Ecological site R026XY032NV
DEEP SODIC FAN

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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 Semiarid Fans and Basins LRU includes basins, alluvial fans and adjacent hill slopes immediately east of the Sierra Nevada mountain range and are affected by its climate or have its granitic substrate. Elevations range from 1355 to 1920 meters and slopes range from 0 to 30 percent, with a median value of 6 percent. Frost free days range from 121 to 170.

Ecological site concept

Fourwing saltbush (Atriplex canescens) is the dominant shrub on the Deep Sodic Fan site, with basin wildrye and Indian ricegrass in the understory. The Deep Sodic Fan site occurs on inset fans and lower piedmont slops at a elevation from 4,300 to 5,000 ft. The soils in this site are formed in alluvium derived from mixed rock and tend to be very deep and well drained.

Associated sites

R026XY016NV	**LOAMY 8-10 P.Z.**
R026XY020NV	**SANDY 8-10 P.Z.**

Similar sites

R026XY004NV	**SALINE BOTTOM** SAVE4 dominant shrub
R026XY012NV	**DRY FLOODPLAIN 8-10 P.Z.** ARTR2 dominant shrub
R026XY030NV	**LOAMY BOTTOM 8-12 P.Z.** ARTRT dominant shrub; more productive site

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Atriplex canescens* (2) *Atriplex torreyi*
Herbaceous	(1) *Leymus cinereus*

Physiographic features

This site occurs on alluvial fans. Slopes range from 0 to 2 percent. Elevations are 4300 to 5000 feet.

Table 2. Representative physiographic features

Landforms	(1) Alluvial fan
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	Rare
Ponding frequency	None
Elevation	4,300–5,000 ft
Slope	0–2%
Water table depth	48–72 in
Aspect	Aspect is not a significant factor

Climatic features

The climate associated with this site is semiarid, characterized by cold, moist winters and warm, dry summers. Average annual precipitation is 8 to 10 inches. Mean annual air temperature is 48 to 52 degrees F. The average growing season is about 90 to 110 days.

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)	8-10 in
Frost-free period (average)	100 days
Freeze-free period (average)	
Precipitation total (average)	9 in

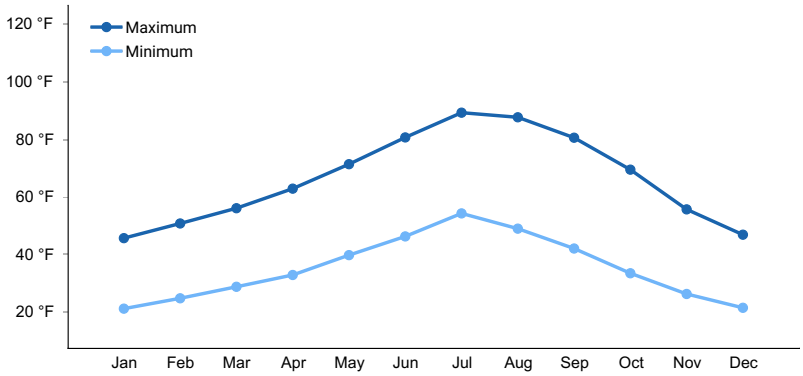


Figure 1. Monthly average minimum and maximum temperature

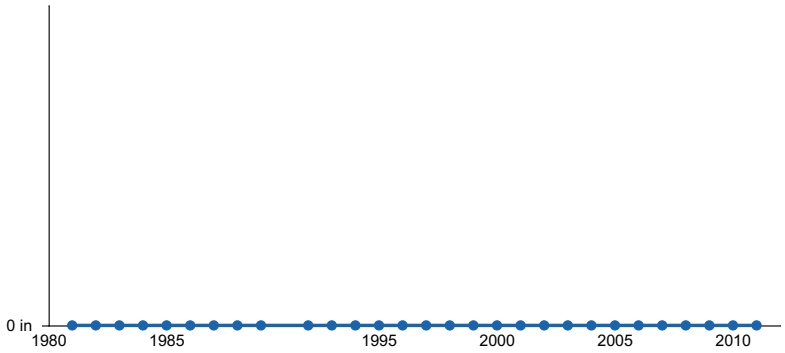


Figure 2. Annual precipitation pattern

Influencing water features

There are no influencing water features associated with this site.

