USDA Natural Resources
Conservation Service

Ecological site F018XI207CA
Deep Volcanic Plateaus and Hills

Last updated: 4/24/2024
Accessed: 05/21/2025

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

This LRU (designated XI) is located on moderate to steep hills in the Sierra Nevada Foothills east of Sacramento, Stockton, and Modesto, CA. Various geologies occur in this region: metavolcanics, granodiorite, slate, marble, argillite, schist and quartzite, as well as ultramafic bands to a limited and localized extent. It includes mesa formations from volcanic flows, where vernal pool habitats occur. Soil temperature regime is thermic and soil moisture regime is xeric. Elevation ranges between 300 and 3400 feet above sea level. Precipitation ranges from 14 to 42 inches annually. Most precipitation falls between the months of November and March in the form of rain. Dominant vegetation includes annual grasslands, blue oak (Quercus douglasii), interior live oak (Quercus wislizeni),

chamise (Adenostoma fasciculatum), buckbrush (Ceanothus cuneatus), and foothill pine (Pinus sabiniana).

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), M261Fb, the Lower Foothills Metamorphic Belt 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 6b, Northern Sierran Foothills, Ecoregion 6c, Comanche Terraces.

Ecological site concept

This site is found on strongly sloping to moderately steep hills and nearly level plateaus. It occurs on colluvium-dominated backslopes and footslopes, skirting volcanic ridge formations, and in deep bedrock fractures on top of the plateaus. Slope class ranges from 3 to 45%. Mean annual precipitation typically ranges from 25 to 29 inches.

Deeper soils on side slopes or in fractures allow for establishment of woody vegetation and overstory canopy trees in contrast to the surrounding shallow soils with indurated volcanic bedrock. The main soil components associated with this ecological site are Angelscreek and Miltonhills. Angelscreek soils are very deep, loamy-skeletal, isotic, thermic Pachic Ultic Haploxerolls. Miltonhills soils are moderately deep, coarse-loamy, mixed, superactive, thermic Typic Humixerepts

Vegetation includes open oak woodland with annual herbaceous plants in the understory. Blue oak (Quercus douglasii) tends to be dominant in the overstory component. Scattered interior live oak (Quercus wislizeni) and California foothill pine (Pinus sabiniana) can also occur. Forbs and annual grasses generally exceed 50% canopy cover.

Associated sites

R018XI007CA	**Loamy Foothills** This site commonly occurs nearby.

Similar sites

F018XI206CA	**Clayey Thermic Marble Hills** Site relationships being developed.

Table 1. Dominant plant species

Tree	(1) *Quercus douglasii* (2) *Quercus wislizeni*
Shrub	Not specified
Herbaceous	(1) *Bromus diandrus* (2) *Bromus hordeaceus*

Physiographic features

This site occurs on nearly level plateaus to moderately steep hills with slopes generally ranging from 3-45% and elevations from 350 to 2000 ft.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Lava plateau (2) Foothills > Lahar (3) Foothills > Ridge (4) Foothills > Hill
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	107–610 m
Slope	3–45%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	37–792 m
Slope	2–60%

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 25 to 29 inches and usually falls from October to May. Mean annual temperature is 59 to 64 degrees F with 234 to 332 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	234-332 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	635-737 mm
Frost-free period (actual range)	209-357 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	610-762 mm
Frost-free period (average)	283 days
Freeze-free period (average)	365 days
Precipitation total (average)	686 mm

