USDA Natural Resources
Conservation Service

Ecological site R018XA101CA
Basalt Flow Plateaus

Last updated: 4/24/2024
Accessed: 05/11/2025

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.

MLRA notes

Major Land Resource Area (MLRA): 018X–Sierra Nevada Foothills

Major Land Resource Area (MLRA) 18, Sierra Nevada Foothills is located entirely in California and runs north to south adjacent to and down-slope of the west side of the Sierra Nevada Mountains (MLRA 22A). MLRA 18 includes rolling to steep dissected hills and low mountains, with several very steep river valleys. Climate is distinctively Mediterranean (xeric soil moisture regime) with hot, dry summers, and relatively cool, wet winters. Most of the precipitation comes as rain; average annual precipitation ranges from 15 to 55 inches in most of the area (precipitation generally increases with elevation and from south to north). Soil temperature regime is thermic; mean annual air temperature generally ranges between 52 and 64 degrees F. Geology is rather complex in this region; there were several volcanic flow and ashfall events, as well as tectonic uplift, during the past 25 million years that contributed to the current landscape.

LRU notes

The Tuscan Flows LRU is the northernmost Land Resource Unit in MLRA 18. It occurs down slope of and is geologically related to the southern Cascades; however, its inclusion in MLRA 18 stems from the ecosystem’s close resemblance to other Sierra Nevada Foothill systems. This LRU is situated on a low elevation volcanic plateau at the northeast end of the Sacramento Valley. The geology includes, but not limited to late Pliocene and Quartenary basalt, andesite and andesitic lahars (mudflows). Several cinder cones dot the landscape and active fluvial processes are occurring in the larger canyons. Elevation ranges between 250 and 2000 feet above sea level on the main plateau, but can range as high as 3000 feet on the highest hills. Precipitation is among the highest in MLRA 18, ranging from 30 to 55 inches annually. Mean annual air temperature ranges between 56 and 62 F. Frost free days (generally exhibiting an inverse relationship with elevation) range from 184 to 282 days.

Classification relationships

CLASSIFICATION RELATIONSHIPS
This site is located within M261F, the Sierra Nevada Foothills Section, (McNab et al., 2007) of the National Hierarchical Framework of Ecological Units (Cleland et al., 1997), M261Fa, the Tuscan Flows Subsection.

Level III and Level IV ecoregions systems (Omernik, 1987, and EPA, 2011) are: Level III, Central California Foothills and Coastal Mountains and Level IV, Ecoregion 6a, Tuscan Flows.

Ecological site concept

This ecological site occurs on plateaus and erosion remnants formed in residuum from basalt lava flows. This site comprises a fine-scale mosaic with mounds, swale, and bedrock outcrops. Annual precipitation typically ranges between 32 and 36 inches. Slope percent ranges from 2 to 20%. Elevation ranges from 400 to 1350 feet. Soil temperature regime is thermic.

Plant communities in this ecological site are primarily constrained by hydrology, especially in the most poorly drained positions where seasonal ponding occurs. Common soils correlated to this ecological site are Doemill and Jokerst (Loamy, mixed, superactive, thermic Lithic Haploxeralfs); and Beatsonhollow and Thermalrocks (Loamy-skeletal, mixed, superactive, thermic Lithic Haplohumults). In some map units where this ecological site has been identified, particularly on broad plateau summits, there are unnamed components occurring in the swale positions representing frequent long ponding.

Beatsonhollow soils represent the swale portions of the landscape; these soils are poorly drained and are classified as loamy-skeletal, mixed, superactive, thermic Lithic Haplohumults. The vegetation community most likely to be found on the Beatsonhollow component includes soft chess (Bromus hordeaceus), medusahead (Taeniatherum caput-medusae), fillaree (Erodium spp.), rattlesnake brome (Bromus briziformis), lupine (Lupinus spp.), brodiaea (Brodiaea spp.) and vinegarweed (Trichostema lanceolatum).