Soil features

The soils are formed in alluvium derived from mixed rock. They are very deep and well drained. The soils are characterized by an ochric epipedon and an argillic horizon. Reaction is neutral to slightly alkaline in the control section. The soil moisture regime is aridic bordering on xeric. The soil series associated with this site include Turria, a fine-loamy, mixed, superactive, mesic Xeric Haplargid.

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Loam (2) Clay loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately slow
Soil depth	72–84 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6.9–7.9 in
Calcium carbonate equivalent (0-40in)	0%
Electrical conductivity (0-40in)	0 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

As ecological condition declines, perennial grasses and fourwing saltbush decrease. Species most likely to invade

this site are annuals.

Fire Ecology:
Grassland communities with a basin wildrye component historically experienced mostly infrequent to frequent stand replacing fires. Grassland vegetation types experienced both short fire intervals of less than 35 years as well as intervals ranging from 35 to 100 years, depending on climate and ignition sources.
Basin wildrye is top-killed by fire. Older basin wildrye plants with large proportions of dead material within the perennial crown can be expected to show higher mortality due to fire than younger plants having little debris. Basin wildrye is generally tolerant of fire but may be damaged by early season fire combined with dry soil conditions.
Fourwing saltbush is most common under regimes of infrequent fire and moderate browsing. Fire top-kills or kills fourwing saltbush, depending upon ecotype. Fourwing saltbush may sprout after top-kill.

State and Transition Model Narrative for Group 11
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 11. Additional sites included in the group are R026XY012NV and R026XY034NV.

Reference State 1.0:
The Reference State 1.0 is a representation 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 Phase 1.1:
Basin wildrye and basin big sagebrush dominate the plant community. Forbs and other grasses make up smaller components.

Community Phase Pathway 1.1a, from phase 1.1 to 1.2:
Fire would decrease or eliminate the overstory of sagebrush and allow the perennial bunchgrasses and forbs to dominate the site. Fires would typically be small and patchy due to low or moist fuel loads.

Community Phase Pathway 1.1b, from phase 1.1 to 1.3:
Time and lack of disturbance such as fire allows sagebrush to increase and become dominant. Long-term drought, herbivory, or combinations of these would cause a decline in basin wildrye and fine fuels, leading to a reduced fire frequency allowing big sagebrush to dominate the site.

Community Phase 1.2:
This community phase is characteristic of a post-disturbance, early- to mid-seral community. Basin wildrye, western wheatgrass, and other perennial bunchgrasses dominate. Depending on fire severity or intensity of Aroga moth infestation, patches of intact sagebrush may remain. Rabbitbrush may be sprouting and may be a significant component of the plant community.

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:
Big sagebrush dominates in the absence of disturbance. Mature sagebrush may be decadent. The deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs and/or from herbivory. Basin wildrye is a minor component.

Community Phase Pathway 1.3a, from phase 1.3 to 1.2:
Fire would decrease or eliminate the overstory of sagebrush and allow the perennial bunchgrasses to dominate the site. Fires would typically be low severity resulting in a mosaic pattern due to low fine 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. A severe infestation of Aroga moth could also cause a large decrease in

sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs.

Community Phase Pathway 1.3b, from phase 1.3 to 1.1:
Low severity fire, Aroga moth, or a combination of both will reduce some of the sagebrush overstory and allow grass species to increase.

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.
Slow variables: Over time, the annual non-native plants 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.

Current Potential State 2.0:
This state is similar to the Reference State 1.0 with the addition of one community phase. 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, 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. 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. Seeded species may be present in all phases of this group. This site was not seen in a seeded state, however crested wheatgrass was found, likely from nearby seedings.