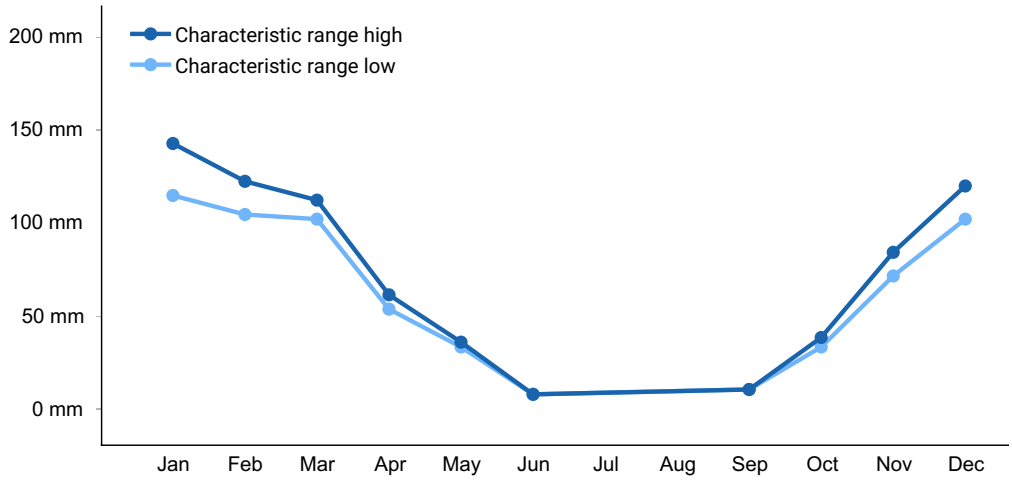

Figure 1. Monthly precipitation range

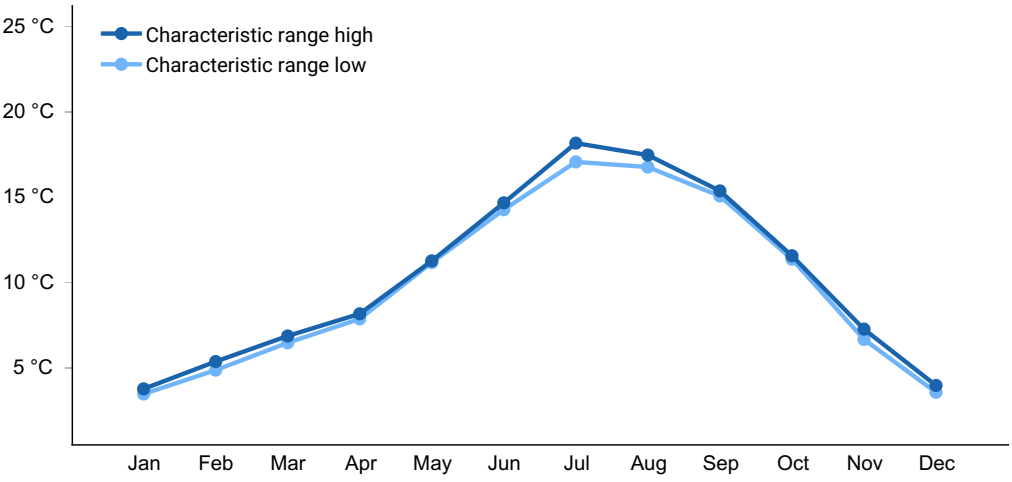

Figure 2. Monthly minimum temperature range

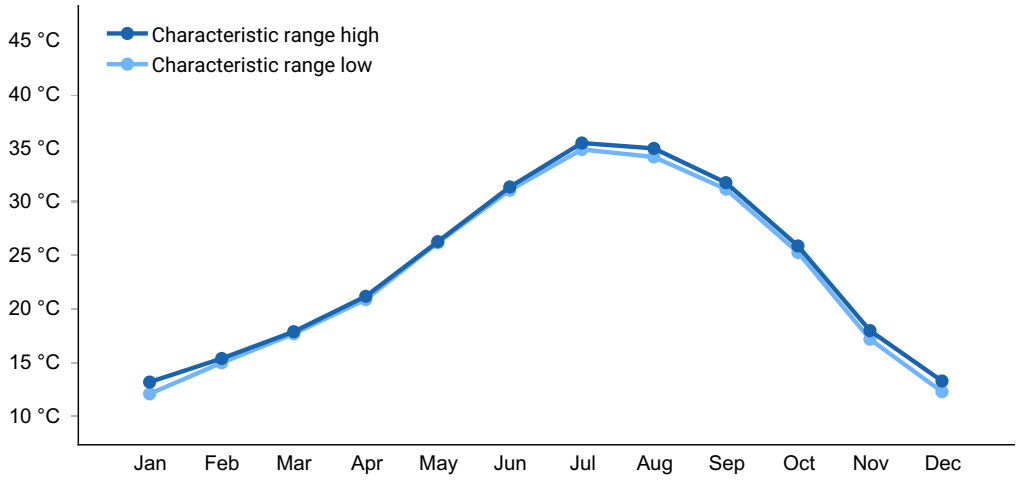

Figure 3. Monthly maximum temperature range

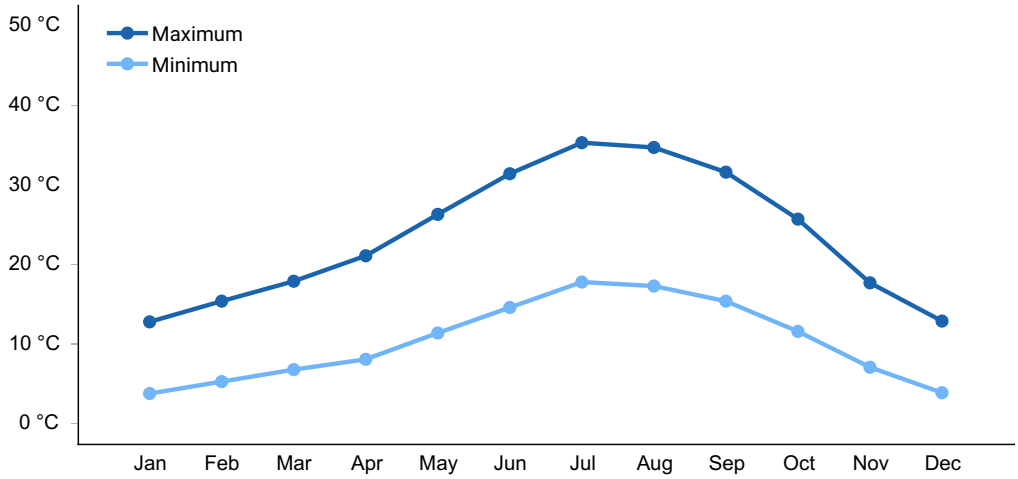

Figure 4. Monthly average minimum and maximum temperature

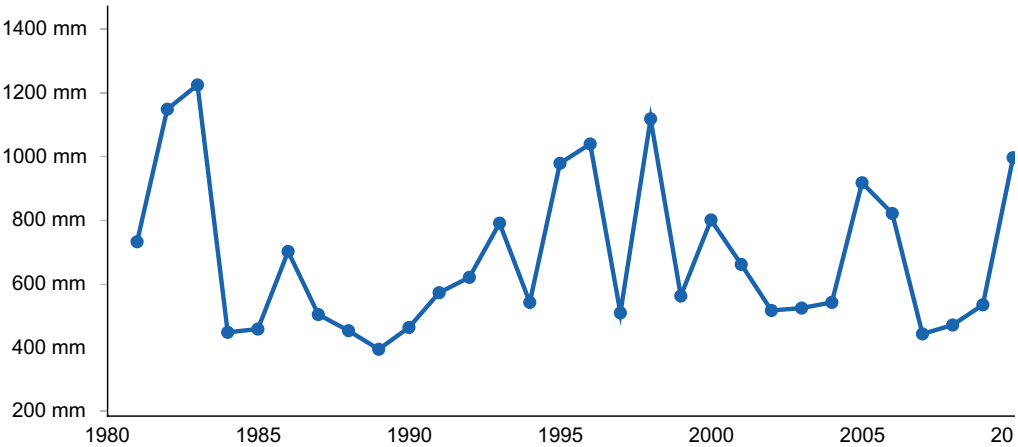

