USDA Natural Resources Conservation Service

Ecological site R028AY106NV
SALINE BOTTOM

Accessed: 05/10/2025

General information

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

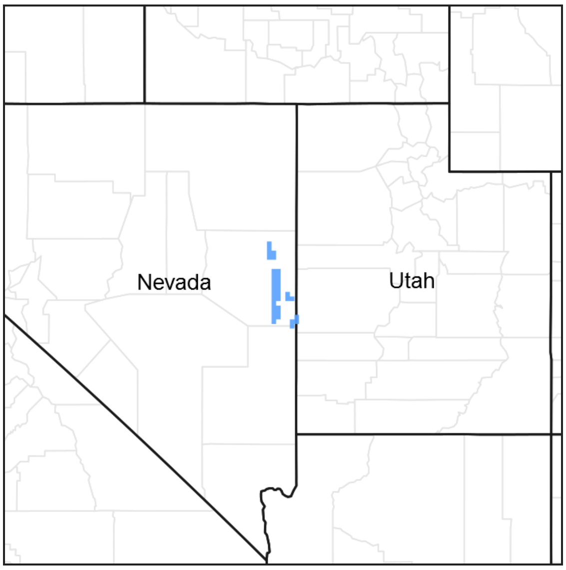

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 028A–Ancient Lake Bonneville

MLRA 28A occurs in Utah (82%), Nevada (16%), and Idaho (2%). It makes up about 36,775 square miles. A large area west and southwest of Great Salt Lake is a salty playa. This area is the farthest eastern extent of the Great Basin Section of the Basin and Range Province of the Intermontane Plateaus. It is an area of nearly level basins between widely separated mountain ranges trending north to south. The basins are bordered by long, gently sloping alluvial fans. The mountains are uplifted fault blocks with steep side slopes. They are not well dissected because of low rainfall in the MLRA. Most of the valleys are closed basins containing sinks or playa lakes. Elevation ranges from 3,950 to 6,560 ft. in the basins and from 6,560 to 11,150 ft. in the mountains. Most of this area has alluvial valley fill and playa lakebed deposits at the surface. Great Salt Lake is all that remains of glacial Lake Bonneville. A level line on some mountain slopes indicates the former extent of this glacial lake. Most of the mountains in the interior of this area consist of tilted blocks of marine sediments from Cambrian to Mississippian age. Scattered outcrops of Tertiary continental sediments and volcanic rocks are throughout the area. The average annual precipitation is 5 to 12 ins. in the valleys and is as much as 49 ins. in the mountains. Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The driest period is from midsummer to early autumn. Precipitation in winter typically occurs as snow. The average annual temperature is 39 to 53 °F. The freeze-free period averages 165 days and ranges from 110 to 215 days, decreasing in length with elevation. The dominant soil orders in this MLRA are Aridisols, Entisols, and Mollisols. The soils in the area dominantly have a mesic or frigid soil temperature regime, an aridic or xeric soil moisture regime, and mixed mineralogy. They generally are well drained, loamy or loamy-skeletal, and very deep.

Ecological site concept

This site occurs on lake plains and alluvial flats. Slope gradients of 0 to 2 percent are typical. Elevations range from 5,400 to about 5,800 feet.

The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 6 to about 10 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 100 to about 120 days.

Soils associated with this site are very deep and have formed in alluvium and lacustrine deposits from mixed rock sources. The soils are strongly salt and sodium affected in their upper profile with soil reaction and salinity decreasing with soil depth. These soils are moderately well drained and have a seasonally high water table at depths of 42 to 60 inches which allows for significant fluctuations in herbage production. The available water holding capacity is moderate. Additional moisture is received on this site as overflow from adjacent streams or as run-in from higher landscapes. Runoff is very low to very high and some areas may be ponded for short periods in the early spring.

The reference state is dominated by basin wildrye and alkali sacaton. Black greasewood is the dominant shrub. Where Rocky Mountain juniper occurs on the site, tree canopy cover is less than 10 percent.
Production ranges from 800 to 2200 pounds per acre.

Associated sites

R028AY104NV	**DRY SALINE MEADOW**
R028AY105NV	**SALINE MEADOW**
R028BY001NV	**WET MEADOW 10-14 P.Z.**

Similar sites

R028AY105NV	**SALINE MEADOW** SPAI-SPGR codominant grasses, LECI4 minor grass, if present
R028AY008NV	**SODIC TERRACE 8-10 P. Z.** Less productive site; ARTR2 codominant shrub
R028BY004NV	**SALINE BOTTOM** JUSC2 absent
R028AY024NV	**SODIC TERRACE 5-8 P.Z.** Less productive site; SAVE4-ATCO codominant shrubs
R028AY025NV	**DRY FLOODPLAIN** LETR5 codominant grass; SAVE4 minor shrub, if present; ARTR2 dominant shrub

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Sarcobatus vermiculatus*
Herbaceous	(1) *Leymus cinereus* (2) *Sporobolus airoides*

Physiographic features

This site occurs on lake plains and alluvial flats. Slope gradients of 0 to 2 percent are typical. Elevations are 5400 to about 5800 feet.