Community Phase 2.1:
This community phase is similar to Reference State Community Phase 1.1, with the presence of non-native annual species present. Basin wildrye and basin big sagebrush dominate the plant community. Forbs and other grasses make up smaller components.

Community Phase Pathway 2.1a, from phase 2.1 to 2.2:
Fire would decrease or eliminate the overstory of sagebrush and allow the perennial bunchgrasses and forbs to dominate the site. Fires would typically be small and patchy due to low or moist fuel loads.

Community Phase Pathway 2.1b, from phase 2.1 to 2.3:
Time without disturbance, long-term drought, grazing management that favors shrubs, or combinations of these would allow the sagebrush overstory to increase and dominate the site.
Community Phase 2.2:
This community phase is characteristic of a post-disturbance, early- to mid-seral community. Basin wildrye, western wheatgrass, and other perennial bunchgrasses dominate. Depending on fire severity or intensity of Aroga moth infestation, patches of intact sagebrush may remain. Rabbitbrush may be sprouting and may be a significant component of the plant community. Annual non-native species are stable or increasing within the community.

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

Community Phase Pathway 2.2b, from phase 2.2. to 2.4:
Fall and spring growing conditions that favor the germination and production of non-native, annual grasses cause these species to codominate with bunchgrasses in the understory. This pathway typically occurs three to five years post fire and phase 2.4 may be a transitory plant community.

Community Phase 2.3:
Big sagebrush dominates in the absence of disturbance. Mature sagebrush may be decadent. The deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs and/or from herbivory. Basin wildrye is a minor component. Rabbitbrush may be a significant component. Annual non-natives species may

be stable or increasing due to lack of competition with perennial bunchgrasses. This site is susceptible to further degradation from grazing, drought, and fire.

Community Phase Pathway 2.3a, from phase 2.3 to 2.2:
Fire would decrease or eliminate the overstory of sagebrush and allow the perennial bunchgrasses to dominate the site. Fires would typically be low severity resulting in a mosaic pattern due to low fine 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. A severe infestation of Aroga moth could also cause a large decrease in sagebrush within the community, giving a competitive advantage to the perennial grasses and forbs. Annual non-native species respond well to fire and may increase post-burn. Brush management with minimal soil disturbance and/or late-fall/winter grazing that causes mechanical damage to sagebrush may also cause this change.

Community Phase Pathway 2.3b, from phase 2.3 to 2.1:
A change in grazing management that decreases shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall/winter grazing will reduce sagebrush and increase the herbaceous understory. A moderate infestation of Aroga moth may reduce some sagebrush overstory and allow perennial grasses to increase in the community. Brush treatments with minimal soil disturbance will also decrease sagebrush and release the perennial understory. Annual non-native species are present in the community.

Community Phase Pathway 2.3c, from phase 2.3 to 2.4:
Fall and spring growing season conditions that favor the germination and production of non-native annual grasses cause these species to become dominant. This phase may be a transitory plant community.

Community Phase 2.4:
This community is at risk of crossing to an annual state. Native bunchgrasses and forbs still comprise 50% or more of the understory annual production, however, non-native annual grasses are nearly codominant. If this site originated from phase 2.3 there may be significant shrub cover as well. Annual production and abundance of these annuals may increase drastically in years with heavy spring precipitation. Seeded species may be present. This site is susceptible to further degradation from grazing, drought and fire.

Community Phase Pathway 2.4a, from phase 2.4 to 2.3:
Growing season conditions that favor perennial bunchgrass production and reduce cheatgrass production.

Community Phase Pathway 2.4b, from phase 2.4 to 2.2:
Growing season conditions that favor perennial bunchgrass production and reduce cheatgrass production. May occur as site recovers from fire.