Thermalrocks components are on shallow convex positions of basalt plateaus. These soils are classified as loamy-skeletal, mixed, superactive, thermic Lithic Haplohumults. These are better drained portions of the landscape with very high runoff; the vegetation consists of silver hairgrass (Aira caryophyllea), Sierra mock stone crop (Sedulla pumila), Hansons spike moss (Selaginella hansenii), soft chess (Bromus hordeaceus), filaree (Erodium spp.), red brome (Bromus rubens), medusahead (Taeniatherum caput-medusae), fiddleneck (Amsinckia spp.), lupine (Lupinus spp.), buckwheat (Eriogonum spp.), nitgrass (Gastridium spp.), vinegar weed (Trichostema), brodiaea (Brodiaea spp.) and Mariposa lily (Calochortus spp.).

Vernal pools make up approximately one to 2 percent of the landscape and may not be associated with every swale. These seasonal pools can vary year-to-year in size and duration. Between-year and within-year differences in hydrology influence the vegetation communities around the pools, which are generally dominated by annuals. During the early spring when the water table is high, plants such as Pacific foxtail (Alopecurus saccatus), eryngo (Eryngium), and meadowfoam (Limnanthes spp.) can be found near or within the pools.

Associated sites

F018XA201CA	**Deep Thermic Hillslopes** This site commonly occurs nearby.

Similar sites

R018XI101CA	**Shallow Latite Ridgetops** Site relationships being developed.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Lupinus* (2) *Erodium*
Herbaceous	(1) *Bromus hordeaceus* (2) *Taeniatherum caput-medusae*

Physiographic features

This site generally occurs at elevations ranging from 210 to 1330 feet on slopes ranging from 1 to 5%.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Plateau > Mound (2) Foothills > Plateau > Swale
Runoff class	Very high
Flooding duration	Very brief (4 to 48 hours)

Flooding frequency	None to frequent
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to frequent
Elevation	210–1,330 ft
Slope	1–5%
Ponding depth	0–2 in
Water table depth	0–40 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Very high
Flooding duration	Very brief (4 to 48 hours)
Flooding frequency	None to frequent
Ponding duration	Brief (2 to 7 days)
Ponding frequency	None to frequent
Elevation	150–1,580 ft
Slope	0–30%
Ponding depth	0–5 in
Water table depth	0–40 in

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 32 to 36 inches and usually falls from October to May. Mean annual temperature is 59 to 63 degrees F with 222 to 238 frost-free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	222-238 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	32-36 in
Frost-free period (actual range)	218-242 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	31-37 in
Frost-free period (average)	230 days
Freeze-free period (average)	365 days
Precipitation total (average)	34 in

