USDA Natural Resources Conservation Service

Ecological site F018XI205CA
Thermic Granitic Foothills

Last updated: 4/24/2024
Accessed: 05/20/2024

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 steep hills, in granitic parent material. It has a wide range in soil depth classes (moderately deep to very deep). Mean annual precipitation typically ranges from 31 to 51 inches. Elevation ranges from 750 to 2500 feet. Soil temperature regime is thermic.

The soils in this site are susceptible to erosion because of the granitic parent material which may weather into grus. Later states of this ecological site (shrub dominated/annual vegetation or post-fire communities) are more vulnerable to erosion, particularly on the steep portions of the landscape. Loss of topsoil can lead to losses in productivity and the ability to regenerate woodland vegetation. The most common soil components include Ahwahnee and Sierra. Ahwahnee soils have a mollic epipedon, where dense vegetation and organic matter lead to dark A horizons. This soil is moderately deep and classified as a coarse-loamy, mixed active thermic Mollic Haploxeralfs. Sierra soils are very deep which favors tree and shrub production, but these soils are also vulnerable to erosion as explained above. They are classified as fine-loamy, mixed active, thermic Ultic Haploxeralfs.

The dominant vegetation in this ecological site consists of mixed (approximately equal proportions) blue oak (Quercus douglasii) and interior live oak (Quercus wislizeni) and scattered shrubs such as manzanita (Arctostaphylos spp.), toyon (Heteromeles arbutifolia). Herbaceous annual vegetation ranges from sparse to greater than 60% of the annual production, depending on overstory canopy and sunlight availability.

Associated sites

R018XI105CA	**Mesic Steep Convex Slopes bordering thermic** This site commonly occurs nearby.

Similar sites

F018XI204CA	**North-facing Steep Draws and Hillslopes** Site relationships being developed.
F018XI206CA	**Clayey Thermic Marble Hills** Site relationships being developed.

Table 1. Dominant plant species

Tree	(1) *Quercus wislizeni* (2) *Quercus douglasii*
Shrub	(1) *Arctostaphylos* (2) *Heteromeles arbutifolia*
Herbaceous	(1) *Bromus carinatus*

Physiographic features

This site occurs on moderate to steep slopes of hills. Slope generally ranges from 4 to 65%. Elevation generally ranges from 750 to 2500 feet.

Table 2. Representative physiographic features

Landforms	(1) Foothills > Hill (2) Foothills > Ridge
Runoff class	Medium
Flooding frequency	None
Ponding frequency	None
Elevation	750–2,500 ft
Slope	4–65%
Aspect	W, NW, N, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Medium
Flooding frequency	None

Ponding frequency	None
Elevation	120–3,600 ft
Slope	0–75%

Climatic features

This ecological site is characterized by hot, dry summers and cool, wet winters, a typical Mediterranean climate. Mean annual precipitation ranges from 31 to 51 inches and usually falls from October to April. Mean annual temperature ranges from 55.4 to 59.5 degrees F with 365 frost free days.

Table 4. Representative climatic features

Frost-free period (characteristic range)	180-307 days
Freeze-free period (characteristic range)	292-365 days
Precipitation total (characteristic range)	31-51 in
Frost-free period (actual range)	160-351 days
Freeze-free period (actual range)	255-365 days
Precipitation total (actual range)	25-56 in
Frost-free period (average)	246 days
Freeze-free period (average)	324 days
Precipitation total (average)	41 in

