

Ecological site R024XY003NV SODIC TERRACE 6-8 P.Z.

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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): 024X–Humboldt Basin and Range Area

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Major land resource area (MLRA) 24, the Humboldt Area, covers an area of approximately 8,115,200 acres (12,680 sq. mi.). MLRA 24 is in the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. Elevations predominantly range from 3,950 to 5,900 feet (1,205 to 1,800 meters). The elevations of some mountain peaks are more than 8,850 feet (2,700 meters).

A series of widely spaced north-south trending mountain ranges are separated by broad valleys filled with alluvium washed in from adjacent mountain ranges. Most valleys are drained by tributaries to the Humboldt River. Playas, however, are in lower elevation valleys with closed drainage systems. Isolated ranges are dissected, uplifted fault-block mountains.

Geology is comprised of Mesozoic and Paleozoic volcanic rock and marine and continental sediments. Young andesite and basalt flows (6 to 17 million years old) are at the margins of the mountains.

Dominant soil orders include Aridisols, Entisols, Inceptisols and Mollisols. Soils of the area are generally characterized by a mesic soil temperature regime, an aridic soil moisture regime and mixed geology. They are generally well drained, loamy and very deep.

75 percent of MLRA 24 is federally owned. The remainder is primarily used for farming, ranching and mining. Irrigated land comprises 3 percent of the area; most of the irrigation

water is from surface water sources, such as the Humboldt River and Rye Patch Reservoir.

Annual precipitation typically ranges from 6 to 12 inches (15 to 30 cm) for most of the area. In the mountains however the precipitation may be up to 40 inches (101 cm). Most of the annual precipitation is from snow in the winter. In the spring and fall, rainfall occurs as high- intensity, convective thunderstorms.

Nevada is 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. The warm moist air from the Pacific Ocean ascends the western slopes of the Sierra Range, the air cools, condenses and 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. The result is the lowlands of Nevada are largely desert or steppes.

Ecological site concept

This ecological site is on lake plains and basin floor remnants. Soils are very deep, well drained and formed in a thin layer of loess and alluvium derived from mixed parent material influenced by volcanic ash over lacustrine sediments. Soils are characterized by a very low infiltration, an ochric epipedon, moderate to very strong alkalinity, and SAR greater than 45 in the upper profile. The soil temperature regime is mesic, and the soil moisture regime is typic aridic.

The reference state is characterized by the mixing of shadscale saltbrush (ATCO) and black greasewood (SAVE4) and approximate canopy cover is less than 15 percent. This site has similar species composition and does not compete based on soil characteristic or abiotic factors with Sodic Terrace 8-10"PZ R024XY022NV, Sodic Terrace 6-10"PZ R024XY014OR, or Sodic Fan 6- 10"PZ R024XY113OR.

Associated sites

R024XY007NV	SALINE BOTTOM The soil profile is characterized by an ochric epipedon, strong to moderate salinity throughout and a high-water table between 27 to 39 inches (70 to 100 cm) at some time during the year. Sodicity (SAR) is 13-99 in the upper 20 inches (50cm) and decreases with depth. Dominant plant species are Black greasewood (SAVE4) and Basin wildrye (LECI4)
R024XY011NV	SODIC FLAT 6-8 P.Z. The soil profile is characterized by an ochric epideon, a pH greater than 8.0 throughout, sodicity (SAR) greater than 30 and a water table between 35 to 59 inches (90 to 150 cm) at some point during the spring. Dominant plant species are Black greasewood (SAVE4), Basin wildrye (LECI4), and saltgrass (DISP).

Similar sites

R024XY060NV	SHALLOW SILTY 8-10 P.Z. Soils are dominated by fine loams and fine sands and have a strong vesicular horizon and very platy structure in the surface horizon. Shadscale (ATCO) dominant plant; bud sagebrush (ARSP5) and black greasewood (SAVE4) rare.
R024XY008NV	SODIC FLAT 8-10 P.Z. This site presents crusting & baking of the surface layer upon drying, inhibiting water infiltration and seedling emergence. High salt concentrations reduce seed viability, germination and the available water capacity of these soils. Black greasewood (SAVE4) dominant shrub; Shadscale (ATCO) minor shrub; Basin wildrye (LECI4) dominant grass.
R024XY011NV	SODIC FLAT 6-8 P.Z. The upper portion of these soils is strongly salt and sodium affected due to capillary movement of dissolved salts upward from the ground water. Effective rooting depths are limited by a fluctuating water table. Black greasewood (SAVE4) dominant shrub; Shadscale (ATCO) minor shrub.
R024XY067NV	SHALLOW SILTY 5-8 P.Z. This site occurs on lake plains. Soils are very deep, well drained and formed in alluvium. The soil profile is characterized by an ochric epipedon, continuous weak cementation within 20 inches (51 cm), and coarse silty particle size control section. Shadscale (ATCO) dominant shrub; less productive site.
R024XY022NV	SODIC TERRACE 8-10 P.Z. The plant community is characterized by the mixing of shadscale (ATCO), black greasewood (SAVE4), and big sagebrush (ARTR2). More productive site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Atriplex confertifolia</i> (2) <i>Sarcobatus vermiculatus</i>
Herbaceous	(1) <i>Elymus elymoides</i>

Physiographic features

This site is on lake plains and basin floor remnants. Slopes range from 0 to 4 percent. Elevations are 3,600 to 6,800 feet (1,097 to 2,073 meters).