Table 2. Representative physiographic features

Landforms	(1) Lake plain (2) Alluvial flat
Ponding duration	Brief (2 to 7 days)
Ponding frequency	Occasional
Elevation	5,400–5,800 ft
Slope	0–2%
Water table depth	42–60 in
Aspect	Aspect is not a significant factor

Climatic features

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).

The climate associated with this site is semiarid, characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 6 to about 10 inches. Mean annual air temperature is 45 to 50 degrees F. The average growing season is 100 to about 120 days.

Mean annual precipitation at ELY WBO, NEVADA
climate station (262631)is 9.72 inches.

Monthly mean precipitation is:
January 0.77; February 0.78; March 1.01;
April 1.03; May 1.1; June 0.65; July 0.64;
August 0.81; September 0.75; October 0.82;
November 0.68; December 0.68.

Table 3. Representative climatic features

Frost-free period (average)	0 days
Freeze-free period (average)	110 days
Precipitation total (average)	8 in

Influencing water features

Additional moisture is received on this site as overflow from adjacent streams or as run-in from higher landscapes.

Soil features

Soils associated with this site are very deep and have formed in alluvium and lacustrine deposits from mixed rock sources. The soils are strongly salt and sodium affected in their upper profile with soil reaction and salinity decreasing with soil depth. Surface textures are clay loams and silty clays and subsurface textures are silty clays. These soils are moderately well drained and have a seasonally high water table at depths of 42 to 60 inches which allows for significant fluctuations in herbage production. The available water holding capacity is moderate. Additional moisture is received on this site as overflow from adjacent streams or as run-in from higher landscapes. Runoff is high and some areas may be ponded for short periods in the early spring. The soil series associated with this site include: Biji.

The representative soil component is Biji (SS779, MU 3510), classified as a fine, carbonatic, mesic Vertic Haplocalcid. Diagnostic horizons include an ochric epipedon from the soil surface to 7 inches, and a calcic horizon from 16 to 46 inches. Clay content in the particle control section averages 35 to 45 percent. Reaction is moderately alkaline through very strongly alkaline. Effervescence is violently effervescent. Lithology consists of alluvium and lacustrine deposits from mixed rocks. The soil moisture regime is aridic.

Table 4. Representative soil features

Surface texture	(1) Clay loam (2) Silty clay (3) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Moderately well drained
Permeability class	Slow
Soil depth	60–72 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	6.5–6.6 in
Calcium carbonate equivalent (0-40in)	40–60%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	46–90
Soil reaction (1:1 water) (0-40in)	8.4–9.4
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

An ecological site is the product of all the environmental factors responsible for its development and 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 et al 2013). Biotic factors that influence resilience include site productivity, species composition and structure, and population regulation and regeneration (Chambers et al. 2013).

The Great Basin shrub communities have high spatial and temporal variability in precipitation, both among years and within growing seasons. Nutrient availability is typically low but increases with elevation and closely follows moisture availability. The moisture resource supporting the greatest amount of plant growth is usually the water stored in the soil profile during the winter. The invasibility of plant communities is often linked to resource availability. Disturbance can decrease resource uptake due to damage or mortality of the native species and depressed competition or can increase resource pools by the decomposition of dead plant material following disturbance.
This ecological site is dominated by basin wildrye, a cool-season perennial grass and co-dominated by alkali sacaton, a warm-season perennial grass. Black greasewood dominates the overstory.

Black greasewood is classified as a phreatophyte (Eddleman 2002), and its distribution is well correlated with the distribution of groundwater (Mozingo 1987). Meinzer (1927) discovered that the taproots of black greasewood could penetrate from 20 to 57 feet below the surface. Romo (1984) found water tables ranging from 3.5 to 15 m under black greasewood dominated communities in Oregon. Black greasewood stands develop best where moisture is readily available, either from surface or subsurface runoff (Brown 1965). It is commonly found on floodplains that are either subject to periodic flooding, have a high water table at least part of the year, or have a water table less than 34 feet deep (Harr and Price 1972, Blauer et al. 1976, Branson et al. 1976, Blaisdell and Holmgren 1984, Eddleman 2002). Ganskopp (1986) reported that water tables within 9.8 to 11.8 inches of the surface had no effect on black greasewood in Oregon. However, a study, conducted in California, found that black greasewood did not survive six months of continuous flooding (Groeneveld and Crowley 1988, Groeneveld 1990). Black greasewood is usually a deep rooted shrub but has some shallow roots near the soil surface; the maximum rooting depth can be determined by the depth to a saturated zone (Harr and Price 1972).

