# Ecological site R024XY008NV
# SODIC FLAT 8-10 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

Major Land Resource Area (MLRA): 024X–Humboldt Basin and Range Area 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, occur 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

## Ecological site concept

This ecological site is on alluvial flats. Soils are deep, poorly to somewhat poorly drained, and formed in alluvium derived from mixed rocks with a component of volcanic ash. The soil profile is characterized by an ochric epipdeon, a pH greater than 8.0 throughout, sodicity (SAR) greater than 30 and a water table between 90 to 150cm at some point during the spring. Soil textures are fine sandy loam or silt clay loam. Important abiotic factors include 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. Full consideration should be given to combining this ecological site concept with Sodic Flat 6-8" PZ (024XY011NV), and Dry Sodic Floodplain (024XY112OR). These sites may not compete on soil characteristics, abiotic factors or species composition.

## Associated sites

| | |
|---|---|
| **R024XY007NV** | **SALINE BOTTOM**<br><br>Saline Bottom ecological site is on alluvial flats, stream terraces and flood plains. Soils are very deep, somewhat poorly drained and formed in alluvium derived from mixed alluvium, loess and volcanic ash. Dominant plant species are greasewood (SAVE4) and basin wildrye (LEXI4). |

| | |
|---|---|
| **R024XY006NV** | **DRY FLOODPLAIN**<br><br>The plant community is dominated by basin wildrye (LEXI4). Big sagebrush (ARTRT) is an important associated species. Important abiotic factors associated with this site include silt loam soil textures resulting in increased water holding capacity. |

## Similar sites

| | |
|---|---|
| **R024XY011NV** | **SODIC FLAT 6-8 P.Z.**<br><br>Less productive site; typically occurs on basin floor adjacent to playa, not along axial-streams. |
| **R024XY006NV** | **DRY FLOODPLAIN**<br><br>Soils are very deep and a landform position that experiences rare flooding and concentrates run-in moisture. Big sagebrush (ARTR2) dominant shrub; Greasewood (SAVE4) minor shrub, or absent. |
| **R024XY007NV** | **SALINE BOTTOM**<br><br>This ecological site includes sodicity, and high amounts of soluble salts in the profile. More productive site; Basin wildrye (LECI4) dominant plant. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | (1) *Sarcobatus vermiculatus* |
| Herbaceous | (1) *Leymus cinereus* |

## Physiographic features

This site typically is on lake plains, alluvial flats and lake terraces. Slopes range from 0 to 8 percent, but slope gradients of 0 to 2 percent are most typical. Elevations are 3900 to 5800 feet (1189 to 1768 meters).

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Lake plain<br>(2) Alluvial flat<br>(3) Lake terrace |
| Runoff class | Low to medium |
| Ponding duration | Very brief (4 to 48 hours) to long (7 to 30 days) |
| Ponding frequency | Rare to occasional |

| | |
|---|---|
| Elevation | 1,190 – 1,770 m |
| Slope | 0 % |
| Water table depth | 100 – 180 cm |
| Aspect | Aspect is not a significant factor |

### Climatic features

The climate associated with this site is semiarid and characterized by cool, moist winters and warm, dry summers. Average annual precipitation is 8 to 10 inches (20 to 25 cm) Mean annual air temperature is 45 to 50 degrees F. The average growing season is about 90 to 120 days.

**Table 3 Representative climatic features**

| | |
|---|---|
| Frost-free period (average) | 110 days |
| Freeze-free period (average) | |
| Precipitation total (average) | 250 mm |

### Influencing water features

This site is associated with lake plains and is subjected to flooding or ponding.

### Soil features

The soils associated with this site are deep to very deep, poorly to somewhat poorly drained, and formed in alluvium derived from mixed rocks with a component of volcanic ash. The soil profile is characterized by an ochric epipdeon, a pH greater than 8.0 throughout and a water table between 90 to 150cm at some point during the spring. Sodicity (SAR) is greater than 30 and soil surface will crust on drying. Soil textures are fine sandy loam or silt clay loam.
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. Ponding from run-on water is common. Potential for sheet and rill erosion is slight to moderate. Soil series associated with this site include: Cluro, Gund, Moranch, Ocala, and Updike.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Alluvium<br>(2) Volcanic ash |
| Surface texture | (1) Silt loam<br>(2) Loam<br>(3) Sandy loam |

| | |
|---|---|
| Family particle size | (1) Loamy |
| Drainage class | Somewhat poorly drained to well drained |
| Permeability class | Slow to moderately slow |
| Soil depth | 180 – 210 cm |
| Surface fragment cover <=3" | Not specified |
| Surface fragment cover >3" | Not specified |
| Available water capacity (0-101.6cm) | 16.51 – 20.07 cm |
| Calcium carbonate equivalent (0-101.6cm) | 0 – 30 % |
| Electrical conductivity (0-101.6cm) | 0 – 30 mmhos/cm |
| Sodium adsorption ratio (0-101.6cm) | 30 – 90 |
| Soil reaction (1:1 water) (0-101.6cm) | 7.4 – 9.6 |
| Subsurface fragment volume <=3" (Depth not specified) | 0 – 40 % |
| Subsurface fragment volume >3" (Depth not specified) | Not specified |