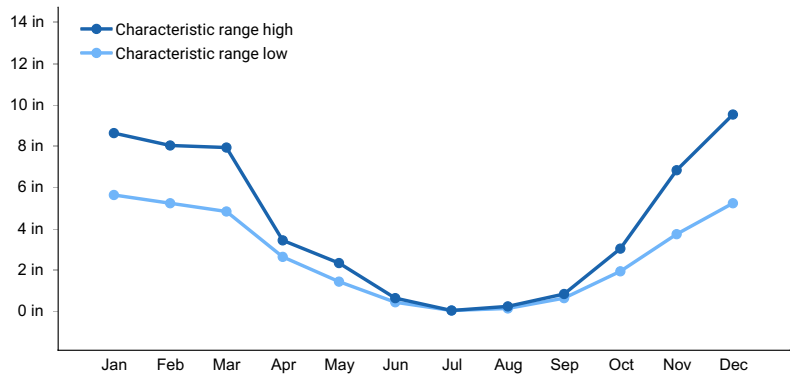

Figure 1. Monthly precipitation range

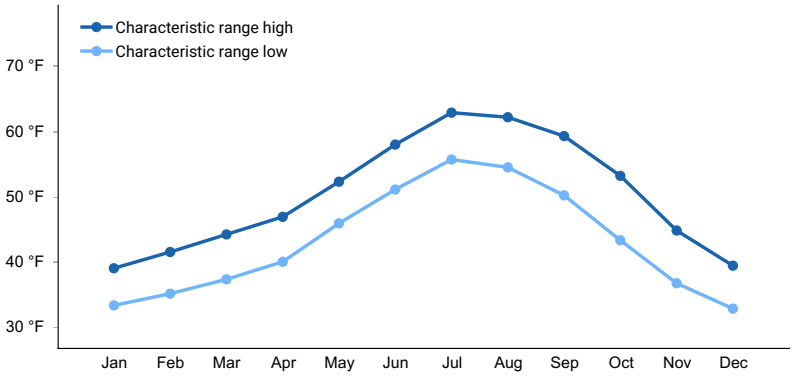

Figure 2. Monthly minimum temperature range

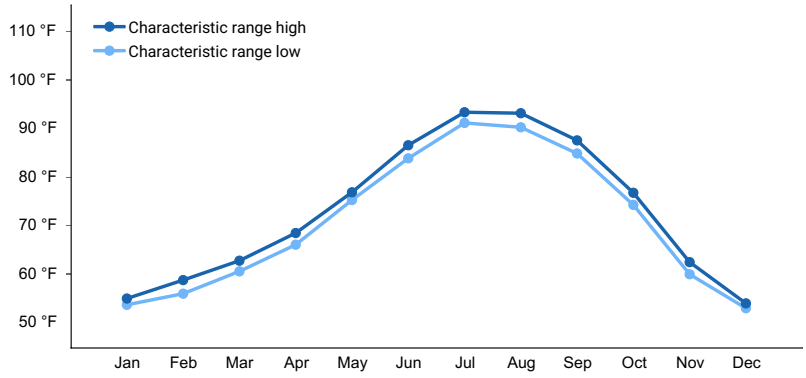

Figure 3. Monthly maximum temperature range

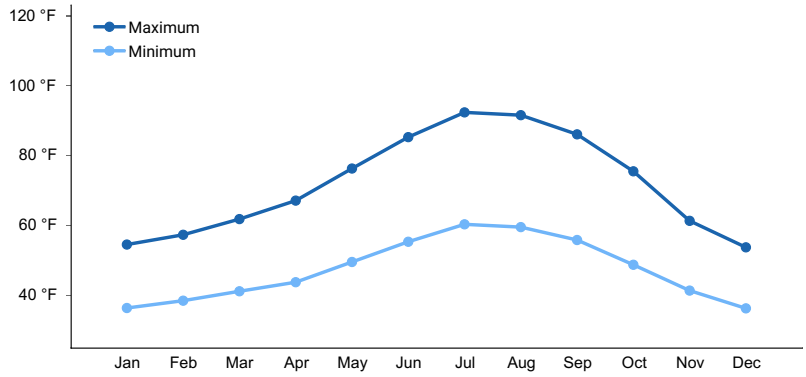

Figure 4. Monthly average minimum and maximum temperature

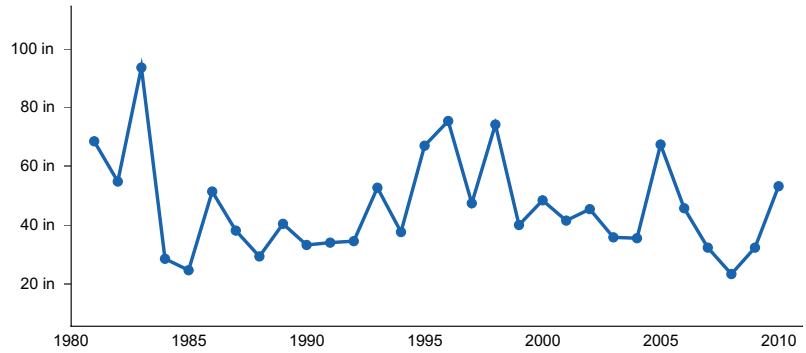

Figure 5. Annual precipitation pattern

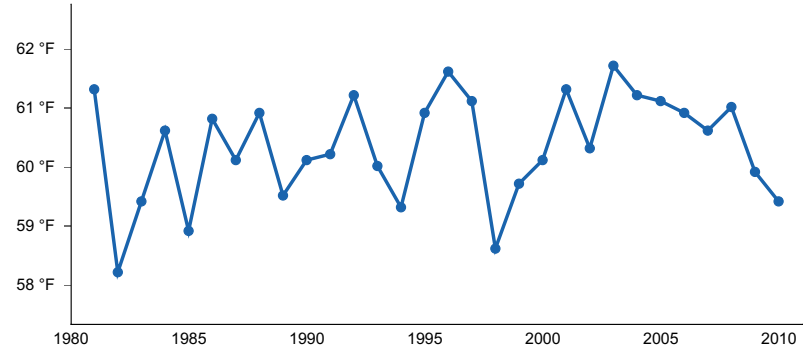

Figure 6. Annual average temperature pattern

Climate stations used

- (1) GROVELAND 2 [USC00043669], Groveland, 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 granodioritic rock. The typical depth range is from moderately to very deep, the particle size control sections are coarse-loamy to fine-loamy, and surface textures include coarse sandy loams, sandy loams and loams. These soils can be as shallow as 23 inches and as deep as 66 inches. The bedrock, when observed, is a restrictive paralithic contact. Gravels (< 3 inch diameter) on the surface range from 0 to 15%, while larger fragments (=> 3 inch diameter) occupy between 0 and 5% cover. Below the soil surface gravels range from 0 to 10% by volume and larger fragments range from 0 to 5%. The soils in this ecological site are well drained and the permeability class ranges from moderate to rapid. Available Water Capacity (AWC) ranges from 2 to 6.1 inches (in accordance with depth). Surface pH ranges from 5.8 to 6.5 while subsurface reaction is from 5.7 to 6.3.

