegrass to dominate the site.

Pathway 3.2a
Community 3.2 to 3.1

Time and lack of disturbance and/or grazing management that favors the establishment and growth of sagebrush allows the shrub component to recover. The establishment of low and/or Lahontan sagebrush can take many years.

State 4
Annual State

An abiotic threshold has been crossed and state dynamics are driven by fire and time. The herbaceous understory is dominated by annual non-native species such as cheatgrass and mustards. Resiliency has declined and further degradation from fire facilitates a cheatgrass and sprouting shrub plant community. Fire return interval has shortened due to the dominance of cheatgrass in the understory and is a driver in site dynamics.

Community 4.1
Annual non-native species

Annuals nonnative species dominate. Sagebrush and perennial bunchgrasses may still be present in trace amounts. Surface erosion may increase with summer convection storms and would be verified through increased pedestalling of plants, rill formation or extensive water flow paths.

Community 4.2
Sprouting shrubs/annual non-native species

Rabbitbrush is typically the dominant overstory shrub. Sagebrush is a minor component or missing. Annual non-native species dominate the understory.

Pathway 4.1a
Community 4.1 to 4.2

Time and lack of disturbance allows rabbitbrush and/or other sprouting shrubs to recover after fire. Probability of sagebrush establishment is extremely low.

Pathway 4.2a
Community 4.2 to 4.1

Fire reduces/eliminates overstory brush component and allows for annual non-native species to dominate the site.

State 5
Tree State

The Tree State is characterized by a dominance of Utah juniper and/or singleleaf pinyon in the overstory. Big sagebrush and perennial bunchgrasses may still be present, but they are no longer controlling site resources. Soil moisture, soil nutrients and soil organic matter distribution and cycling have been spatially and temporally altered.

Community 5.1
Pinyon-juniper/perennial bunchgrasses

Utah juniper and/or singleleaf pinyon dominates the overstory and site resources. Trees are actively growing with noticeable leader growth. Trace amounts of bunchgrasses may be found under tree canopies with trace amounts of Sandberg bluegrass and forbs in the interspaces. Sagebrush is stressed and dying. Annual non-native species are present under tree canopies. Bare ground interspaces are large and connected.

Community 5.2
Pinyon-juniper

Utah juniper and/or singleleaf pinyon dominates the site and tree leader growth is minimal; annual non-native species may be the dominant understory species and will typically be found under the tree canopies. Trace amounts of sagebrush may be present, however, dead skeletons will be more numerous than living sagebrush. Bunchgrass

may or may not be present. Sandberg bluegrass or mat forming forbs may be present in trace amounts. Bare ground interspaces are large and connected. Soil redistribution is evident.

Pathway 5.1a
Community 5.1 to 5.2

Time and lack of disturbance or management action allows Utah juniper and/or singleleaf pinyon to further mature and dominate site resources.

Pathway 5.2a
Community 5.2 to 5.1

Tree thinning treatment, typically done for fuels management.

Transition T1A
State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as cheatgrass, mustards, redstem stork's bill (*Erodium cicutarium*), or bur buttercup (*Ceratocephala testiculata*).Slow variables: Over time the annual non-native species will increase within the community. 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.

Transition T2A
State 2 to 3

Trigger: To Community Phase 3.1: Inappropriate grazing will decrease or eliminate deep rooted perennial bunchgrasses and increase bare ground and shallow-rooted grazing-tolerant grasses. Shrub growth and establishment is favored under these conditions. To Community Phase 3.2: Severe fire in Community Phase 2.3 will remove sagebrush overstory, decrease perennial bunchgrasses and enhance annual and perennial forb growth. Squirreltail and/or Sandberg bluegrass may increase. Annual non-native species are present. Slow variables: Long term decrease in deep-rooted perennial grass density. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter.

Transition T2B
State 2 to 4

Trigger: Fire or soil disturbing treatment would transition to Community Phase 4.1. Slow variables: Increased production and cover of non-native annual species. Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs changes temporal and spatial nutrient capture and cycling within the community. Increased, continuous fine fuels modify the fire regime by increasing frequency, size and spatial variability of fires.