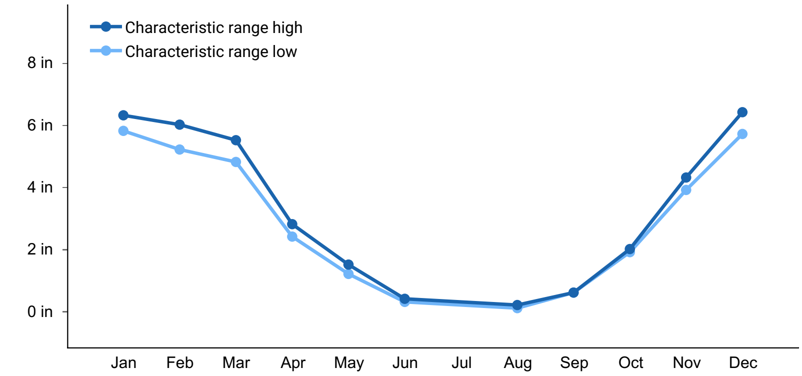


Figure 1. Monthly precipitation range

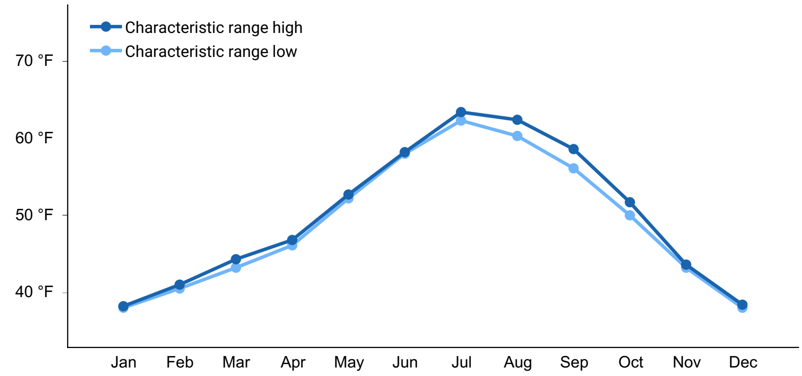


Figure 2. Monthly minimum temperature range

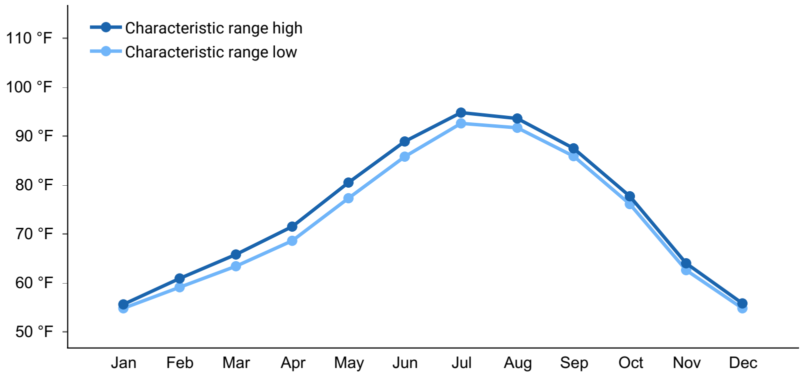


Figure 3. Monthly maximum temperature range

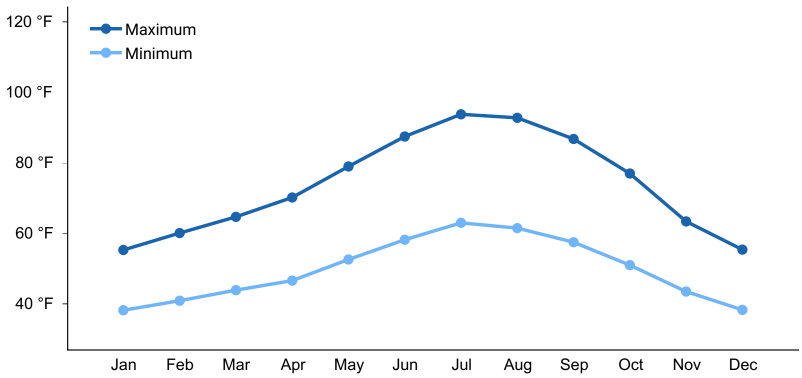


Figure 4. Monthly average minimum and maximum temperature

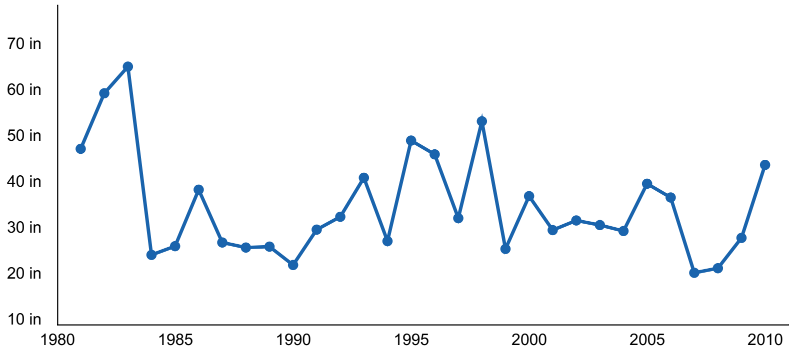


Figure 5. Annual precipitation pattern

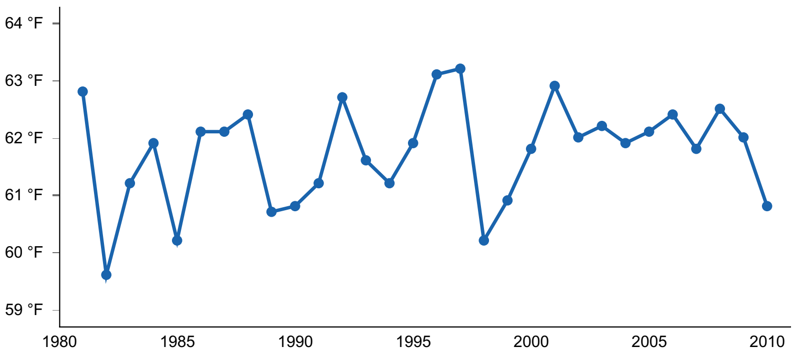


Figure 6. Annual average temperature pattern

Climate stations used

- (1) AUBURN [USC00040383], Auburn, CA
- (2) OROVILLE [USC00046521], Oroville, CA