The most common soils correlated to this ecological site are Sierra and Flanly which are both fine-loamy, mixed, active, thermic Ultic Haploxeralfs, as well as Ahwahnee, a Coarse-loamy, mixed, active, thermic Mollic Haploxeralf. Sierra is deep to very deep while Flanly and Ahwahnee are moderately deep.

Table 5. Representative soil features

Parent material	(1) Residuum–granitoid (2) Colluvium–granitoid
Surface texture	(1) Sandy loam (2) Loam (3) Coarse sandy loam
Family particle size	(1) Fine-loamy (2) Coarse-loamy
Drainage class	Well drained
Permeability class	Moderate to rapid
Depth to restrictive layer	23–66 in
Soil depth	23–66 in
Surface fragment cover <=3"	0–15%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	2–6.1 in
Soil reaction (1:1 water) (0-10in)	5.8–6.5
Subsurface fragment volume <=3" (0-60in)	0–10%
Subsurface fragment volume >3" (0-60in)	0–5%

Table 6. Representative soil features (actual values)

Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Moderately slow to rapid
Depth to restrictive layer	10–84 in

Soil depth	10–84 in
Surface fragment cover <=3"	0–40%
Surface fragment cover >3"	0–34%
Available water capacity (0-40in)	0.9–7.7 in
Soil reaction (1:1 water) (0-10in)	4.7–7.7
Subsurface fragment volume <=3" (0-60in)	0–54%
Subsurface fragment volume >3" (0-60in)	0–54%

Ecological dynamics

Community pathways and Transitions
T1.a This transition occurs after decades of little to no disturbance agents (including management) which builds up fuels. A high severity, stand replacing fire may then trigger an abrupt change in plant/animal communities and hydrological and nutrient cycling. Shrubs adapted to the new fire regime, sprout and seed at a much higher rate than the tree component.