Seasonally high water tables have been found necessary for maintenance of productivity and reestablishment of basin wildrye following disturbances such as fire, drought or excessive herbivory (Eckert et al. 1973). The sensitivity of basin wildrye seedling establishment to reduced soil water availability is increased as soil pH increases (Stuart et al. 1971). Lowering of the water table through extended drought or water pumping will decrease basin wildrye production and establishment while black greasewood, rabbitbrush, inland saltgrass and invasive weeds will increase. 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).

As site condition deteriorates, these sites may become a pure stand of black greasewood or a pure stand with an annual understory. Marcum and Kopec (1997) found inland saltgrass more tolerant of increased levels of salinity than alkali sacaton; thus, dewatering and/or long term drought that causes increased levels of salinity would create environmental conditions more favorable to inland saltgrass over alkali sacaton. Alkali sacaton is considered a facultative wet species in this region; it is not drought tolerant. A lowering of the water table can occur with groundwater pumping and this may contribute to the loss of deep-rooted species such as black greasewood and basin wildrye and an increase in rabbitbrush, shadscale and other species that are not groundwater dependent.

Annual non-native species such as halogeton and cheatgrass invade these sites where competition from perennial species is decreased. This ecological site has moderate resilience to disturbance and resistance to invasion. A primary disturbance on these ecological sites is drought, fire, flooding, and other disturbances leading to a lowered seasonal water table. This facilitates an increase in shrubs and evergreen trees and a decrease in perennial grasses. Three possible stable states have been identified for this site, though a fourth Annual State has been identified in other MLRAs.

Fire Ecology:
Fire is a rare disturbance in these salt-desert shrub communities, and likely occurs in years with above average production. Natural fire return intervals are estimated to vary between less than 35 to 100+ years in salt- desert ecosystems that contain basin wildrye (Paysen et al. 2000). Historically, black greasewood-saltbush communities had sparse understories and bare soil in intershrub spaces, making these communities somewhat resistant to fire (Young 1983, Paysen et al. 2000). They may burn only during high fire hazard conditions; for example, years with high precipitation can result in almost continuous fine fuels, increasing fire hazard (West 1994, Paysen et al. 2000).

Black greasewood may be killed by severe fires, but can resprout after low to moderate severity fires (Robertson

1983, West 1994). Sheeter (1969) reported that following a Nevada wildfire, black greasewood sprouts reached approximately 2.5 feet within 3 years. Grazing and other disturbances may result in increased biomass production due to sprouting and increased seed production, which also leads to greater fuel loads (Sanderson and Stutz 1994). Higher production sites will experience fire more frequently than lower production sites.

Basin wildrye is relatively resistant to fire, particularly dormant season fire, as plants sprout from surviving root crowns and rhizomes (Zschaechner 1985). Miller et al. (2013) reports fall and spring burning increased total shoot and reproductive shoot densities in the first year, although live basal areas were similar between burn and unburned plants. By year two, there was little difference between burned and control treatments.

Alkali sacaton, a dominant grass on this site, is a native, long-lived, warm-season densely tufted perennial bunchgrass ranging from 20 to 40 inches in height. Alkali sacaton is typically top-killed, but will resprout from tillers. A severe fire can kill it and summer fires have more of an effect than winter fires (Brakie 2007). The recovery time after fire is estimated at two to four years (Bock et al 1978).

Shadscale is intolerant of fire and can only regenerate through seed (Zielinski 1994). Increases in the fire return interval leads to increases in the shrub component of the plant community, potentially facilitating increases in bare ground, inland saltgrass and invasive weeds. Lack of fire combined with excessive herbivory decreases or eliminates the herbaceous understory, favoring black greasewood and annual species. Therefore, fire can be detrimental to these communities, especially in the presence of fire tolerant, annual non-native species.