Table 2. Representative physiographic features

Landforms	(1) Basin floor (2) Basin-floor remnant (3) Lake plain
Runoff class	Low to high
Flooding frequency	None

Ponding frequency	None
Elevation	1,097–2,073 m
Slope	0–4%
Water table depth	102–183 cm
Aspect	Aspect is not a significant factor

Climatic features

The climate on this site is semiarid, characterized by cold, moist winters, and hot, dry summers. Average annual precipitation ranges from 6 to 9 inches (15 to 23 cm) with most of the precipitation falling from winter to early spring. Mean annual air temperatures range from 45 to 53 degrees F. The average growing season is approximately 90 to 130 days.

Table 3. Representative climatic features

Frost-free period (average)	110 days
Freeze-free period (average)	
Precipitation total (average)	152 mm

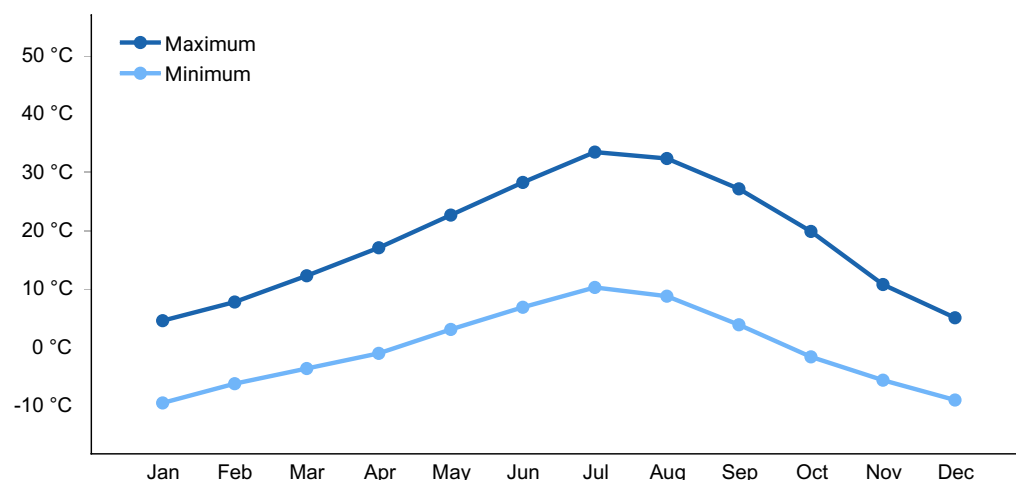


Figure 1. Monthly average minimum and maximum temperature

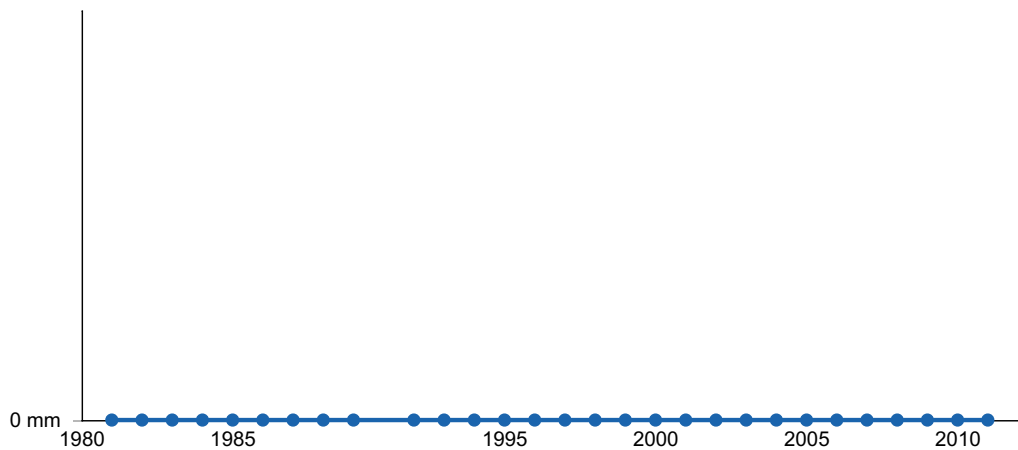


Figure 2. Annual precipitation pattern

Influencing water features

This site is not associated with influencing water features.

Soil features

The soils associated with this site are very deep, well drained and formed in a thin layer of loess and alluvium derived from mixed rocks influenced by volcanic ash over lacustrine sediments. The soil profile is characterized by a surface horizon with a platy soil structure, moderate to strong alkalinity and a SAR greater than 45.

Soil texture is silt loam throughout. Many of these soils formed with poorly drained conditions. Conditions are not currently as wet. Relict redox concentrations are below 30cm. The surface horizon is violently effervescent and will normally crust and bake upon drying inhibiting both water infiltration and seedling emergence.