**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 black greasewood with an understory of basin wildrye. Inland saltgrass and alkali sacaton are also common on these sites.
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 (6 to17 meters) below the surface.
Romo (1984) observed water tables ranging from 3.5-15 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 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 (10 meters) deep (Harr and Price 1972, Blauer et al. 1976, Branson et al. 1976, Blaisdell and Holmgren 1984, Eddleman 2002). Black greasewood is typically 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). (Ganskopp (1986) reported that water tables within 9.8 to 11.8 inches (25 to 30 cm) of the surface had no effect on black greasewood in Oregon. However, a study, conducted in California, observed black greasewood to not survive six months of continuous flooding (Groeneveld and Crowley 1988, Groeneveld 1990). Additionally, seasonally high water tables is 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, but prolonged drought will eventually cause a decline in shrubs, including black greasewood. Marcum and Kopec (1997) observed inland saltgrass more tolerant of increased levels of salinity than alkali sacaton therefore dewatering and/or long term drought causing 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; therefore 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 greasewood and basin wildrye and an increase in rabbitbrush (Ericameria nauseosa) and other species that are not groundwater dependent. Annual non-native species such as halogeton (Halogeton glomeratus) and cheatgrass (Bromus tectorum) invade these sites where competition from perennial species is decreased. Three alternative stable states have been identified for this site.

Fire Ecology:
Fire is a rare disturbance in these plant communities likely occurring in years with above average production. Natural fire return intervals are estimated to vary between 35 years up to 100+ years in salt desert ecosystems with 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 (76 cm) within 3 years. Grazing and other disturbance may result in increased biomass production due to sprouting and increased seed production, also leading to greater fuel loads (Sanderson and Stutz 1994). Higher production sites would have experienced 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.

Bottlebrush squirreltail's small size, coarse stems, and sparse leafy material aid in its tolerance of fire. Postfire regeneration is a result of surviving root crowns and from seed sources both onsite and offsite. Frequency of disturbance greatly influences postfire response of bottlebrush squirreltail. Undisturbed plants within a 6 to 9 year age class generally contain large amounts of dead material, increasing bottlebrush squirreltail's susceptibility to fire.

Inland saltgrass rhizomes occur deep in the soil where they are insulated from the heat of most fires. Saltgrass survives fire by sending up new growth from rhizomes.

## State and transition model

**Figure 3. State and Transitional Model**

**Figure 4. STM Narrative**

## Additional community tables

**Table 5. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Primary Perennial Grasses** | | | 96-293 | |
| | basin wildrye | LECI4 | *Leymus cinereus* | 76-202 | – |
| | squirreltail | ELEL5 | *Elymus elymoides* | 10-50 | – |
| | saltgrass | DISP | *Distichlis spicata* | 10-40 | – |
| 2 | **Secondary Perennial Grasses** | | | 10-26 | |
| | western wheatgrass | PASM | *Pascopyrum smithii* | 2-16 | – |
| | alkali sacaton | SPAI | *Sporobolus airoides* | 2-16 | – |
| **Forb** | | | | | |
| 3 | **Perennial Forbs** | | | 10-40 | |
| | povertyweed | IVAX | *Iva axillaris* | 2-10 | – |
| | princesplume | STANL | *Stanleya* | 2-10 | – |
| | thelypody | THELY | *Thelypodium* | 2-10 | – |
| **Shrub/Vine** | | | | | |
| 4 | **Primary Perennial Shrubs** | | | 252-328 | |
| | greasewood | SAVE4 | *Sarcobatus vermiculatus* | 252-328 | – |
| 5 | **Secondary Shrubs** | | | 10-40 | |
| | rubber rabbitbrush | ERNAN5 | *Ericameria nauseosa ssp. nauseosa var. nauseosa* | 6-16 | – |
| | spiny hopsage | GRSP | *Grayia spinosa* | 6-16 | – |

**Table 6. Community 1.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 7. Community 1.3 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 8. Community 2.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 9. Community 2.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 10. Community 2.3 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 11. Community 3.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 12. Community 3.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 13. Community 4.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