State and transition model

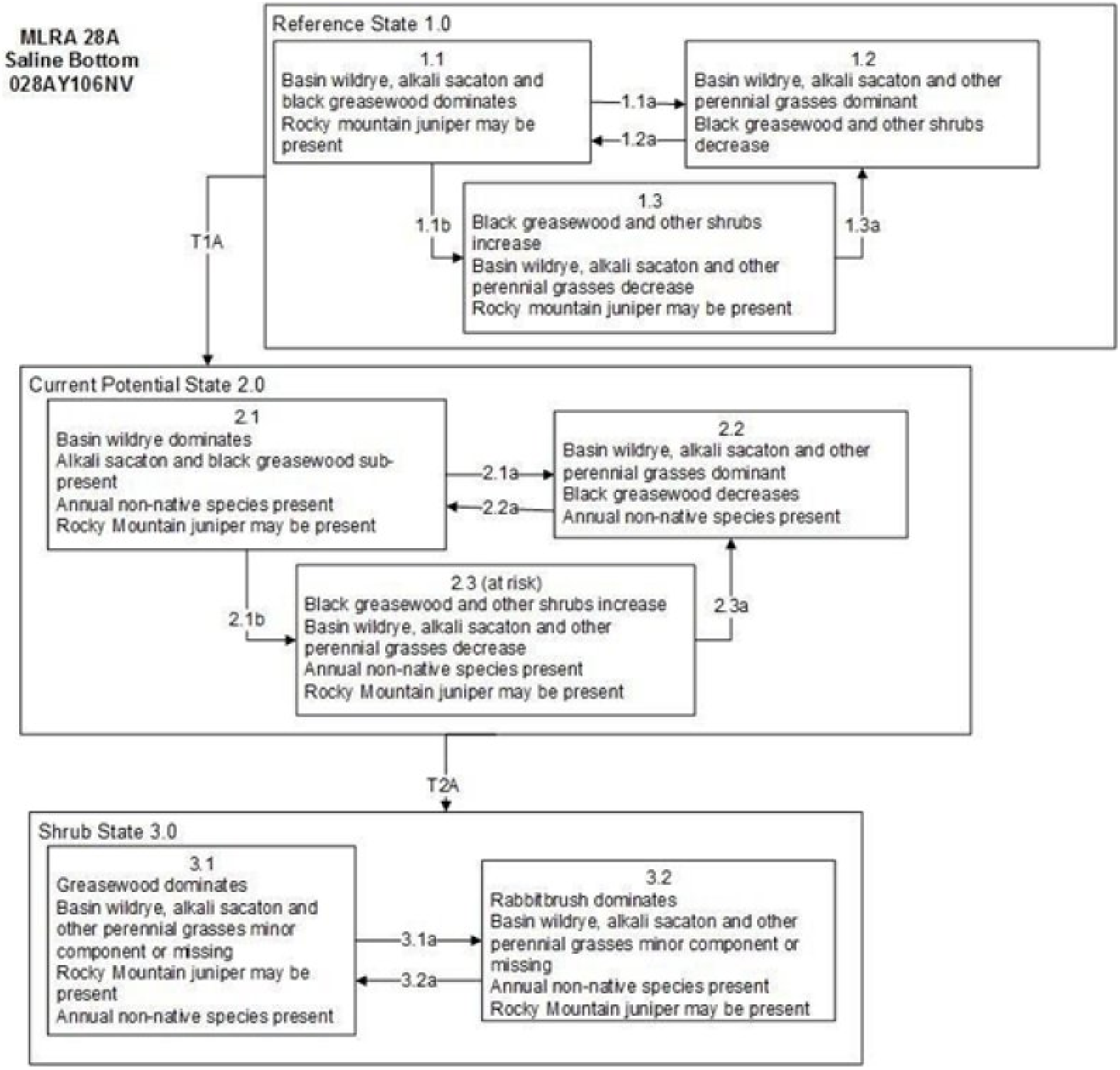

Figure 5. State and Transition Model

MLRA 28A
Saline Bottom
028AY106NV

Reference State 1.0 Community Pathways
1.1a: Low severity fire resulting in a mosaic pattern.
1.1b: Time and lack of disturbance such as fire, long-term drought herbivory, or combinations of these.
1.2a: Time and lack of disturbance such as fire, long-term drought, herbivory, or combinations of these.
1.3a: Fire significantly reduces shrub cover

Transition T1A: Introduction of non-native plants.

Current Potential State 2.0 Community Pathways:
2.1a: Fire or brush treatments (i.e. mowing) with minimal soil disturbance.
2.1b: Time and lack of disturbance such as fire, long-term drought, inappropriate grazing management, or combinations of these.
2.2a: Time and lack of disturbance such as fire, long-term drought, inappropriate grazing management, or combinations of these.
2.3a: Heavy late fall/winter grazing causing mechanical damage to shrubs and/or brush treatment with minimal soil disturbance and/or fire.

Transition T2A: Time and lack of disturbance and/or inappropriate grazing management would reduce the perennial understory(3.1). Severe fire, lowering of water table from groundwater pumping and/or soil disturbing brush treatments (3.2)

Shrub State 3.0 Community Phase Pathways
3.1a: Long-term drought and/or lowering of the water table due to groundwater pumping and/or severe fire.
3.2a: Release of drought and/or grazing pressure may allow for black greasewood and perennial bunchgrasses to increase

Figure 6. Legend

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

This community is dominated by basin wildrye and black greasewood. Alkali sacaton, shadscale, rubber rabbitbrush and other shrubs make up minor components. Where Rocky Mountain juniper occurs on the site, tree canopy cover is less than 10 percent. Potential vegetative composition is about 80% grasses, 5% forbs and 15% shrubs and trees. Approximate ground cover (basal and crown) is 20 to 35 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	640	1200	1760
Shrub/Vine	113	195	285
Forb	40	75	110
Tree	7	30	45
Total	**800**	**1500**	**2200**

Community 1.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community phase. Basin wildrye and alkali sacaton dominate the community. Black greasewood will decrease but will likely sprout and return to pre-burn levels within a few years. Early colonizers such as rabbitbrush and shadscale may increase.