T2A: Transition from Current Potential State 2.0 to Shrub State 3.0:
Trigger: Inappropriate, long-term grazing of perennial bunchgrasses during growing season favors shrubs and initiates the transition to Phase 3.1 from Phase 2.3. May be exacerbated by a lowered seasonal water table. Fire causes a transition to Community Phase 3.2.
Slow variables: Long term reduction in deep-rooted perennial grass density results in a decrease in organic matter inputs and subsequent soil water decline.
Threshold: Loss of deep-rooted perennial bunchgrasses spatially and temporally changes nutrient cycling and redistribution, and reduces soil organic matter. Loss of high seasonal water table prevents regeneration of basin wildrye.

T2B: Transition from Current Potential State 2.0 to Annual State 4.0:
Trigger: Severe fire or multiple fires, long term inappropriate grazing, and/or soil disturbing treatments such as plowing.
Slow variables: Increased production and cover of non-native annual species.
Threshold: Loss of deep-rooted perennial bunchgrasses and shrubs truncates, spatially and temporally, nutrient capture and cycling within the community. Increased, continuous fine fuels from annual non-native plants modify the fire regime by changing intensity, size and spatial variability of fires.

Shrub State 3.0:
This state is a product of many years of heavy grazing during time periods harmful to perennial bunchgrasses. Sagebrush dominates the overstory and rabbitbrush may be a significant component. Sagebrush cover exceeds site

concept and may be decadent, reflecting stand maturity and lack of seedling establishment due to competition with mature plants. The shrub overstory dominates site resources such that soil water, nutrient capture, nutrient cycling and soil organic matter are temporally and spatially redistributed.

Community Phase 3.1:
Sagebrush and/or rabbitbrush dominates the overstory and other shrubs may be a significant component. Perennial bunchgrasses are a minor component. Annual non-native species are present to increasing. Understory may be sparse, with bare ground increasing.

Community Phase Pathway 3.1a, from phase 3.1 to 3.2:
Fire or heavy fall grazing reduces or eliminates the overstory of sagebrush to trace amounts and allows bunchgrasses to dominate the site. Brush treatments causing minimal soil disturbance causing mechanical damage to shrubs may also cause this change.

Community Phase 3.2:
Rabbitbrush dominates the overstory. Annual non-native species may be present in the understory but are not dominant. Perennial bunchgrasses may be a minor component. Bare ground may be increasing.

Community Phase Pathway 3.2a, from phase 3.2 to 3.1:
Time and lack of disturbance over time and/or grazing management that favors the establishment and growth of sagebrush allows sagebrush to recover.

T3A: Transition from Shrub State 3.0 to Annual State 4.0:
Trigger: Fire or inappropriate grazing management can eliminate the perennial community and transition to community phase 4.1 or 4.2. This may be coupled with gullying and loss of seasonally high water table that maintains basin wildrye.
Slow variable: Increased seed production and cover of annual non-native species.
Threshold: Increased, continuous fine fuels modify the fire regime by changing 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 nutrient cycling and distribution.

R3A: Restoration from Shrub State 3.0 to Current Potential State 2.0:
Brush management coupled with seeding of desired perennial bunchgrass. Concurrent herbicide treatment may be needed to avoid an increase in annual invasive species. If changes in vegetation were caused by altered hydrology, restoration of associated channels will be needed to achieve success.