The representative soil series associated with this site is Boton. Other series include: Batan, Benin, Beoska, Blacka, Broyles, Bubus, Caphor, Chuckles, Creemon, Cren, Cresal, Essal, Geysen, Iron Blossom, Jerval, Kawich, Mazuma, Misad, Nomazu, Raglan, Ragtown, Relley, Rosney, Soolake, Swinger, Tresed, Wardenot, Weso, Whirlo, and Yipor. Where this ecological site is correlated to Ocala components will be field checked for re-correlation to 024XY008NV/024XY011NV.

Table 4. Representative soil features

Parent material	(1) Alluvium (2) Alluvium–volcanic rock (3) Loess (4) Lacustrine deposits (5) Volcanic ash–volcanic rock
Surface texture	(1) Silt loam (2) Fine sandy loam (3) Very fine sandy loam

Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Very slow to slow
Soil depth	152 cm
Surface fragment cover $\leq 3"$	0–10%
Surface fragment cover $> 3"$	0–5%
Available water capacity (0-101.6cm)	17.78–20.32 cm
Calcium carbonate equivalent (0-101.6cm)	1–20%
Electrical conductivity (0-101.6cm)	0–32 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	13–99
Soil reaction (1:1 water) (0-101.6cm)	7.9–9.6
Subsurface fragment volume $\leq 3"$ (Depth not specified)	0–10%
Subsurface fragment volume $> 3"$ (Depth not specified)	0–5%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and it has a set of key characteristics that influence a site's resilience to disturbance and resistance to 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 influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

This ecological site is dominated by drought tolerant salt-desert shrubs with high root to shoot ratios. The dominant shrubs typically root to the full depth of the winter-spring soil moisture recharge, which Fernandez and Caldwell (1975) reported as between 80 and 110 cm for shadscale. Shadscale (*Atriplex confertifolia*) initiates root growth, in early April, a few days to a week prior to aerial plant parts and shadscale in particular exhibits active root growth for several weeks after termination of shoot growth (Fernandez and Caldwell 1975). Continued root growth, even for established plants that are not exploring new areas of the soil, facilitates water absorption particularly in low soil moisture conditions (Gardner 1960). Fernandez and Caldwell (1975) concluded that the ability of shadscale to explore

the soil volume at greater depths with a more profuse system of small branching lateral roots than winterfat or sagebrush (*Artemisia tridentata*) may play a role in its ability to remain photosynthetically active longer into the summer season. Although shadscale exhibits the ability to withstand drought conditions on a short-term basis the forty year photographic record (1951-1990) from the Raft River Valley of south-central Idaho visually demonstrates the impact of multiple years of drought on shadscale communities (Sharp et al. 1990). Scale insects have also been implicated in the death of shadscale (Sharp et al. 1990) however the data on this subject remains inconclusive (Nelson et al. 1990). Periods of above normal springtime precipitation are also linked to shadscale die-off. Nelson et al. (1990) investigated areas of severe shadscale die-off that were, for the most part, located in low areas in valley bottoms or upland depressions that apparently incurred prolonged high soil moisture during a wet period. The high soil moisture appeared to be correlated with increased pythiaceous fungi leading to rootlet mortality and plant stress (Nelson et al. 1990). The authors suggest that depending on the degree and duration of plant stress, injury could range from a sustained disease to rapid death.

Shadscale is a densely clumped, rounded, compact native shrub. It generally attains heights of 8 to 32 inches (20 to 81 cm) and widths of 12 to 68 inches (30 to 173 cm) (Blaisdell and Holmgren 1984). Shadscale is considered an evergreen to partially deciduous shrub, since a small percentage of leaves are dropped in the winter (Smith and Nobel 1986). Shadscale possesses wider ecological amplitude than most *Atriplex* species (Crofts and Van Epps 1975), and shows ploidy levels from diploid (2x) to decaploid (10x). The extensive polyploidy of shadscale is an important consideration when implementing revegetation projects because ploidy levels are typically associated with distinct habitats (Sanderson et al. 1990). Diploid individuals are unlikely to perform as well in areas where tetraploids are more common. Diploid individuals generally are above Pleistocene lake levels, whereas lake floors are typically occupied by autotetraploids. Overall, tetraploids are the most widespread throughout its range (Carlson 1984). Thus, the diploid most associated with this site is a tetraploid. Bud sagebrush, a common shrub to this ecological site, is a native, summer-deciduous shrub. It is low growing, spinescent, aromatic shrub with a height of 4 to 10 inches (10 to 25 cm) and a spread of 8 to 12 inches (20 to 30 cm) (Chambers and Norton 1993).

Hydrology of this site is critical for site function and maintenance. Romo (1985) observed water tables ranging from 3.5-15 m under black greasewood dominated communities in Oregon. Black greasewood is classified as a phreatophyte (Eddleman 2002), and its distribution is well correlated with the distribution of groundwater (Mozingo 1987). Black greasewood stands develop best where moisture is readily available, either from surface or subsurface runoff (Brown 1965).