Community 1.3
Community Phase

Black greasewood and shadscale increase in the absence of disturbance. Decadent shrubs dominate the overstory and deep-rooted perennial bunchgrasses in the understory are reduced either from competition with shrubs, herbivory, drought or combinations of these.

Pathway a
Community 1.1 to 1.2

A low severity fire would decrease the overstory of black greasewood and allow for the understory perennial grasses to increase. Fires are typically low severity resulting in a mosaic pattern due to low fuel loads. A fire following an unusually wet spring facilitating an increase in fine fuels may be more severe and reduce black greasewood cover to trace amounts.

Pathway b
Community 1.1 to 1.3

Absence of disturbance over time, significant herbivory, chronic drought or combinations of these would allow the black greasewood overstory to increase and dominate the site. This will generally cause a reduction in perennial bunchgrasses; however inland saltgrass may increase in the understory depending on the timing and intensity of herbivory. Heavy spring utilization will favor an increase in black greasewood.

Pathway a
Community 1.2 to 1.1

Time and lack of disturbance will allow black greasewood to increase.

Pathway a
Community 1.3 to 1.2

Fire will decrease the overstory of black greasewood and allow for the perennial bunchgrasses to dominate the site. Fires are typically high severity in this phase due to the dominance of black greasewood resulting in removal of the overstory shrub community.

State 2
Current Potential

This state is similar to the Reference State 1.0 with three similar community phases. 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

This community phase 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 basin wildrye and black greasewood. Alkali sacaton, shadscale, rubber rabbitbrush and other shrubs comprise the minor components. Non-native annual species such as halogeton and cheatgrass are present in minor amounts (<5%). Potential vegetative composition is about 80% grasses, 5% forbs and 15% shrubs and trees.

Community 2.2
Community Phase

This community phase is characteristic of a post-disturbance, early-seral community where annual non-native species are present. Perennial bunchgrasses such as alkali sacaton, inland saltgrass and basin wildrye dominate the site. Depending on fire severity patches of intact shrubs may remain. Black greasewood and rabbitbrush may be sprouting. Annual non-native species are stable to increasing in the community.

Community 2.3
Community Phase (at risk)

Figure 8. T. Stringham_4/2013; SS NV779, MU 3510

Black greasewood dominates the overstory and perennial bunchgrasses in the understory are reduced, either from competition with shrubs or from inappropriate grazing management, or from both. Rabbitbrush may be a significant component. Annual non-native species are stable or increasing. This community is at risk of crossing a threshold to State 3.0 (grazing or fire).

Pathway a
Community 2.1 to 2.2

A low severity fire would decrease the overstory of black greasewood and allow for the understory perennial grasses to increase. 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 black sagebrush cover to trace amounts. Brush treatments with minimal soil disturbance may also reduce black greasewood and allow for perennial bunchgrasses to increase. Annual non-native species are likely to increase after fire.

Pathway b
Community 2.1 to 2.3

Absence of disturbance over time, chronic drought, inappropriate grazing management or combinations of these would allow the black greasewood overstory to increase and dominate the site. Inappropriate grazing management reduces the perennial bunchgrass understory; conversely inland saltgrass may increase in the understory.

Pathway a
Community 2.2 to 2.1

Absence of disturbance over time, drought and/or grazing management that favors the establishment and growth of black greasewood allows the shrub component to recover.

Pathway a
Community 2.3 to 2.2

Grazing management that reduces shrubs will allow for the perennial bunchgrasses in the understory to increase. Heavy late-fall/winter grazing may cause mechanical damage to black greasewood promoting the perennial bunchgrass understory. Brush treatments with minimal soil disturbance will also decrease greasewood and release the perennial understory. Fires may be high severity due to the dominance of black greasewood in this community phase; a fire would decrease the shrub overstory and may allow for an increase in perennial bunchgrasses. Annual non-native species are present and may increase in the community.

State 3
Shrub State

This state has two community phases, one that is characterized by a dominance of black greasewood overstory and the other with a rabbitbrush overstory. This site has crossed a biotic and abiotic threshold and site processes are being controlled by shrubs. Bare ground has increased and pedestalling of grasses may be excessive.

Community 3.1
Community Phase

Black greasewood dominates the overstory. Rabbitbrush may be a significant component. Deep-rooted perennial bunchgrasses such as basin wildrye have significantly declined. Annual non-native species increase. Bare ground is significant.