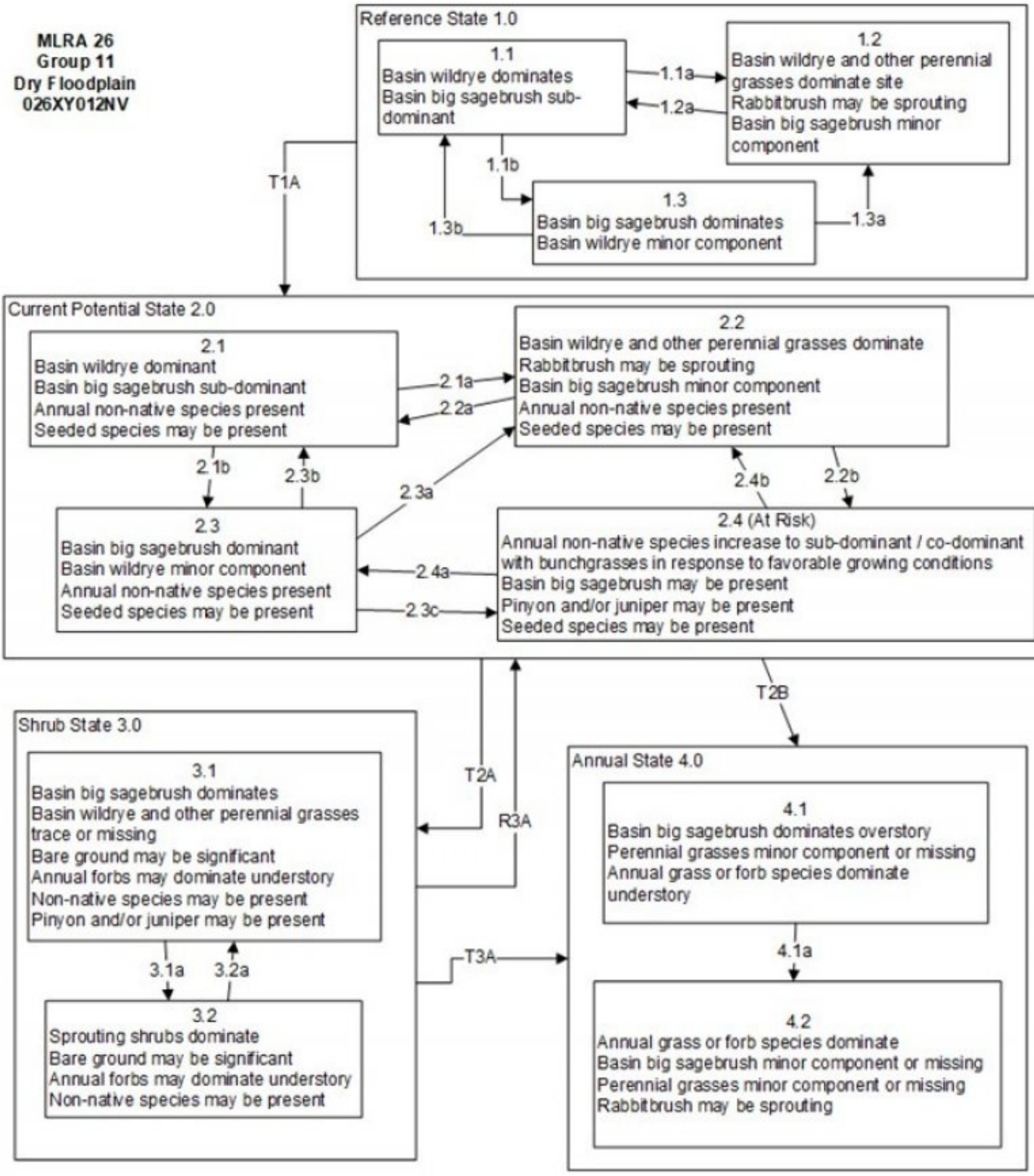
Annual State 4.0:
An abiotic threshold has been crossed and state dynamics are driven by fire and time. The herbaceous understory is dominated by annual non-native species such as cheatgrass and mustards. Resiliency has declined and further degradation from fire facilitates a cheatgrass and sprouting 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 Phase 4.1:
Big sagebrush dominates the overstory, with non-native annual grasses and forb species in the understory. Perennial grasses are a minor component and may be missing entirely.

Community Phase pathway 4.1a, from phase 4.1 to 4.2:
Fire and/or a failed brush treatment or seeding eliminates the shrub overstory. Annuals such as cheatgrass increase after fire and dominate the site.

Community Phase 4.2:
Annual non-native plants such as cheatgrass dominate the site. This phase may have seeded species present if resulting from a failed seeding attempt. Perennial bunchgrasses and forbs may still be present in trace amounts. Rabbitbrush may be sprouting Surface erosion may increase with summer convection storms; increased pedestalling of plants, rill formation, or extensive water flow paths identify these events.