The invasibility of plant communities is commonly 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. Historically, shadscale dominant salt-desert shrub communities were free of exotic invaders; however, excessive grazing pressure during settlement and into the 20th century has increased the overall presence of cheatgrass (*Bromus tectorum*), halogeton (*Halogeton glomeratus*), Russian thistle (*Salsola*

iberica) and weedy mustard species (*Brassica* L.) (Peters and Bunting 1994). The presence of exotic annual plants within these ecosystems decreases ecosystem resilience and resistance to disturbance through competition for limited resources. Dobrowolski et al. (1990) cite multiple authors on the extent of the soil profile exploited by the competitive exotic annual cheatgrass. Specifically, the depth of rooting is dependent on the size the plant achieves and in competitive environments cheatgrass roots penetrate only 15 cm whereas isolated plants and pure stands root at least 1 m in depth with plants rooting as deep as 1.5 to 1.7 m.

Drought will initially cause a decline in bunchgrasses. Prolonged drought will cause a decline in shrubs, including shadscale and black greasewood, while annual weedy species and bare ground will increase. Shadscale is less adapted to drought than many of its common associates (Vest 1962, Holmgren and Hutchings 1972), showing high mortality during periods of prolonged drought (Schultz and Ostler 1995). Tolerance to drought is achieved through partial shedding of leaves; this reduces water loss during severe moisture stress (Lei 1999). 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. Three possible alternative states have been identified for this site.

Fire Ecology:

The lack of continuous fuels to carry fires made fire rare to nonexistent in shadscale communities (Young and Tipton 1990), thus it is not surprising that shadscale and bud sagebrush are both fire intolerant (Banner 1992, West 1994). Shadscale does not readily recover from fire, except for establishment through seed (West 1994). The slow reestablishment allows for easy invasion by cheatgrass and other non-native weedy species (Sanderson et al. 1990). Black greasewood may be killed by severe fires, but can resprout after low to moderate severity fires (Robertson 1983, West 1994). Bentz et al. (2008) reported that following a Nevada wildfire, black greasewood sprouts reached approximately,

2.5 feet (76 cm) within 3 years. The increased presence of exotic annual grasses has greatly altered fire regimes in areas of the Intermountain West where shadscale is a major vegetation component. Exotic annuals increase fire frequency under wet to near-normal summer moisture conditions and repeated, frequent fire has converted large expanses of shadscale rangeland to annual non-native plant communities (Knapp 1998).

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

Bottlebrush squirreltail (*Elymus elymoides*), the dominant cool-season native bunchgrass on this site, is considered fire tolerant due to its small size, coarse stems, and sparse leafy

material (Britton et al. 1990). Postfire regeneration is from surviving root crowns and from on- and off-site seed sources. Bottlebrush squirreltail has the ability to produce large numbers of highly germinable seeds, with relatively rapid germination (Young and Evans 1977) when exposed to the correct environmental cues. Early spring growth and ability to grow at low temperatures contribute to the persistence of bottlebrush squirreltail among cheatgrass dominated ranges (Hironaka and Tisdale 1972).

Indian ricegrass (*Achnatherum hymenoides*), a minor component, is considered fairly fire tolerant (Wright 1985), which is likely due to its low culm density and below ground plant crowns. Vallentine (1989) cites several studies in the sagebrush zone that classified Indian ricegrass as being slightly damaged from late summer burning. Indian ricegrass will reestablish on burned sites through seed dispersed from adjacent unburned areas (Young 1983). Thus, the presence of surviving, seed producing plants is necessary for reestablishment of Indian ricegrass. Grazing management following fire to promote seed production and establishment of seedlings is important.