Community 3.2
Community Phase

Figure 9. Saline Bottom , T. Stringham, April 2013, NV779 MU 3510

Figure 10. Saline Bottom,T. Stringham, April 2013, NV779 MU 3510

Rabbitbrush dominates the site. Perennial bunchgrasses are present but a minor component. Annual non-native species are present and may be increasing in the understory.

Pathway a
Community 3.1 to 3.2

Drought and/or lowering of water table by groundwater pumping would reduce black greasewood and allow for rabbitbrush and other shrubs on the site to dominate. Severe fire would also reduce black greasewood overstory and allow for an increase rabbitbrush.

Pathway a
Community 3.2 to 3.1

Release from drought and/or grazing pressure may allow for black greasewood, basin wildrye and other perennial bunchgrasses to increase.

Transition A
State 1 to 2

Trigger: Introduction of non-native annual plants. 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.

Transition A
State 2 to 3

Trigger: To Community Phase 3.1: Inappropriate cattle/horse grazing will decrease or eliminate deep rooted perennial bunchgrasses and favor shrub growth and establishment. To Community Phase 3.2: Severe fire will reduce and/or eliminate black greasewood overstory and decrease perennial bunchgrasses. Soil disturbing brush treatments will reduce black greasewood and possibly increase non-native annual species. Lowering of the water table due to groundwater pumping will also decrease black greasewood and allow for rabbitbrush and other shrubs to increase. Slow variables: Long term decrease in deep-rooted perennial grass density and/or black greasewood. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter. Loss of long-lived, black greasewood changes the temporal and depending on the replacement shrub, the spatial distribution of nutrient cycling. Slow variables: Long term decrease in deep-rooted perennial grass density and/or black greasewood. Threshold: Loss of deep-rooted perennial bunchgrasses changes nutrient cycling, nutrient redistribution, and reduces soil organic matter. Loss of long-lived, black greasewood changes the temporal and depending on the replacement shrub, the spatial distribution of nutrient cycling.

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**			810–1650	
	basin wildrye	LECI4	*Leymus cinereus*	450–750	–
	alkali sacaton	SPAI	*Sporobolus airoides*	300–600	–
	western wheatgrass	PASM	*Pascopyrum smithii*	30–75	–
	saltgrass	DISP	*Distichlis spicata*	30–75	–
2	**Secondary Perennial Grasses**			75–152	
	squirreltail	ELEL5	*Elymus elymoides*	8–45	–
	bluegrass	POA	*Poa*	8–45	–
	alkali cordgrass	SPGR	*Spartina gracilis*	8–45	–
Forb					
3	**Perennial**			30–120	
	milkvetch	ASTRA	*Astragalus*	8–30	–
	lupine	LUPIN	*Lupinus*	8–30	–
	ragwort	SENEC	*Senecio*	8–30	–
	thelypody	THELY	*Thelypodium*	8–30	–
Shrub/Vine					
4	**Primary Shrubs**			75–150	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	75–150	–
5	**Secondary Shrubs**			30–120	
	shadscale saltbush	ATCO	*Atriplex confertifolia*	7–45	–
	rubber rabbitbrush	ERNAO	*Ericameria nauseosa ssp. consimilis var. oreophila*	7–45	–
	currant	RIBES	*Ribes*	7–45	–
Tree					
6	**Evergreen**			7–45	
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	7–45	–

Animal community

Livestock Interpretations:
This site is suited for livestock grazing. Grazing management considerations include timing, intensity, frequency, and duration of grazing. During settlement, many of the cattle in the Great Basin were wintered on extensive basin wildrye stands however due to sensitivity to spring use many stands were decimated by early in the 20th century (Young et al. 1976). 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.
Alkali sacaton is a valuable forage species in arid and semiarid regions. Plants are tolerant to moderate grazing and can produce abundant herbage utilized by livestock. Alkali sacaton has been found to be sensitive to early growing season defoliation whereas late growing season and/or dormant season use allowed recovery of depleted stands (Hickey and Springfield 1966).
Saltgrass's value as forage depends primarily on the relative availability of other grasses of higher nutritional value and palatability. It can be an especially important late summer grass in arid environments after other forage grasses have deceased. Saltgrass is rated as a fair to good forage species only because it stays green after most other

grasses dry. Livestock generally avoid saltgrass due to its coarse foliage. Saltgrass is described as an “increaser” under grazing pressure. Western wheatgrass provides important forage for domestic sheep. Fall regrowth cures well on the stem, so western wheatgrass is good winter forage for domestic livestock.
Black greasewood is an important winter browse plant for domestic sheep and cattle. It also receives light to moderate use by domestic sheep and cattle during spring and summer months. Black greasewood contains soluble sodium and potassium oxalates that may cause poisoning and death in domestic sheep and cattle if large amounts are consumed in a short time. In a study by Smith et al. (1992), utilization of new growth on greasewood shrubs by cattle was 77 percent in summer, and greasewood was found to have the highest amounts of crude protein when compared to perennial and annual grasses. These shrubs can be used lightly in the spring as long as there is a substantial amount of other preferable forage available (Benson et al. 2011).