State and transition model


MLRA 26
Group 11
Dry Floodplain
026XY012NV
Reference State 1.0
1.1
Basin wildrye dominates
Basin big sagebrush sub-dominant
1.2
Basin wildrye and other perennial grasses dominate site
Rabbitbrush may be sprouting
Basin big sagebrush minor component
1.3
Basin big sagebrush dominates
Basin wildrye minor component
1.1a
1.2a
1.1b
1.3a
1.3b
T1A
Current Potential State 2.0
2.1
Basin wildrye dominant
Basin big sagebrush sub-dominant
Annual non-native species present
Seeded species may be present
2.2
Basin wildrye and other perennial grasses dominate
Rabbitbrush may be sprouting
Basin big sagebrush minor component
Annual non-native species present
Seeded species may be present
2.1a
2.2a
2.1b
2.3b
2.3a
2.4b
2.2b
2.3
Basin big sagebrush dominant
Basin wildrye minor component
Annual non-native species present
Seeded species may be present
2.4 (At Risk)
Annual non-native species increase to sub-dominant / co-dominant with bunchgrasses in response to favorable growing conditions
Basin big sagebrush may be present
Pinyon and/or juniper may be present
Seeded species may be present
2.4a
2.3c
T2B
Shrub State 3.0
3.1
Basin big sagebrush dominates
Basin wildrye and other perennial grasses trace or missing
Bare ground may be significant
Annual forbs may dominate understory
Non-native species may be present
Pinyon and/or juniper may be present
3.1a
3.2a
3.2
Sprouting shrubs dominate
Bare ground may be significant
Annual forbs may dominate understory
Non-native species may be present
T2A
R3A
T3A
Annual State 4.0
4.1
Basin big sagebrush dominates overstory
Perennial grasses minor component or missing
Annual grass or forb species dominate understory
4.1a
4.2
Annual grass or forb species dominate
Basin big sagebrush minor component or missing
Perennial grasses minor component or missing
Rabbitbrush may be sprouting

026XY012NV
KEY

Reference State 1.0 Community Phase Pathways.
1.1a: Fire significantly reduces sagebrush cover and leads to early/mid-seral community, dominated by grasses and forbs. Aroga moth may cause a large die-off in sagebrush resulting in a mosaic of grass and sagebrush.
1.1b: Time and lack of disturbance such as fire. Excessive herbivory, chronic drought or combinations may also decrease perennial understory.
1.2a: Time and lack of disturbance allows for shrub regeneration.
1.3a: Fire significantly reduces sagebrush cover and leads to early/mid-seral community, dominated by grasses and forbs. Aroga moth may cause a large die-off in sagebrush resulting in a mosaic of grass and sagebrush.
1.3b: A low severity fire, Aroga moth, or combinations will reduce some of the sagebrush overstory and allow grass species to increase.

Transition T1A: Introduction of non-native species such as cheatgrass.

Current Potential State 2.0 Community Phase Pathways.
2.1a: Low severity fire creates grass/sagebrush mosaic; high severity fire significantly reduces sagebrush and leads to early/mid-seral community, dominated by grasses and forbs: non-native annual species present.
2.1b: Time and lack of disturbance such as fire. Inappropriate grazing management may also reduce perennial understory.
2.2a: Time and lack of disturbance allows for shrub reestablishment.
2.2b: Fall and spring growing conditions that favors the germination and production of non-native, annual grasses. Pathway typically occurs 3 to 5 years post-fire and 2.4 may be a transitory plant community.
2.3a: High severity fire significantly reduces sagebrush cover and allows grass species to dominate.
2.3b: A low severity fire, Aroga moth, or combinations will reduce some of the sagebrush overstory and allow grass species to increase.
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: Hydrologic alteration (lowering of water table i.e. gullying of associated channel), inappropriate grazing management or combinations of these lead to 3.1. Fire can lead to phase 3.2.
Transition T2B: Inappropriate grazing management in the presence of non-native annual species leads to 4.1. Fire in the presence of annual species leads to 4.2.