Figure 5. Annual precipitation pattern

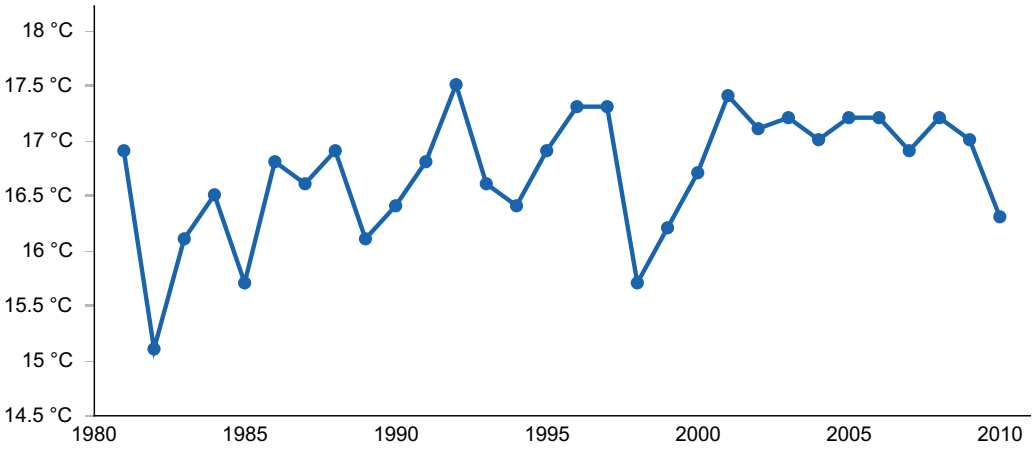

Figure 6. Annual average temperature pattern

Climate stations used

- (1) NEW MELONES DAM HQ [USC00046174], Angels Camp, CA
- (2) CAMP PARDEE [USC00041428], Valley Springs, CA

Influencing water features

Due to the topographic position, this site does not have water features or wetlands.