T1.b This transition occurs after active grazing and/or brush management suppresses woody vegetation, resulting in loss of overstory trees and a dominance of annuals.

T1.c This transition occurs as undesirable invasive annual grasses and forbs gain a foothold (> 25% cover).

1.1a Time without fire or other disturbances.

1.1b This community pathway occurs following a moderate intensity fire promoting a sprouting response from trees.

1.1c Low intensity fire or severe grazing, which opens up the community and reduces woody vegetation.

1.2a Time without fire or other disturbances.

1.2b Reburn after 10 years or less. Note that requent of burns may cross threshold T1.b.

1.3a This community pathway occurs over time as woody vegetation (sprouts and seedlings) attain heights above browsing line.

1.4a This community pathway occurs with windfall events, localized insect outbreaks, or patchy fire dynamics.

T2.a This transition occurs with active (often repeated) brush management or annual burning/chemical treatment.

R2.a This restoration pathway occurs after active brush management, chemical treatment, followed up with tree planting.

2.1a This community pathway occurs following a high intensity wildfire.

2.2a This community pathway occurs over time with no management action.

T3.a This transition occurs after invasive plants posing extreme economic/environmental issues become established.

R3.a This restoration pathway occurs with tree planting, often requires shade screens, and seedling protection from browsers to be successful.

Community pathways and Transitions cont.

3.1a This community pathway occurs as forbs become more dominant, often following low winter precipitation and reduced litter layers.

3.2a This community pathway occurs as grasses become more dominant, often in response to higher litter levels.

R4.a This restoration pathway occurs with integrated weed management. May require mowing, herbicides, and/or biological control.

R4.b This restoration pathway occurs with integrated weed management. May require mowing, herbicides, and/or biological control.

4.1a This community pathway occurs as invasive forb species become dominant.

4.2a This community pathway occurs as invasive grass species become dominant.

State and transition model

Community pathways and Transitions

T1.a This transition occurs after decades of little to no disturbance agents (including management) which builds up fuels. A high severity, stand replacing fire may then trigger an abrupt change in plant/animal communities and hydrological and nutrient cycling. Shrubs adapted to the new fire regime, sprout and seed at a much higher rate than the tree component.

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Community pathways and Transitions cont.

3.1a This community pathway occurs as forbs become more dominant, often following low winter precipitation and reduced litter layers.