State and transition model

Modal State and Transition Model for Group 3A MLRA 24

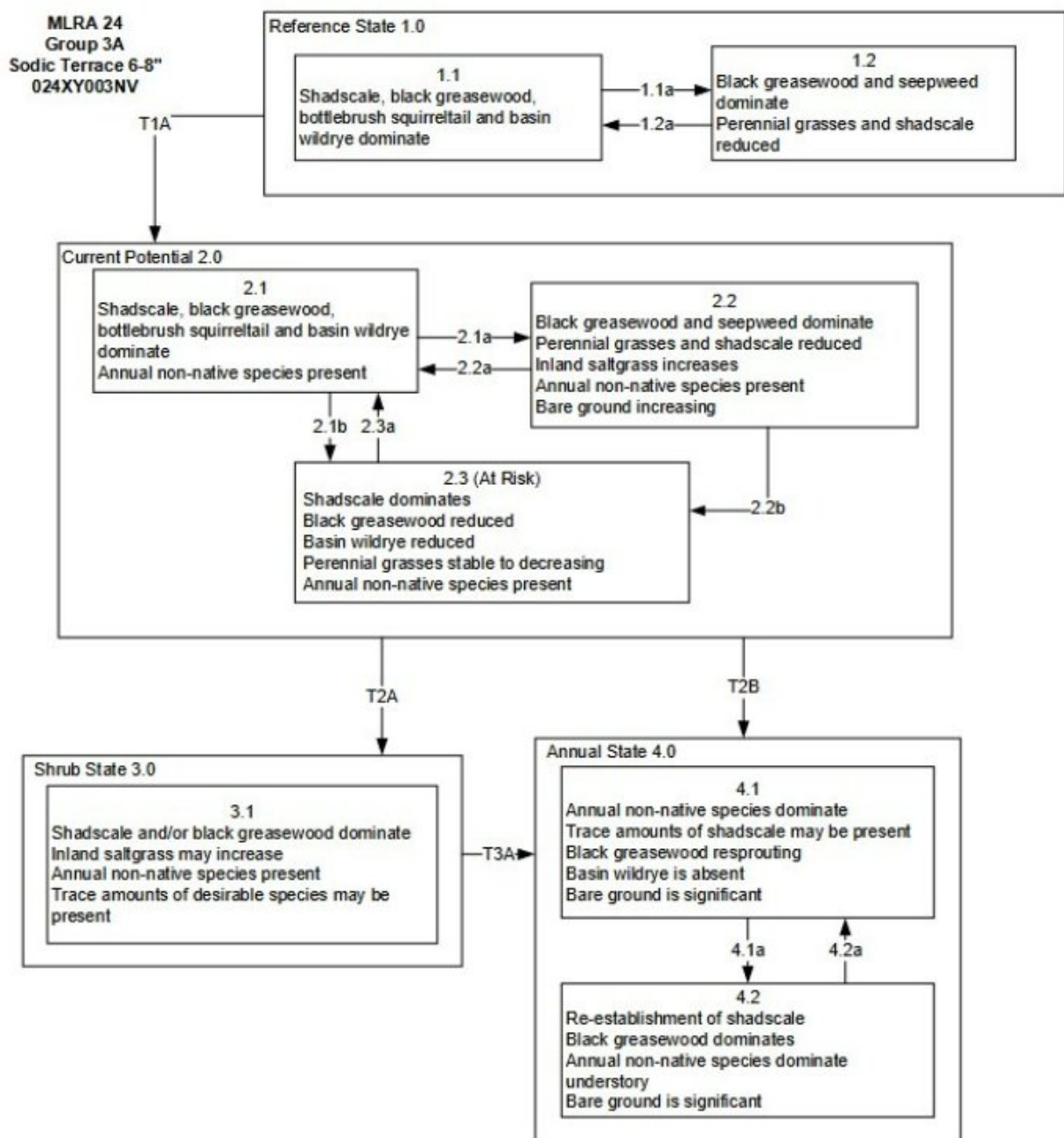


Figure 4. State and Transition Model

Reference State 1.0 Community Phase Pathways:

- 1.1a: Prolonged drought and/or herbivory.
- 1.2a: Release from drought and/or herbivory.

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

Current Potential State 2.0 Community Phase Pathways:

- 2.1a: Prolonged drought and/or inappropriate grazing management.
- 2.2a: Release from drought and/or appropriate grazing management that allows for an increase in shadscale and perennial grasses. Extreme growing season moisture may reduce shadscale.
- 2.2b: Inappropriate grazing and/or drought.
- 2.3a: Release from drought and/or inappropriate grazing management allows for an increase in bud sagebrush and perennial grasses. Extreme growing season moisture may reduce shadscale.

Transition T2A: Inappropriate grazing management and/or drought.

Transition T2B: Long-term inappropriate grazing management and/or soil disturbing treatments. An unusually wet spring may facilitate an increase in annual species.

Shrub State 3.0 Community Phase Pathways:
None.

Transition T3A: Fire and/or soil disturbing treatments, may be combined with an unusually wet spring which facilitates an increase in annual species.

Annual State 4.0 Community Phase Pathways:

- 4.1a: Time and lack of disturbance allows for the reestablishment of shadscale.
- 4.2a: Fire.

Figure 5. STM Narrative

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 two general community phases: a shrub-grass dominate 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. This site is very stable, with little variation in plant community composition. Plant community changes would be reflected in production response to long term drought or herbivory. Wet years will increase grass production, while drought years will reduce production. Shrub production will also increase during wet years; however, extreme growing season wet periods has been shown to cause shadscale death.

Community 1.1

Reference Plant Community 1.1

This community is dominated by shadscale and bottlebrush squirreltail. Black

greasewood, bud sagebrush and other perennial grasses are minor components. Community phase changes are primarily a function of chronic drought. Drought will favor shrubs over perennial bunchgrasses. However, long-term drought will result in an overall decline in plant community production, regardless of functional group. Extreme growing season wet periods may also reduce the shadscale component. Fire is very infrequent to non-existent.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	286	429	572
Grass/Grasslike	34	50	67
Forb	17	25	34
Total	337	504	673

Community 1.2

Community Phase 1.2

Shrubs such as shadscale and black greasewood increase in the community. Perennial bunchgrasses decrease with drought and may become a minor component.

Pathway 1.1a

Community 1.1 to 1.2

This pathway is a result of long-term drought, extreme wet periods or herbivory. Drought will favor shrubs over perennial bunchgrasses. Extreme wet periods will reduce the shadscale component.