Influencing water features

Vernal pools comprise up to 2 percent of the landscape, but may not be associated with every plateau or swale position on a plateau. Size and duration of ponding in pools varies from year-to-year, connectivity of drainageways and proximity to edge of plateau. Broader plateaus have longer periods of saturation/ponding reflecting the longer transit time of water to the edge of the landform, where conspicuous water falls can occur. Vernal pools generally experience frequent, very brief flooding (4 to 48 hours) in months of December through March, as well as frequent, very brief to brief ponding (4 hours to 7 days) from November to April. Between-year and within-year differences in hydrology influence the vegetation communities around the pools, which are generally dominated by annuals.

Soil features

The soils in this ecological site are formed in residuum from basalt or volcanic breccia on tops of plateaus or eroded remnants of volcanic plateaus. The typical depth range is very shallow to moderately deep. These soils are generally 4 to 36 inches deep to restrictive bedrock. Deeper soils (20 to 40 inches) occur on mound positions, in fissures in the basalt bedrock, or colluvium around margins of plateaus or on eroded remnants of volcanic plateaus. The particle size control section is Loamy or Loamy-skeletal. Deeper soils occurring on mound positions are generally fine-loamy. Surface textures include gravelly loam, very gravelly loam and very cobbly loam. Gravels on the soil surface range from 5 to 15% cover, and larger fragments on the soil surface range from 5 to 40% cover. Gravels (<3 inch diameter) range from 5 to 35% by volume throughout the profile. Larger fragments (=3 inch diameter) range from 0 to 25% by volume throughout the profile. Most soils in this ecological site are somewhat poorly drained (mound) or poorly drained (swale). Well drained areas occur on narrower plateaus or areas with deeper soils. The mound/swale microtopography leads to water collecting in concave areas with very shallow and shallow soils. Soils in this ecological site have impeded drainage because of their shallow depth over impermeable bedrock, which in some cases results in a seasonal shallow (perched) water table. These soils experience frequent, very brief flooding (4 to 48 hours) in months of December through March, as well as frequent, very brief to brief ponding (4 hours to 7 days) from November to April. Available Water Storage (AWS) in the profile ranges from 0.5

to 4.5 inches. Surface pH ranges from 5.1 to 6.7 while subsurface reaction is from 5.5 to 6.7. Common soil series correlated to this ecological site include Doemill / Jokerst (both Loamy, mixed, superactive, thermic Lithic Haploxeralfs); and Beatsonhollow /Thermalrocks (both Loamy-skeletal, mixed, superactive, thermic Lithic Haplohumults).

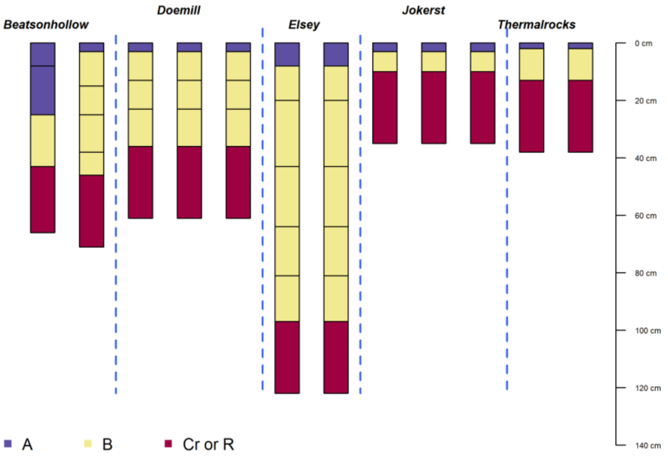


Figure 7.