Transition T3A
State 3 to 4

Trigger: Fire and/or treatments that disturb the soil and existing plant community. Slow variables: Increased seed production (following a wet spring) and cover of annual non-native species. Threshold: Increased, continuous fine fuels modify the fire regime by changing frequency, intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture and impact the temporal and spatial aspects of nutrient cycling and distribution.

Transition T3B
State 3 to 5

Trigger: Absence of disturbance over time allows Utah juniper and/or singleleaf pinyon dominance. Feedbacks and ecological processes: Trees increasingly dominate use of soil water, contributing to reductions in soil water

availability to grasses and shrubs. Overtime, grasses and shrubs are outcompeted. Reduced herbaceous and shrub production slows soil organic matter inputs and increases soil erodibility through loss of cover and root structure. Slow variables: Long-term increase in pinyon pine and/or Utah juniper density. Threshold: Trees overtop sagebrush and out-compete shrubs for water and sunlight. Shrub skeletons exceed live shrubs in number. There is minimal recruitment of new shrub cohorts.

Transition T5A
State 5 to 4

Trigger: Catastrophic fire causing a stand replacement event will transition Annual State 4.0. Inappropriate tree removal practices with soil disturbance will cause a transition to the Annual State 4. Slow variables: Increased production and cover of non-native annual species under tree canopies. Threshold: Closed tree canopy with non-native annual species dominant in the understory changes the intensity, size and spatial variability of fires. Changes in plant community composition and spatial variability of vegetation due to the loss of perennial bunchgrasses and sagebrush truncate energy capture and impact nutrient cycling and distribution.

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**			95–176	
	Thurber's needlegrass	ACTH7	*Achnatherum thurberianum*	70–123	–
	Sandberg bluegrass	POSE	*Poa secunda*	18–35	–
	squirreltail	ELEL5	*Elymus elymoides*	7–18	–
2	**Secondary Perennial Grasses**			7–18	
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	2–11	–
	desert needlegrass	ACSP12	*Achnatherum speciosum*	2–11	–
	Webber needlegrass	ACWE3	*Achnatherum webberi*	2–11	–
Forb					
3	**Perennial**			35–53	
	twinleaf onion	ALAN	*Allium anceps*	2–11	–
	aster	ASTER	*Aster*	2–11	–
	Hooker's balsamroot	BAHO	*Balsamorhiza hookeri*	2–11	–
	desertparsley	LOMAT	*Lomatium*	2–11	–
	phlox	PHLOX	*Phlox*	2–11	–
	largehead clover	TRMA3	*Trifolium macrocephalum*	2–11	–
Shrub/Vine					
4	**Primary Shrubs**			105–158	
	little sagebrush	ARARL3	*Artemisia arbuscula ssp. longicaulis*	105–158	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	2–11	–
	spiny hopsage	GRSP	*Grayia spinosa*	2–11	–
5	**Secondary Shrubs**			18–53	
	fourwing saltbush	ATCA2	*Atriplex canescens*	4–11	–
	yellow rabbitbrush	CHVI8	*Chrysothamnus viscidiflorus*	4–11	–
	mormon tea	EPVI	*Ephedra viridis*	4–11	–
	spiny greasebush	GLSPA	*Glossopetalon spinescens var. aridum*	4–11	–
	spiny hopsage	GRSP	*Grayia spinosa*	4–11	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	4–11	–
	antelope bitterbrush	PUTR2	*Purshia tridentata*	4–11	–
	littleleaf horsebrush	TEGL	*Tetradymia glabrata*	4–11	–
Tree					
6	**Evergreen**			4–22	
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	2–11	–
	Utah juniper	JUOS	*Juniperus osteosperma*	2–11	–
	singleleaf pinyon	PIMO	*Pinus monophylla*	2–11	–

Animal community

Livestock Interpretation:
This site is suitable for livestock grazing. Grazing management should focus on maintaining resilient plant communities. Grazing management considerations include intensity, duration and timing of grazing. Needlegrass species begin growth early in the year and remain green throughout a relatively long growing season.

This pattern of development enables animals to use needlegrass when many other grasses are unavailable. Cattle prefer needlegrasses in early spring before fruits have developed as it becomes less palatable when mature. Needlegrasses are grazed in the fall only if the fruits are softened by rain.
Domestic sheep and to a much lesser degree cattle consume Lahontan sagebrush, particularly during the spring, fall and winter.