Pathway 1.2a

Community 1.2 to 1.1

This pathway is a result of release from drought or herbivory which facilitates the vegetation cover to increase and bare ground cover to decrease. Extreme growing season wet period may reduce shadscale.

State 2

Current Potential State

This state is similar to the Reference State 1.0 with the addition of a shadscale and a sprouting shrub dominated community phase. Ecological function has not changed, however the resiliency of the state has been reduced by the presence of invasive weeds. Non-natives may increase in abundance but will not become dominant within this State. These non-natives can be highly flammable and can 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

Community Phase 2.1

This community is compositionally similar to the Reference State Community Phase 1.1 with the presence of non-native species in trace amounts. This community is dominated by shadscale and bottlebrush squirreltail. Black greasewood, bud sagebrush and other perennial bunchgrasses are also important components on this site. Community phase changes are primarily a function of chronic drought or extreme wet periods. Fire is infrequent and patchy due to low fuel loads.

Community 2.2

Community Phase 2.2



Figure 7. Sodic Terrace 6-8 Community Phase 2.2 NV777 MU773 Broyles Soil
P. Novak-Echenique June 2010

Shadscale and greasewood increase while squirreltail and other perennial grasses decrease. Bare ground increases along with annual weeds. Prolonged drought may lead to an overall decline in the plant community. Wet periods will decrease the shadscale component.

Community 2.3

Community Phase 2.3 (At Risk)



**Figure 8. Sodic Terrace 6-8 Community Phase 2.3 NV777 MU178 Bubus Soil
P. Novak-Echenique June 2010**

Shadscale, greasewood and rabbitbrush dominate the overstory and perennial bunchgrasses, are reduced, either from competition with shrubs or from inappropriate grazing, chronic drought or both. Annual non-native species may be stable or increasing due to a lack of competition with perennial bunchgrasses. Bare ground may be significant. This community is at risk of crossing a threshold to either State 3.0 (shrub) or State 4.0 (annual).

Pathway 2.1a Community 2.1 to 2.2

This pathway is a result of inappropriate grazing during the growing season which favors unpalatable shrubs cover over bunchgrass cover. Long term drought will also decrease the perennial bunchgrasses cover in the understory.

Pathway 2.1b Community 2.1 to 2.3

This pathway is a result of chronic drought or lowering of the water table, decreasing percent cover of the black greasewood component of the overstory.

Pathway 2.2a Community 2.2 to 2.1

This pathway is a result of a release from drought or appropriate grazing management that facilitates an increase in cover of perennial grass and shadscale. Extreme growing season wet periods may reduce cover of shadscale and increase cover of black greasewood.

Pathway 2.2b

Community 2.2 to 2.3



Community Phase 2.2



Community Phase 2.3 (At Risk)

This pathway is a result of long-term drought or inappropriate grazing significantly reducing cover of perennial grasses in favor of shadscale and rabbitbrush.

Pathway 2.3a

Community 2.3 to 2.1

This pathway is a result of a release from drought or inappropriate grazing significantly increasing cover of perennial grasses. Extreme growing season wet periods may reduce shadscale.

State 3

Shrub State

This state has one community phase that is characterized by shadscale and black greasewood with little to no understory. The site has crossed a biotic threshold and ecological processes are controlled by shrubs. Shrub cover exceeds the 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. Bare ground has increased.

Community 3.1

Community Phase 3.1



Figure 9. Sodic Terrace 6-8 Community Phase 3.1 NV777 MU178 Broyles Soil T. Stringham June 2010



Figure 10. Sodic Terrace 6-8 Community Phase 3.1 NV777 MU178 Broyles Soil P. Novak-Echenique June 2010

Decadent shadscale and black greasewood dominate the overstory. Rabbitbrush and other sprouting shrubs may be a significant component or dominant shrub. Deep-rooted perennial bunchgrasses may be present in trace amounts or absent from the community. Annual non-native species increase. Bare ground is significant.

State 4

Annual State

This state has two community phases. In this state, a biotic threshold has been crossed and state dynamics are driven by the dominance and persistence of the annual plant community which is perpetuated by a shortened fire return interval. The herbaceous understory is dominated by annual non-native species such as cheatgrass and halogeton. Bare ground may be significant. Resiliency has declined and further degradation from fire

facilitates a cheatgrass and sprouting shrub plant community. The fire return interval has shortened due to the dominance of cheatgrass in the understory and is a driver in site dynamics.

Community 4.1

Community Phase 4.1

This community is dominated by annual non-native species. Halogeton most commonly invades these sites. Trace amounts of shadscale and other shrubs may be present, but are not contributing to site function. Bare ground may be significant, especially during low precipitation years. Soil erosion from wind and soil temperature are driving factors in site function.

Community 4.2

Community Phase 4.2

This community is dominated by black greasewood which can re-sprout after fire. Shadscale is increasing within the community. Annual non-native species dominate the understory.

Pathway 4.1a

Community 4.1 to 4.2

This pathway is a result of time and lack of disturbances facilitating reestablishment of shadscale.