In general, livestock forage only lightly on rubber rabbitbrush during the summer, but winter use can be heavy in some locations. Fall use is variable, but flowers are often used by livestock. A few leaves and the more tender stems may also be used.
Spring defoliation of basin wildrye and/or consistent, heavy grazing during the growing season has been found to significantly reduce basin wildrye production and density (Krall et al. 1971). Basin wildrye is valuable forage for livestock (Ganskopp et al. 2007) and wildlife, but is intolerant of heavy, repeated, or spring grazing (Krall et al. 1971). Basin wildrye is used often as a winter feed for livestock and wildlife; not only providing roughage above the snow but also cover in the early spring months (Majerus 1992). Additionally, basin wildrye seed viability has been found to be low and seedlings lack vigor (Young and Evans 1981). Roundy (1985) found that although basin wildrye is adapted to seasonally dry saline soils, high and frequent spring precipitation is necessary to establish it from seed suggesting that establishment of natural basin wildrye seedlings occurs only during years of unusually high precipitation. Therefore, reestablishment of a stand that has been decimated by grazing may be episodic.
Shadscale, squirreltail, and saltgrass will eventually decline with continued inappropriate grazing. Thus, inadequate rest and recovery from defoliation can cause a decrease in basin wildrye and an increase in rabbitbrush and black greasewood, along with inland saltgrass and non-native weeds (Young et al. 1976, Roundy 1985). Less palatable species such as black greasewood, rabbitbrush and inland salt grass increased in dominance along with invasive non-native species such as povertyweed, Russian thistle, mustards and cheatgrass (Roundy 1985).
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:
Salt-desert shrub communities provide valuable habitat for a number of species. Black greasewood provides good cover for wildlife species as well an important winter browse plant for big game animals and a food source for many other wildlife species. (Nevada Wildlife Action Plan 2012, Dayton 1931, Austin and Hash 1988, Johnson 1979, Benson et al. 2011). Ungulates, such as pronghorns (Antilocapra americana), browse black greasewood. It also receives light to moderate use by mule deer (Odocoileus hemionus) during spring and summer months. Trace amounts of black greasewood were identified in the feces of pronghorn (seasonal preference was not determined) in a microhistology study by Johnson (1979). Furthermore, pronghorn and mule deer that occurred in greasewood habitat, utilized greasewood for cover, although the study did not determine if black greasewood was a desirable forage (Hanley and Hanley 1982). Small mammals will also utilize black greasewood. For example, trace amounts of black greasewood were identified in the feces of black-tailed jack rabbits (Lepus californicus), seasonal preference was not determined (Johnson 1979). A study in the Great Basin by Feldhamer (1979) found that pocket mice (Chaetodipus pencillatus) and chipmunk (Neotamias quadrimaculatus) populations were restricted to plant communities dominated by black greasewood. Furthermore, black greasewood habitat is documented as used in minor amounts by other small mammals including voles, chipmunks, porcupines (Hystricomorph hystricidae), and raccoons (Anderson 2004). Soils of this habitat tend to be loose and either sandy or gravelly and are often easy to dig making them attractive to species such as the pale kangaroo mouse (Microdipodops pallidus) (Nevada Wildlife Action Plan 2012). This habitat is also an important feeding ground for pallid bats (Antrozous pallidus), which eat scorpions and other large invertebrates off its exposed desert flats (Nevada Wildlife Action Plan 2012). Black greasewood provides cover and nest sites for birds including lark buntings (Calamospiza melanocorys). Bird species, such as the sage sparrow (Artemisiospiza nevadensis) and lark buntings, are known to utilize black grease wood habitat (Wiens and Rotenberry 1981, USDA, Ecological Site Interpretation). The loggerhead shrike (Lanius ludovicianus) will use black greasewood for nesting and cover. Burrowing owls (Athene cunicularia) will use the loose soils for burrowing. Bald eagles (Haliaeetus leucocephalus) and prairie falcons (Falco mexicanus) winter in the valley bottoms where black greasewood occurs, preying on jack rabbits, and other rodents Nevada Wildlife Action Plan 2012).