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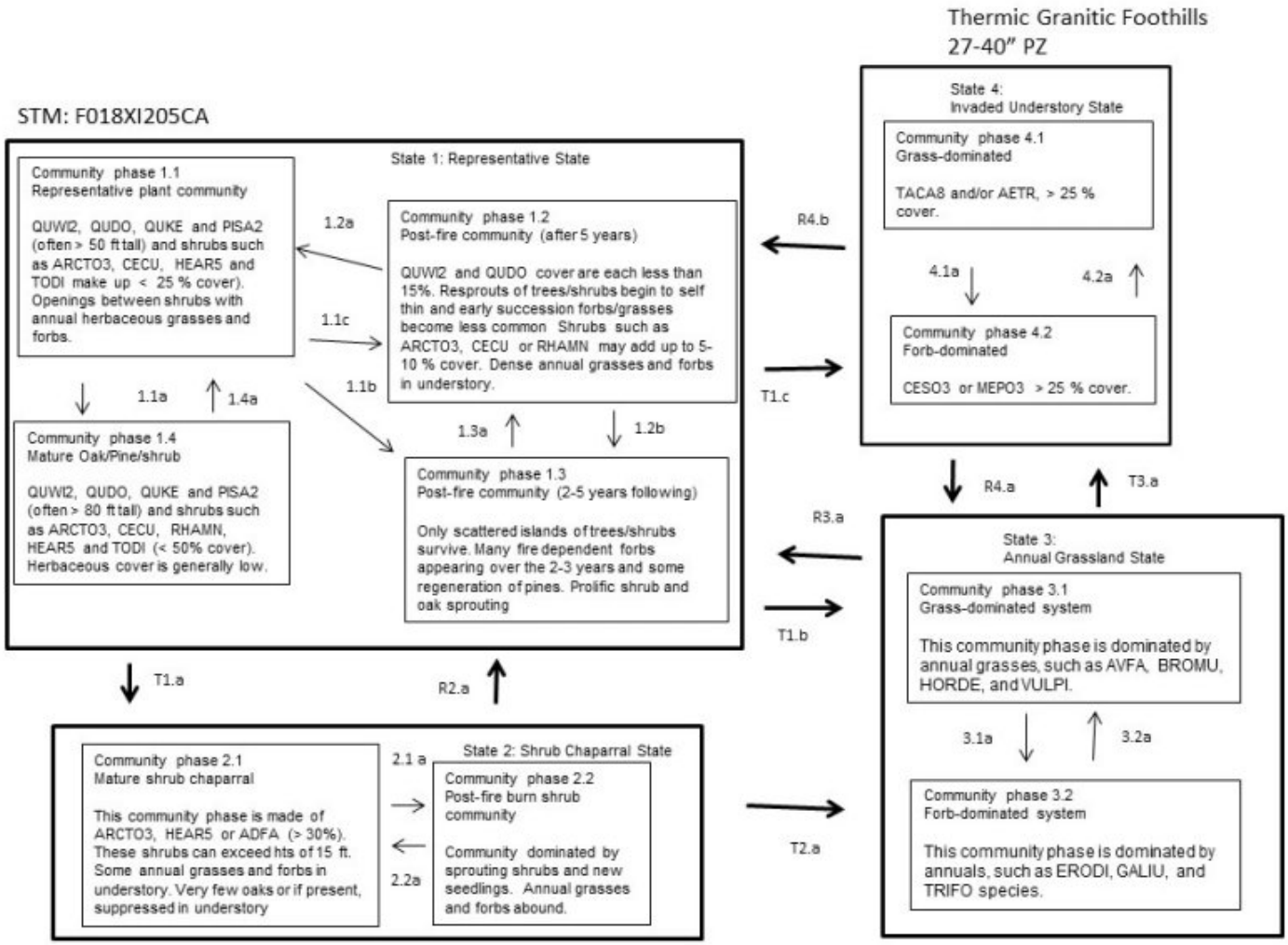

State 1
Representative State

Community 1.1
Representative plant community

QUWI2, QUDO, QUKE and PISA2 (often > 50 ft tall) and shrubs such as ARCTO3, CECU, HEAR5 and TODI make up 25 % cover). Openings between shrubs with annual herbaceous grasses and forbs.

Community 1.2
Post-fire community (after 5 years)

QUWI2 and QUDO cover are each less than 15%. Resprouts of trees/shrubs begin to self thin and early succession forbs/grasses become less common Shrubs such as ARCTO3, CECU or RHAMN may add up to 5-10 % cover. Dense annual grasses and forbs in understory.

Community 1.3
Post-fire community (2-5 years following)

Only scattered islands of trees/shrubs survive. Many fire dependent forbs appearing over the 2-3 years and some regeneration of pines. Prolific shrub and oak sprouting

Community 1.4
Mature Oak/Pine/shrub

QUWI2, QUDO, QUKE and PISA2 (often > 80 ft tall) and shrubs such as ARCTO3, CECU, RHAMN, HEAR5 and

TODI (< 50% cover). Herbaceous cover is generally low.

Pathway 1.1c
Community 1.1 to 1.2

Representative plant community

Post-fire community (after 5 years)

Low intensity fire or severe grazing, which opens up the community and reduces woody vegetation.