Wetland description

N/A

Soil features

The soils in this ecological site are formed from the colluvium and residuum of volcanic rocks such as latite, agglomerate and/or tuff. Depth ranges vary from moderately to very deep, the particle size control sections are coarse-loamy to loamy-skeletal. Surface textures include loams, fine sandy loams, gravelly loams, gravelly sandy loams and very stony loams. The bedrock is a restrictive layer found between 24 and 50 inches of depth. Gravels (< 3 inch diameter) range between 0 to 7% cover, while larger fragments (= 3 inch diameter) are 0 to 15% cover. Subsurface gravels range between 4 to 32% and larger fragments occupy 0 to 32% by volume. The soils in this ecological site are well drained and the permeability class ranges from moderately slow to moderately rapid. The Available Water Capacity (AWC) ranges from 3.3 to 6.1 inches. The pH of the top 10 inches of the soil is between 5.8 and 6.4, while the pH of the subsurface ranges from 5.4 to 6.3.

The main soil components associated with this ecological site are Angelscreek and Miltonhills. Angelscreek soils are very deep, loamy-skeletal, isotic, thermic Pachic Ultic Haploxerolls. Miltonhills soils are moderately deep, coarse-loamy, mixed, superactive, thermic Typic Humixerepts.

Table 5. Representative soil features

Parent material	(1) Colluvium–tuff breccia (2) Residuum–tuff breccia (3) Colluvium–latite (4) Colluvium–volcanic rock
Surface texture	(1) Loam (2) Fine sandy loam (3) Gravelly loam (4) Gravelly sandy loam
Family particle size	(1) Coarse-loamy (2) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	61–127 cm
Soil depth	61–127 cm
Surface fragment cover <=3"	0–7%
Surface fragment cover >3"	0–15%
Available water capacity (0-101.6cm)	8.38–15.49 cm
Soil reaction (1:1 water) (0-25.4cm)	5.8–6.4
Subsurface fragment volume <=3" (0-152.4cm)	4–32%
Subsurface fragment volume >3" (0-152.4cm)	0–32%

Table 6. Representative soil features (actual values)

Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	51–152 cm
Soil depth	51–152 cm
Surface fragment cover <=3"	0–25%
Surface fragment cover >3"	0–45%
Available water capacity (0-101.6cm)	2.29–22.35 cm

Soil reaction (1:1 water) (0-25.4cm)	4.6–7.3
Subsurface fragment volume <=3" (0-152.4cm)	0–60%
Subsurface fragment volume >3" (0-152.4cm)	0–69%

Ecological dynamics

State and transition model

Community pathways and Transitions

T1.a This transition occurs after mechanical clearing and/or grazing management that results in loss of oak and acorn (seed) source.

T1.b This transition occurs when invasive grasses or forbs become established.

1.1a This community pathway occurs when a high severity fire removes most of the woody vegetation. Some oaks remain on or near the site. Alternatively, brushing or tree clearing may cause this community pathway.

1.1b This uncommon community pathway occurs when favorable conditions such as abundant moisture and/or seeds (acorns) etc. cause oak regeneration. Low intensity fire or clearing can also result in a resprouting of oaks.

1.2a This community pathway occurs shortly after CP 1.1a, resulting in profuse sprouting of oak trees, some of which escape herbivory and establish into sapling stage.

1.3a This community pathway occurs with normal time and growth.

1.3b This community pathway occurs with intense brushing/tree clearing which removes most of woody vegetation.

T2.a This transition occurs after undesirable invasive plants become established.

R2.a This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

2.1a This community pathway occurs as forbs become more dominant, often following low winter precipitation and reduced litter layers.

2.2a This community pathway occurs as grasses become more dominant, often in response to higher litter levels.

R3.a. This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful. This also may require integrated weed management to reduce the seedling's competition from annual invasive species.

R3.b This restoration pathway occurs with integrated weed management and may require mowing, herbicides, and/or biological control.