Shrub State 3.0 Community Phase Pathways.
3.1a: Fire and/or brush management with minimal soil disturbance.
3.2a: Time and lack of disturbance (not likely to occur).

Transition T3A: Continual inappropriate grazing management and/or hydrologic alteration (i.e. gullying of associated channel) (4.1). Severe fire, and/or failed brush management and seeding (4.2).

Restoration R3A: Brush management and seeding of desired perennial bunchgrass, may be coupled with restoration of channel (2.2).

Annual State 4.0 Community Phase Pathways.
4.1a: Severe fire or failed brush treatment and seeding.

State 1
Reference State

Community 1.1
Reference Plant Community

The reference plant community is dominated by basin wildrye, fourwing saltbush and Torrey's quailbush. Potential vegetative composition is about 65% grasses, 5% forbs and 30% shrubs.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	585	780	975
Shrub/Vine	270	360	450
Forb	45	60	75
Total	**900**	**1200**	**1500**

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**			564–840	
	basin wildrye	LECI4	*Leymus cinereus*	420–540	–
	western wheatgrass	PASM	*Pascopyrum smithii*	60–120	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	60–120	–
	squirreltail	ELEL5	*Elymus elymoides*	24–60	–
2	**Secondary Perennial Grasses**			60–120	
	saltgrass	DISP	*Distichlis spicata*	6–36	–
	Sandberg bluegrass	POSE	*Poa secunda*	6–36	–
Forb					
3	**Perennial**			60–120	
	basin wildrye	LECI4	*Leymus cinereus*	420–540	–
Shrub/Vine					
4	**Primary Shrubs**			180–360	
	fourwing saltbush	ATCA2	*Atriplex canescens*	120–240	–
	Torrey's saltbush	ATTO	*Atriplex torreyi*	60–120	–
	western wheatgrass	PASM	*Pascopyrum smithii*	60–120	–
5	**Secondary Shrubs**			60–120	
	big sagebrush	ARTR2	*Artemisia tridentata*	12–36	–
	Wyoming big sagebrush	ARTRW8	*Artemisia tridentata ssp. wyomingensis*	12–36	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	12–36	–
	horsebrush	TETRA3	*Tetradymia*	12–36	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Grazing management should be keyed to perennial grass and palatable shrub production. 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. Fourwing saltbush is one of the most palatable shrubs in the West. Its protein, fat, and carbohydrate levels are comparable to alfalfa. It provides nutritious forage for all classes of livestock. Palatability is rated as good for domestic sheep and domestic goats; fair for cattle; fair to good for horses in winter, poor for horses in other seasons.

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:
Fourwing saltbush is one of the most palatable shrubs in the West. Its protein, fat, and carbohydrate levels are comparable to alfalfa. It provides nutritious forage for all classes of livestock. Palatability is rated as good for domestic sheep and domestic goats; fair for cattle; fair to good for horses in winter, poor for horses in other seasons. Leaves and seeds of Torrey’s quailbush are eaten by many species. Mule deer and pronghorn browse the leaves. Small mammals such as rabbits and rodents have been reported to eat Torrey’s quailbush. Dense stands of Torrey’s quailbush provide excellent cover for several 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 low to medium. Permeability is moderately slow.

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

Fourwing saltbush is traditionally important to Native Americans. They ground the seeds for flour. The leaves, placed on coals, impart a salty flavor to corn and other roasted food. Top-growth produces a yellow dye. Young leaves and shoots were used to dye wool and other materials. The roots and flowers were ground to soothe insect bites. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

Other information

Fourwing saltbush is widely used in rangeland and riparian improvement and reclamation projects, including burned area recovery. It is probably the most widely used shrub for restoration of winter ranges and mined land reclamation. 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: Carson City County, NV	
General legal description	This site also occurs in Douglas, Lyon Mineral, Storey, and Washoe Counties.

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).

Contributors

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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)	
Contact for lead author	
Date	05/11/2025
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

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

17. **Perennial plant reproductive capability:**