**Table 14. Community 4.2 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production () | Foliar Cover (%) |
|---|---|---|---|---|---|

## Animal community

Livestock Interpretations: Traditionally, salt-desert shrub communities provided good winter forage for the expanding sheep and cattle industry in the arid west. Basin wildrye and alkali sacaton will eventually decline with continued abusive grazing. Spring defoliation of basin wildrye and/or consistent, heavy grazing during the growing season may significantly reduce basin wildrye production and density (Krall et al. 1971). Alkali sacaton may 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). 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 smotherweed, mustards, halogeton, cheatgrass (Roundy 1985) and Russian thistle. Black greasewood is typically not considered an important browse species for wildlife and livestock. However, 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 observed to have the highest amounts of crude protein when compared to perennial and annual grasses. Black greasewood plants contain high amounts of sodium and potassium oxalates which are toxic to livestock and caution should be taken when grazing these communities. 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). Black greasewood also provides good cover for wildlife species (Benson et al. 2011). 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: 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. Basin wildrye provides winter forage for mule deer, though use is commonly 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. Bottlebrush squirreltail is a dietary component of several wildlife species. Bottlebrush squirreltail may provide forage for mule deer and pronghorn. Saltgrass provides cover for a variety of bird species, small mammals, and arthropods and is on occasion used as forage for several big game wildlife species.

## Hydrological functions

Runoff is low to high. Permeability is slow to moderately slow. Hydrologic soil groups are B, C, and D. Rills are none. Water flow patterns are rare to common. Water flow patterns are typically short, ending in depressional areas. Pedestals are none. "Playette" interspaces between vegetated hummocks have very low infiltration and are ponded for short periods with early spring snow melt (run-in). Tall statured shrubs and associated litter break raindrop impact and provide some opportunity for snow catch and moisture accumulation on the mounds or hummocks that support the majority of vegetation characteristic for this site.

## Recreational uses

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

## Other products

The leaves, seeds and stems of black greasewood are edible. Basin wildrye is 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 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. Bottlebrush squirreltail is tolerant of disturbance and is a suitable species for revegetation. 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.

## Inventory data references

NASIS soil component data was used.

## Type locality

Location 1: Elko County, NV

| | |
|---|---|
| Township/Range/Section | T36N R59E S6 |
| UTM zone | N |
| UTM northing | 4543696 |
| UTM easting | 637795 |
| Latitude | 41° 1′58″ |
| Longitude | 115° 21′38″ |
| General legal description | NW¼NE¼ Approximately 26 miles east of Elko, along south side of I-80, outer margins of Humboldt River floodplain, Elko County, Nevada. This site also occurs in Eureka, Humboldt, Lander, Pershing, and Washoe Counties, Nevada. |

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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) | Patti Novak-Echenique |
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| Date | 12/17/2009 |
| Approved by | |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

### Indicators

1. **Number and extent of rills:** Rills are none.

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2. **Presence of water flow patterns:** Water flow patterns are rare to common. 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.

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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 ± 75 percent.

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5. **Number of gullies and erosion associated with gullies:** Gullies are 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) only expected to move during periods of ponding or flooding. Persistent litter (large woody material) will remain in place except during major ponding or flooding 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 range from 4 to 6 under canopy and 2 to 4 in the interspaces.

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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 thin to medium platy or granular. Soil surface colors are light grays or pale browns and are typified by an ochric epipedon. Organic matter can range from about 1 percent to 2.5 percent.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** "Playette" interspaces between vegetated hummocks have very low infiltration and are ponded for short periods with early spring snowmelt (run-in). Tall statured shrubs and associated litter break raindrop impact and provide some opportunity for snow catch and moisture accumulation on the mounds or hummocks that support the majority of vegetation characteristic for this 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 not typical. Platy, subangular blocky, prismatic, or massive subsurface layers 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: Salt-desert phreatophytic shrubs (Black greasewood)**

    **Sub-dominant: tall-statured, deep-rooted, cool season, perennial bunchgrasses > short-statured rhizomatous grasses > associated perennial grasses and grass-like plants = deep-rooted, cool season, perennial forbs = fibrous, shallow-rooted, cool season, perennial and annual forbs**

    **Other: 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 common and standing dead shrub canopy material may be as much as 25 percent of total woody canopy.**

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14. **Average percent litter cover (%) and depth ( in): Within plant interspaces 10-25% and depth of litter ± ¼ 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 May) ±450 lbs/ac; Winter moisture significantly affects total production. Favorable years ±700 lbs/ac and unfavorable years ±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 annual mustards, bur buttercup, smotherweed, halogeton, and cheatgrass.**

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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.**

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