3.1a This community pathway occurs as invasive forb species become dominant.

3.2a This community pathway occurs as invasive grass species become dominant.

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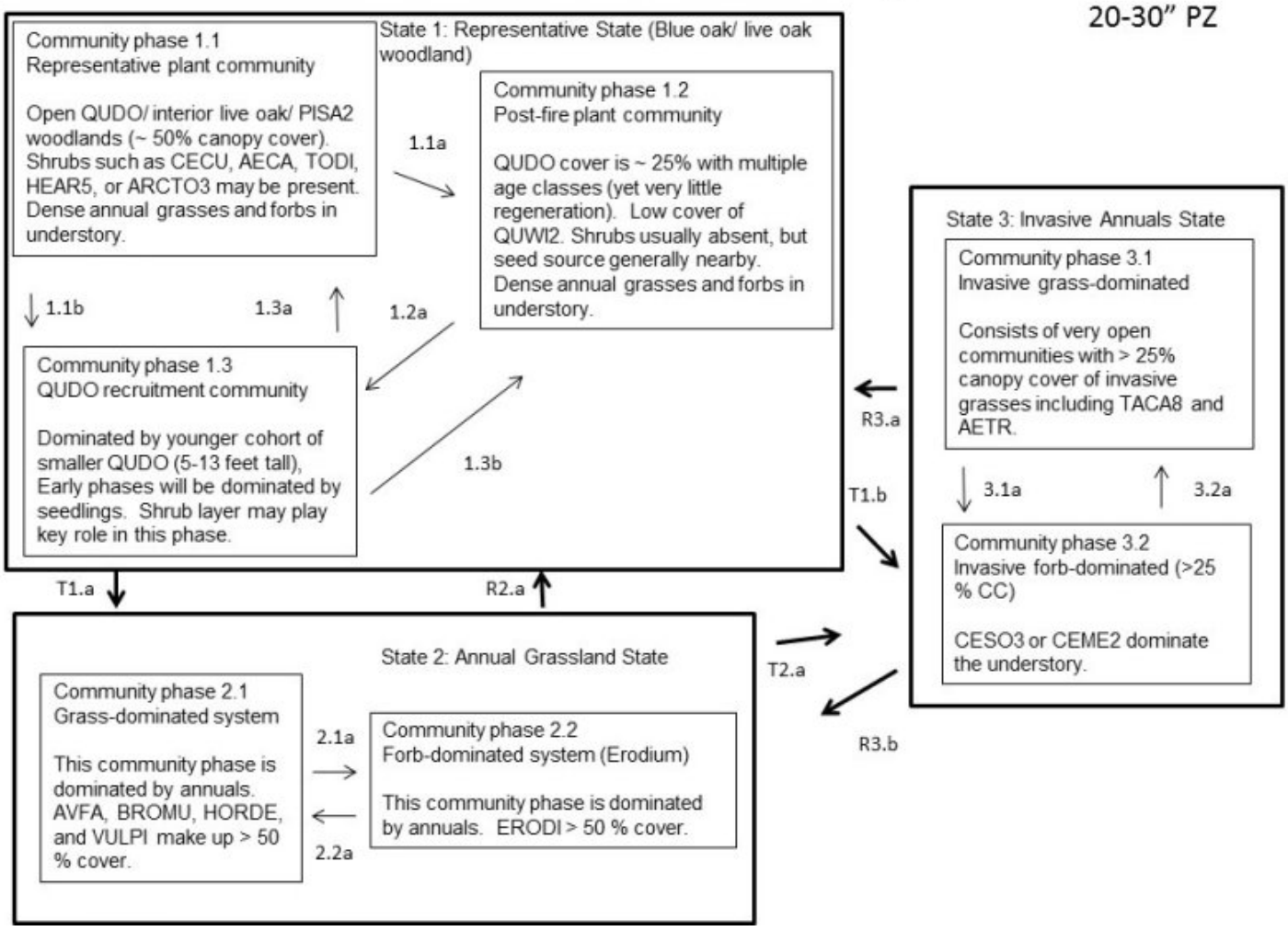
Deep Volcanic Plateaus and Hills
20-30" PZ



State 1
Representative State (Blue oak/ live oak woodland)

Community 1.1
Representative plant community

Open QUDO/ interior live oak/ PISA2 woodlands (~ 50% canopy cover). Shrubs such as CECU, AECA, TODI, HEAR5, or ARCTO3 may be present. Dense annual grasses and forbs in understory.