Pathway 1.1b
Community 1.1 to 1.3

Representative plant community

Post-fire community (2-5 years following)

This community pathway occurs following a moderate intensity fire promoting a sprouting response from trees.

Pathway 1.1a
Community 1.1 to 1.4

Representative plant community

Mature Oak/Pine/shrub

Time without fire or other disturbances.

Pathway 1.2a
Community 1.2 to 1.1

Post-fire community (after 5 years)

Representative plant community

Time without fire or other disturbances.

Pathway 1.2b
Community 1.2 to 1.3

Post-fire community (after 5 years)

Post-fire community (2-5 years following)

Reburn after 10 years or less. Note that requent of burns may cross threshold T1.b.

Pathway 1.3a
Community 1.3 to 1.2

Post-fire community (2-5 years following)

Post-fire community (after 5 years)

This community pathway occurs over time as woody vegetation (sprouts and seedlings) attain heights above browsing line.

Pathway 1.4a
Community 1.4 to 1.1

Mature Oak/Pine/shrub

Representative plant community

This community pathway occurs with windfall events, localized insect outbreaks, or patchy fire dynamics.

State 2
Shrub Chaparral State

Community 2.1
Mature shrub chaparral

This community phase is made of ARCTO3, HEAR5 or ADFA (> 30%). These shrubs can exceed hts of 15 ft. Some annual grasses and forbs in understory. Very few oaks or if present, suppressed in understory

Community 2.2
Post-fire burn shrub community

Community dominated by sprouting shrubs and new seedlings. Annual grasses and forbs abound.

Pathway 2.1a
Community 2.1 to 2.2

Mature shrub chaparral

Post-fire burn shrub community

This community pathway occurs following a high intensity wildfire.

Pathway 2.2a
Community 2.2 to 2.1

Post-fire burn shrub community

Mature shrub chaparral

This community pathway occurs over time with no management action.

State 3
Annual Grassland State

Community 3.1
Grass-dominated system

This community phase is dominated by annual grasses, such as AVFA, BROMU, HORDE, and VULPI.

Community 3.2
Forb-dominated system

This community phase is dominated by annuals, such as ERODI, GALIU, and TRIFO species.

Pathway 3.1a
Community 3.1 to 3.2

Grass-dominated system **Forb-dominated system**

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

Pathway 3.2a
Community 3.2 to 3.1

Forb-dominated system **Grass-dominated system**

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

State 4
Invaded Understory State

Community 4.1
Grass-dominated

TACA8 and/or AETR, > 25 % cover.

Community 4.2
Forb-dominated- no photo

CESO3 or MEPO3 > 25 % cover.

Pathway 4.1a
Community 4.1 to 4.2

This community pathway occurs as invasive forb species become dominant.

Pathway 4.2a
Community 4.2 to 4.1

This community pathway occurs as invasive grass species become dominant.

Transition T1.a
State 1 to 2

This transition occurs after decades of little to no disturbance agents (including management) which builds up fuels. A high severity, stand replacing fire may then trigger an abrupt change in plant/animal communities and hydrological and nutrient cycling. Shrubs adapted to the new fire regime, sprout and seed at a much higher rate than the tree component.

Transition T1.b
State 1 to 3

This transition occurs after active grazing and/or brush management suppresses woody vegetation, resulting in loss of overstory trees and a dominance of annuals.

Transition T1.c
State 1 to 4

This transition occurs as undesirable invasive annual grasses and forbs gain a foothold (> 25% cover).

Restoration pathway R2.a
State 2 to 1

This restoration pathway occurs after active brush management, chemical treatment, followed up with tree planting.

Transition T2.a
State 2 to 3

This transition occurs with active (often repeated) brush management or annual burning/chemical treatment.

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.

Transition T3.a
State 3 to 4

This transition occurs after invasive plants posing extreme economic/environmental issues become established.

Restoration pathway R4.b
State 4 to 1

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

Restoration pathway R4.a
State 4 to 3

This restoration pathway occurs with integrated weed management. 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.

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Other references

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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	05/20/2024
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):**

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

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

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

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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:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