Table 5. Representative soil features

Parent material	(1) Residuum–basalt (2) Residuum–volcanic breccia
Surface texture	(1) Gravelly loam (2) Very cobbly loam (3) Very gravelly loam
Family particle size	(1) Loamy
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Moderately rapid
Depth to restrictive layer	4–36 in
Soil depth	4–36 in
Surface fragment cover <=3"	5–15%
Surface fragment cover >3"	5–40%
Available water capacity (0-40in)	0.5–4.5 in
Soil reaction (1:1 water) (0-10in)	5.1–6.7
Subsurface fragment volume <=3" (0-60in)	5–30%
Subsurface fragment volume >3" (0-60in)	0–25%

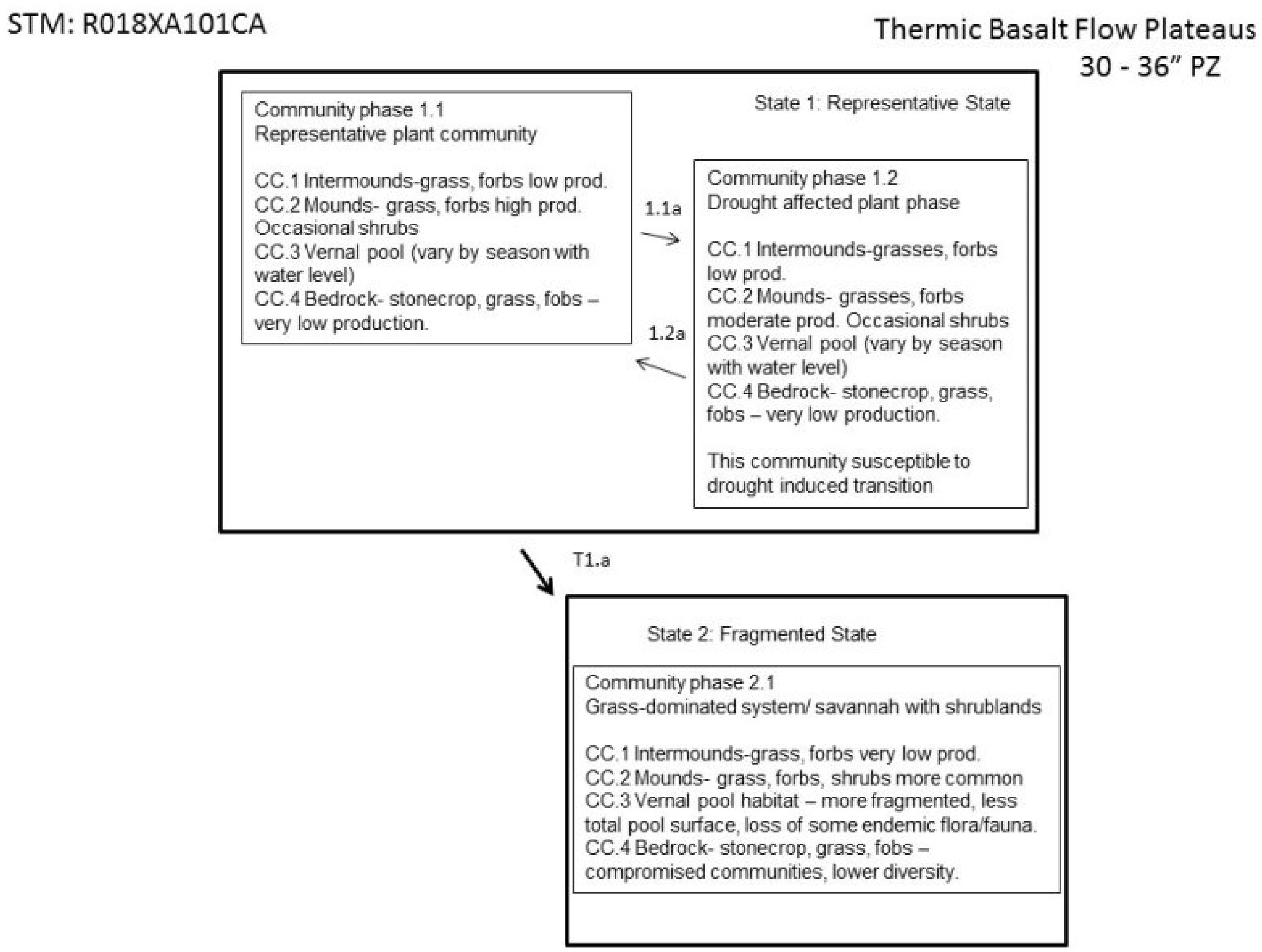
Table 6. Representative soil features (actual values)