Pathway 4.2a

Community 4.2 to 4.1

This pathway is a result of fire.

Transition T1A

State 1 to 2

Trigger: This transition is caused by the introduction of non-native annual plants, such as halogeton, mustards and cheatgrass. 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: Long-term inappropriate grazing and/or long-term drought will decrease or eliminate deep rooted perennial bunchgrasses and favor shrub growth and establishment. 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 and/or soil disturbing treatments such as drill seeding and plowing. An unusually wet spring may facilitate the increased germination and production of cheatgrass leading to its dominance within the community. 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.

Transition T3A
State 3 to 4

Trigger: Fire or soil disturbing treatments such as drill seeding and plowing. An unusually wet spring may facilitate the increased germination and production of cheatgrass leading to its dominance within the community. Slow variables: Increased production and cover of non-native annual 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 shadscale truncate energy capture spatially and temporally thus impacting nutrient cycling and distribution.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Primary Perennial Grasses			10–50	
	squirreltail	ELEL5	<i>Elymus elymoides</i>	10–50	–
2	Secondary Perennial Grasses			10–50	
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	2–16	–
	saltgrass	DISP	<i>Distichlis spicata</i>	2–16	–
	basin wildrye	LECI4	<i>Leymus cinereus</i>	2–16	–
Forb					
3	Perennial Forbs			10–40	
	saltgrass	DISP	<i>Distichlis spicata</i>	3–17	–
	niterwort	NITRO	<i>Nitrophila</i>	2–10	–
	globemallow	SPHAE	<i>Sphaeralcea</i>	2–10	–
	princesplume	STANL	<i>Stanleya</i>	2–10	–
	thelypody	THELY	<i>Thelypodium</i>	2–10	–
4	Annual Forbs			1–16	
Shrub/Vine					
5	Primary Shrubs			248–484	
	shadscale saltbush	ATCO	<i>Atriplex confertifolia</i>	151–252	–
	greasewood	SAVE4	<i>Sarcobatus vermiculatus</i>	76–151	–
	seepweed	SUAED	<i>Suaeda</i>	10–40	–
6	Secondary Shrubs			10–40	
	sickle saltbush	ATFA	<i>Atriplex falcata</i>	2–10	–
	Torrey's saltbush	ATTO	<i>Atriplex torreyi</i>	2–10	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	2–10	–
	spiny hopsage	GRSP	<i>Grayia spinosa</i>	2–10	–
	horsebrush	TETRA3	<i>Tetradymia</i>	2–10	–

Animal community

Livestock Interpretations:

Traditionally, shadscale plant communities provided good winter forage for the expanding sheep and cattle industry in the arid west. Shadscale is a valuable browse species for a wide variety of wildlife and livestock (Blaisdell and Holmgren 1984). The spinescent growth habit of shadscale lends to its browsing tolerance with no more than 15 to 20 percent utilization by sheep being reported (Blaisdell and Holmgren 1984) and significantly less utilization by cattle. Increased presence of shadscale within grazed versus ungrazed areas is generally a result of the decreased competition from more heavily browsed associates (Cibils et al. 1998). Reduced competition from more palatable species in heavily grazed areas may increase shadscale germination and establishment. Chambers and Norton (1993) observed shadscale establishment higher under spring than winter browsing as well as heavy compared to light browsing. During years of below average precipitation, shadscale is very susceptible to grazing pressure regardless of season (Chambers and Norton 1993). Following fire, grazing exclusion for 2 or more years is beneficial for revegetation of shadscale communities as first year shadscale seedlings lack spines and are highly susceptible to browsing. Spines develop in the second year (Zielinski 1994).

Bottlebrush squirreltail, the dominant grass on this site, generally increases in abundance when moderately grazed or protected (Hutchings and Stewart 1953). In addition, moderate trampling by livestock in big sagebrush rangelands of central Nevada enhanced bottlebrush

squirreltail seedling emergence compared to untrampled conditions. Heavy trampling however may significantly reduce germination sites (Eckert et al. 1987). Squirreltail is more tolerant of grazing than Indian ricegrass but all bunchgrasses are sensitive to over utilization within the growing season.

Indian ricegrass is a preferred forage species for livestock and wildlife (Cook 1962, Booth et al. 2006). This species is heavily utilized, commonly, in winter because it cures well (Booth et al. 2006). It is also readily utilized in early spring, being a source of green feed before most other perennial grasses have produced new growth (Quinones 1981). Booth et al. (2006) note that the plant does well when utilized in winter and spring. Cook and Child (1971) however, observed that repeated heavy grazing reduced crown cover, which may reduce seed production, density, and basal area of these plants. Additionally, heavy early spring grazing reduces plant vigor and stand density (Stubbendieck 1985). In eastern Idaho, productivity of Indian ricegrass was at least 10 times greater in undisturbed plots than in heavily grazed ones (Pearson 1965). Cook and Child (1971) observed significant reduction in plant cover even after 7 years of rest from heavy (90 percent) and moderate (60 percent) spring use. The seed crop may be reduced where grazing is heavy (Bich et al. 1995). Tolerance to grazing increases after May, thus spring deferment may be necessary for stand enhancement (Pearson 1964, Cook and Child 1971); however, utilization of less than 60 percent is recommended. In summary, adaptive management is required to manage this bunchgrass well.