Community 1.2
Post-fire plant community

QUDO cover is ~ 25% with multiple age classes (yet very little regeneration). Low cover of QUWI2. Shrubs usually absent, but seed source generally nearby. Dense annual grasses and forbs in understory.

Community 1.3
QUDO recruitment community

Dominated by younger cohort of smaller QUDO (5-13 feet tall), Early phases will be dominated by seedlings. Shrub layer may play key role in this phase.

Pathway 1.1a
Community 1.1 to 1.2

Representative plant community

Post-fire plant community

This community pathway occurs when a high severity fire removes most of the woody vegetation. Some oaks remain on or near the site. Alternatively, brushing or tree clearing may cause this community pathway.

Pathway 1.1b
Community 1.1 to 1.3

Representative plant community

QUDO recruitment community

This uncommon community pathway occurs when favorable conditions such as abundant moisture and/or seeds (acorns) etc. cause oak regeneration. Low intensity fire or clearing can also result in a resprouting of oaks.

Pathway 1.2a
Community 1.2 to 1.3

Post-fire plant community

QUDO recruitment community

This community pathway occurs shortly after CP 1.1a, resulting in profuse sprouting of oak trees, some of which escape herbivory and establish into sapling stage.

Pathway 1.3a
Community 1.3 to 1.1

QUDO recruitment community

Representative plant community

This community pathway occurs with normal time and growth.

Pathway 1.3b
Community 1.3 to 1.2

QUDO recruitment community

Post-fire plant community

This community pathway occurs with intense brushing/tree clearing which removes most of woody vegetation.

State 2
Annual Grassland State

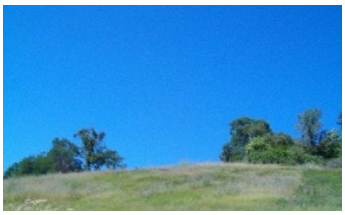
Community 2.1
Grass-dominated system

This community phase is dominated by annuals. AVFA, BROMU, HORDE, and VULPI make up > 50 % cover.

Community 2.2
Forb-dominated system (Erodium)

This community phase is dominated by annuals. ERODI > 50 % cover

Pathway 2.1a
Community 2.1 to 2.2



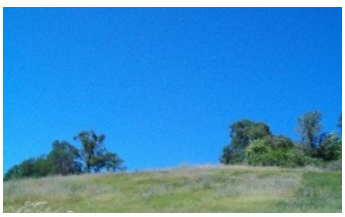
Grass-dominated system

Forb-dominated system (Erodium)

This community pathway occurs as forbs become more dominant, often following low winter precipitation and reduced litter layers.

Pathway 2.2a
Community 2.2 to 2.1

Forb-dominated system (Erodium)



Grass-dominated system

This community pathway occurs as grasses become more dominant, often in response to higher litter levels.

State 3
Invasive Annuals State

Community 3.1
Invasive grass-dominated

Consists of very open communities with > 25% canopy cover of invasive grasses including TACA8 and AETR.

Community 3.2
Invasive forb-dominated (>25 % CC)

CESO3 or CEME2 dominate the understory.

Pathway 3.1a
Community 3.1 to 3.2

Invasive grass-dominated

Invasive forb-dominated (>25 % CC)

This community pathway occurs as invasive forb species become dominant.

Pathway 3.2a
Community 3.2 to 3.1

Invasive forb-dominated (>25 % CC)

Invasive grass-dominated

This community pathway occurs as invasive grass species become dominant.

Transition T1.a
State 1 to 2

This transition occurs after mechanical clearing and/or grazing management that results in loss of oak and acorn (seed) source.

Transition T1.b
State 1 to 3

This transition occurs when invasive grasses or forbs become established.

Restoration pathway R2.a
State 2 to 1

This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

Transition T2.a
State 2 to 3

This transition occurs after undesirable invasive plants become established.

Restoration pathway R3.a
State 3 to 1

This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful. This also may require integrated weed management to reduce the seedling’s competition from annual invasive species.

Restoration pathway R3.b
State 3 to 2

This restoration pathway occurs with integrated weed management and may require mowing, herbicides, and/or biological control.

Additional community tables

Inventory data references

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

References

Natural Resources Conservation Service. . National Ecological Site Handbook.

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	05/21/2025
Approved by	Kendra Moseley
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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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:**