Drainage class	Poorly drained to well drained
Permeability class	Moderately rapid
Depth to restrictive layer	4–40 in
Soil depth	4–40 in
Surface fragment cover <=3"	0–60%
Surface fragment cover >3"	0–85%

Available water capacity (0-40in)	0.1–6.4 in
Soil reaction (1:1 water) (0-10in)	4.5–7
Subsurface fragment volume <=3" (0-60in)	0–80%
Subsurface fragment volume >3" (0-60in)	0–90%

Ecological dynamics

State and transition model



Community Pathways and Transition

T1.a This transition occurs due to variations in climate that create more variability in timing and amount of precipitation coupled with warmer winter temperatures. This may lead to fragmentation and/or less biodiversity in the ephemeral pools, where they do occur. Extinction events may occur for many endemic fauna and flora species within and around the pools. Deeper soils within the complex may increasingly support shrubs (chaparral species) and nutrient and hydrological cycling regimes may be significantly altered.

1.1a Drought conditions and precipitation timing may decrease the extent of the vernal pool communities (a very minor part of the landscape). During drought intermound and mound communities may experience species composition changes and may be less productive. Shrub encroachment may be enhanced, as well. Vernal pools and bedrock plant/animal communities are some of the most vulnerable community types to disruption when environmental changes occur. Additionally, the effect of mismanagement of Increased livestock/ or lack of fencing may lead to nutrient concentration in pools, algal blooms, reduction in biodiversity, and extinction of rare plant and animal species.

1.2a Normal precipitation and/or sustainable range practices.

State 1
Representative State

Community 1.1
Representative plant community

Figure 8. CC1

Figure 9. CC2

Figure 10. CC3

Figure 11. CC4 Higher amounts of winter precipitation

CC.1 Intermounds-grass, forbs low prod. CC.2 Mounds- grass, forbs high prod. Occasional shrubs CC.3 Vernal pool (vary by season with water level) CC.4 Bedrock- stonecrop, grass, fobs – very low production.

Community 1.2
Drought affected plant phase

Figure 12. CC1 Temporary Drought seasons

Figure 13. CC3 Temporary Drought seasons

Figure 14. CC4 Temporary Drought seasons

CC.1 Intermounds-grasses, forbs low prod. CC.2 Mounds- grasses, forbs moderate prod. Occasional shrubs (no photo) CC.3 Vernal pool (vary by season with water level) CC.4 Bedrock- stonecrop, grass, fobs – very low production. This community susceptible to drought induced transition

Pathway 1.1a
Community 1.1 to 1.2

Representative plant community

Drought affected plant phase

Drought conditions and precipitation timing may decrease the extent of the vernal pool communities (a very minor part of the landscape). During drought intermound and mound communities may experience species composition changes and may be less productive. Shrub encroachment may be enhanced, as well. Vernal pools and bedrock plant/animal communities are some of the most vulnerable community types to disruption when environmental changes occur. Additionally, the effect of mismanagement of Increased livestock/ or lack of fencing may lead to nutrient concentration in pools, algal blooms, reduction in biodiversity, and extinction of rare plant and animal species.

Pathway 1.2a
Community 1.2 to 1.1

Drought affected plant phase

Representative plant community

Normal precipitation and/or sustainable range practices.

State 2
Fragmented State

Community 2.1
Grass-dominated system/ savannah with shrublands

CC.1 Intermounds-grass, forbs very low prod. CC.2 Mounds- grass, forbs, shrubs more common CC.3 Vernal pool habitat – more fragmented, less total pool surface, loss of some endemic flora/fauna. CC.4 Bedrock- stonecrop, grass, fobs – compromised communities, lower diversity.

Transition T1.a
State 1 to 2

This transition occurs due to variations in climate that create more variability in timing and amount of precipitation coupled with warmer winter temperatures. This may lead to fragmentation and/or less biodiversity in the ephemeral pools, where they do occur. Extinction events may occur for many endemic fauna and flora species within and around the pools. Deeper soils within the complex may increasingly support shrubs (chaparral species) and nutrient and hydro-logical cycling regimes may be significantly altered.

Additional community tables

Inventory data references

Inventory data to be collected using future projects based on priorities.

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Contributors

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Approval

Kendra Moseley, 4/24/2024

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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

Indicators

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

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

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

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

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

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

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

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

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**