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 Interpretation:
This site provides valuable wildlife habitat for several species.
Lahonton sagebrush is considered a valuable browse plant for wild ungulates during the spring, fall and winter months. In some areas it is of little value in winter due to heavy snow. Lahontan sagebrush is an important food source for sage grouse throughout the year, especially between October and April. Mule deer utilize and sometimes prefer low sagebrush, particularly in winter and early spring. Sagebrush-grassland communities provide critical sage-grouse breeding and nesting habitats. Sagebrush is a crucial component of their diet year-round, and sage-grouse select sagebrush almost exclusively for cover. Leks are often located on dwarf sagebrush sites, including Lahontan sage sites. Thurber's needlegrass is also an important forage for several wildlife species. Squirreltail is a dietary component of several wildlife species, including pronghorn, mule deer, jackrabbits, ground squirreltails, and cottontails.

Hydrological functions

Runoff is very high. Permeability is moderate. Rills and water flow patterns are none to rare. A few can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Pedestals are none to rare with occurrence typically limited to area within water flow patterns. Frost heaving of shallow rooted plants should not be considered as normal condition. Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Thurber's needlegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.

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 has potential for upland and big game hunting.

Other information

Squirreltail has many qualities to effectively compete with cheatgrass. Squirreltail is a short-lived perennial grass which can act as an early-seral species following fire. It's ability to germinate in the late fall and early spring at a wide temperature range allows it to compete with cheatgrass which also germinated in late fall/early spring. Some studies show squirreltail is capable of establishing in medusahead stands.

Type locality

Location 1: Storey County, NV	
Township/Range/Section	T18N R21E S9
General legal description	Approximately 9 miles north of Virginia City. Virginia Range, Storey County, Nevada. This site also occurs in Washoe County, Nevada.

Other references

Fire Effects Information System (Online; http://www.fs.fed.us/database/feis/plants/).

USDA-NRCS Plants Database (Online; http://www.plants.usda.gov).

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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)	GK BRACKLEY/P.NOVAK-ECHENIQUE
Contact for lead author	State Rangeland Management Specialist
Date	02/21/2007
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Rills are none to rare. A few can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt. Rills will be short (< 1m), narrow and not connected. They will begin to heal during the next growing season.

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2. **Presence of water flow patterns:** Water flow patterns are rare but can be expected in areas subjected to summer convection storms or rapid snowmelt. These will be short (<2 m), meandering and interrupted by plant bases and rock fragments.

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3. **Number and height of erosional pedestals or terracettes:** Pedestals are rare with occurrence typically limited to area within water flow patterns. Frost heaving of shallow rooted plants should not be considered as 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 15 to 25% 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) is expected to move the 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.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 2 to 3 in the interspaces and 3 to 5 under canopy.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is typically subangular blocky or fine granular. Soil surface colors are browns or grayish browns and the soils are typified by an ochric epipedon and an argillic horizon. Organic carbon of the surface 2 to 3 inches is typically 1 to 1.5 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.

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

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

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Reference Plant Community: Deep-rooted, cool season, perennial bunchgrasses = Lahontan sagebrush. (By above ground production)

    Sub-dominant: Associated shrubs>shallow-rooted, cool season, perennial bunchgrasses>deep-rooted, cool season, perennial forbs=fibrous, shallow-rooted, cool season, annual and perennial forbs. (By above ground production)

    Other: Evergreen trees

    Additional: With an extended fire return interval, the shrub component will increase and the herbaceous component will decrease.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs are common and standing dead shrub canopy material may be as much as 25% of total woody canopy; some of the mature bunchgrasses (<20%) have dead centers.

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (20-35%) and depth (<1/4 in.)

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-**

production): For normal or average growing season, ± 350 lbs/ac; Spring moisture significantly affects total production. Favorable years ± 600 lbs/ac and unfavorable years ± 200 lbs/ac.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Potential invaders include cheatgrass, medusahead, Russian thistle, and annual mustards. Singleleaf pinyon and Utah juniper may increase on this site.

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