Shadscale, squirreltail, and saltgrass will eventually decline with continued abusive grazing. Less palatable species such as black greasewood, rabbitbrush (*Chrysothamnus viscidiflorus* and *Ericameria nauseosa*) and inland saltgrass increase in dominance along

with invasive non- native species such as fivehook bassia, mustards, halogeton, cheatgrass (Roundy 1985) and Russian thistle. Additionally, seepweed will increase along with bare ground as abusive grazing continues.

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:

Shadscale is a valuable browse species, providing a source of palatable, nutritious forage for a wide variety of wildlife particularly during spring and summer before the hardening of spiny twigs. It supplies browse, seed, and cover for birds, small mammals, rabbits, deer, and pronghorn antelope. Black greasewood is an important winter browse plant for big game animals and a food source for many other wildlife species. It also receives light to moderate use by mule deer and pronghorn during spring and summer months. Budsage is palatable, nutritious forage for upland game birds, small game and big game in winter. Budsage is browsed by mule deer in Nevada in winter and is utilized by bighorn sheep in summer, but the importance of budsage in the diet of bighorns is not known. Bud sage comprises 18 to 35 percent of a pronghorn's diet during the spring where it is available. Chukar will utilize the leaves and seeds of bud sage. Budsage is highly susceptible to effects of browsing. It decreases under browsing due to year-long palatability of its buds and is particularly susceptible to browsing in the spring when it is physiologically most active. Bottlebrush squirreltail is a dietary component of several wildlife species. Bottlebrush squirreltail may provide forage for mule deer and pronghorn.

Hydrological functions

Runoff is very low to very high. Permeability is very slow to moderately rapid. Rills are none to rare. Water flow patterns are rare to common depending on site location relative to major flow areas. Pedestals are none to rare. Sparse shrub canopy and associated litter break raindrop impact. Medium to fine textured surface soils have moderate to slow infiltration and medium runoff.

Recreational uses

In moist years, this site produces minor amounts of flowering forbs. This site has potential for upland bird and big game hunting.

Other products

Seeds of shadscale are used by Native Americans for bread and mush. The leaves, seeds and stems of black greasewood are edible.

Other information

Black greasewood is useful for stabilizing soil on wind-blown areas. It successfully revegetates eroded areas and sites too saline for most plant species. Bottlebrush squirreltail is tolerant of disturbance and is a suitable species for revegetation.

Inventory data references

NASIS data used for Physiographic and Soils sections.

Type locality

Location 1: Eureka County, NV	
Township/Range/Section	T30 N R49 E S5
UTM zone	N
UTM northing	4483404
UTM easting	545064
Latitude	40° 30' 0"
Longitude	116° 28' 5"
General legal description	About five miles south of Beowawe, Crescent Valley area, Eureka County, Nevada. Also occurs in Humboldt, Lander, and Pershing counties, Nevada.

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Contributors

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Approval

Kendra Moseley, 3/07/2025

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)	P. Novak-Echenique
Contact for lead author	State Rangeland Management Specialist

Date	12/02/2009
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.

2. **Presence of water flow patterns:** Water flow patterns are rare to common depending on site location relative to major flow areas.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare Ground \pm 50-70%.

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

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values are 4 to 6 under canopy and 2 to 5 in the interspaces. Areas of this site occurring on soils that have a physical crust will probably have stability values less than 3.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Surface structure is thin to thick platy or granular. Soil surface colors are light grays or very pale browns and soils are typified by an ochric epipedon. Organic matter of the surface 2 to 3 inches is less than 1 percent.
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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Sparse shrub canopy and associated litter break raindrop impact. Medium to fine textured surface soils have moderate to slow infiltration and medium runoff.
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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are not typical. Platy, subangular blocky, or massive sub-surface horizons or subsoil calcic horizons or duripans are not to be interpreted as compacted layers.
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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant: Salt desert shrubs (shadscale & black greasewood)

Sub-dominant: Associated shrubs > shallow-rooted, cool season, perennial bunchgrasses > deep-rooted, cool season, perennial bunchgrasses = perennial, rhizomatous grass > deep-rooted, cool season, perennial forbs = fibrous, shallow-rooted, cool season, annual and perennial forbs

Other: Microbiotic crusts

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 35% of total woody canopy; mature bunchgrasses commonly ($\pm 25\%$) have dead centers.

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14. **Average percent litter cover (%) and depth (in):** Between plant interspaces (\pm 10-20%) and depth (\pm ¼ 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 (February thru April [May]) \pm 450 lbs/ac; Spring moisture significantly affects total production. Favorable years \pm 600 lbs/ac and unfavorable years \pm 300 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 halogeton, Russian thistle, smotherweed, annual mustards, and cheatgrass.
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17. **Perennial plant reproductive capability:** All functional groups should reproduce in average and above average growing season years. Little to no growth or reproduction occurs during extreme drought periods.
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