Reptile and amphibian distribution is not widely studied throughout the intermountain cold desert shrub region; however, several reptiles and amphibians are recorded to occur throughout Nevada, where fourwing saltbush, black greasewood and winterfat are known to grow (Bernard and Brown 1977). In black greasewood habitat specifically, western rattle snakes (Crotalus viridis) and gopher snakes (Pituophis catenifer catenifer) were recorded in a study by Diller and Johnson (1988). Studies have not determined if all species of reptiles and amphibians prefer certain species of saltbush or greasewood; however, researchers agree that maintaining habitat where saltbush and greasewood and reptiles and amphibians occur is important; however, there has been no research regarding the effect of saltbush and greasewood on reptile and amphibian habitat and distribution (Linsdale 1938,West 1999 and ref. therein). It should be noted that habitats within the Great Basin, intermountain cold desert shrub, such as black greasewood dominated communities are also the primary habitat of the long-nosed leopard lizard (Nevada Wildlife Action Plan 2012).

Wildlife forage only lightly on rubber rabbitbrush during the summer, but winter use can be heavy in some locations. Fall use is variable, but flowers are often used by wildlife. A few leaves and the more tender stems may also be used. The forage value of rubber rabbitbrush varies greatly among subspecies and ecotypes.
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

Permeability is slow. Runoff is very low to very high. Water flow patterns are rare to common depending on proximity of site to a well-defined in-flow channel. Moderately fine to fine surface textures result in limited infiltration rates and ponding is of run-in water is common for short period in the late winter or early spring. Concentrations of surface salts and sodium result in chemical crusts which also impedes precipitation infiltration. Water flow patterns are typically short, ending in depressional areas.

Recreational uses

Aesthetic value is derived from the diverse floral and faunal composition. This site offers opportunities to photographers and for nature study. This site has potential for upland and big game hunting.

Other products

The leaves, seeds and stems of black greasewood are edible. Basin wildrye was used as bedding for various Native American ceremonies, providing a cool place for dancers to stand.

Other information

Black greasewood is useful for stabilizing soil on wind-blown areas. It successfully revegetates processed oil shale and is commonly found on eroded areas and sites too saline for most plant species. 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. Alkali sacaton is one of the most commonly used species for seeding and stabilizing disturbed lands. Due to alkali sacaton’s salt tolerance, is recommended for native grass seeding on subirrigated saline sites. Given its extensive system of rhizomes and roots which form a dense sod, saltgrass is considered a suitable species for controlling wind and water erosion. Western wheatgrass is a good soil binder and is well suited for reclamation of disturbed sites such as erosion control and soil stabilization.

Type locality

Location 1: White Pine County, NV	
Township/Range/Section	T15N R67E S29
Latitude	39° 8′ 10″
Longitude	114° 28′ 33″
General legal description	Section 29, T15N. R67E. MDBM. East of South Bastion Spring, Spring Valley area, White Pine County, Nevada.

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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	06/22/2006
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** This site is nearly level, thus rills are not expected.

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2. **Presence of water flow patterns:** Water flow patterns are rare to common depending on proximity of site to a well-defined in-flow channel. Moderately fine to fine surface textures result in limited infiltration rates and ponding is of run-in water is common for short period in the late winter or early spring. Concentrations of surface salts and sodium result in chemical crusts which also impedes precipitation infiltration. Water flow patterns are typically short, ending in depressional areas.

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

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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 30-45%

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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 of grasses and annual & perennial forbs) is only expected to move during periods of flooding by adjacent streams. Persistent litter (large woody material) will remain in place except during major flooding or ponding 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 will range from 3 to 6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure of soil surface is typically subangular blocky parting to fine granular. Soil surface colors are grayish-browns and the soils are typified by an ochric epipedon. Soil surface textures are clay loams and silty clays. Organic carbon can range from 1.5 to over 3 percent and will vary with 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:** Deep-rooted perennial grasses (basin wildrye and alkali sacaton] slow runoff and increase infiltration. Tall stature and relatively coarse foliage of basin wildrye and associated litter break raindrop impact and provide opportunity for snow catch and moisture 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. Massive subsoil structure or calcic horizons are normal for this site and are not to be interpreted as compaction.

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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 State: Tall-statured, deep-rooted, cool season, perennial bunchgrasses (basin wildrye) > warm season perennial bunchgrasses >

    Sub-dominant: Short-statured rhizomatous grasses > tall shrubs >associated perennial grasses and grass-like plants = deep-rooted, cool season, perennial forbs = fibrous, shallow-rooted, cool season, perennial and annual forbs. (By above ground production)

    Other: evergreen trees, microbiotic crusts

    Additional:

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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

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14. **Average percent litter cover (%) and depth (in):** Within plant interspaces (30-40%) and depth of litter ± ½ inch.

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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 (through end of June) ± 1500 lbs/ac; Winter moisture significantly affects total production. Favorable years ±2200 lbs/ac and unfavorable years ±800 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 annual mustards, cheatgrass, thistles, camel thorn, annual kochia, tall whitetop, and salt cedar. Rocky Mountain juniper may also 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. Reduced growth and reproduction occur during extreme or extended drought periods.
