USDA Natural Resources
Conservation Service

Ecological site R039XA141AZ
Cindery-Ashy Upland 17-22"

Last updated: 4/06/2020
Accessed: 05/20/2025

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): 039X–Mogollon Transition North

SITE FEATURES
This Ecological site occurs in MLRA 39.1, on the edge of the Mogollon Rim in northern Arizona. This site occurs in the San Francisco Volcanic field and is characterized by cinder cones and lava flows. The vegetation on this site is in early successional stages.

Soil temperature regime ranges from mesic to frigid
Soil moisture regime ranges from typic ustic to udic ustic

MLRA CHARACTERISTICS-THESE ARE GENERAL STATEMENTS
AZ 39.1 Mogollon Plateau Coniferous Forests

Elevations range from 7000 to 12,500 feet and precipitation averages 20 to 35 inches per year. Vegetation includes ponderosa pine, Gambel oak, Arizona walnut, sycamore, Douglas fir, blue spruce, Arizona fescue, sheep fescue, mountain muhly, muttongrass, junegrass, pine dropseed, and dryland sedges. The soil temperature regime ranges from mesic to frigid and the soil moisture regime ranges from typic ustic to udic ustic. This unit occurs within the Colorado Plateau Physiographic Province and is characterized by a sequence of flat to gently dipping sedimentary rocks eroded into plateaus, valleys and deep canyons. Sedimentary rock classes dominate the plateau with volcanic fields occurring for the most part near its margin.

Associated sites

R039XA129AZ	**Clay Bottom 17-22"** This site occurs on the open meadow area on the road to the Visitors Center to the Park.
R039XA142AZ	**Cinders-Lava Flow Upland 17-22"** This site differs because of solid lava flows interspersing the site. This changes the hydrology of the site due to the solid lava collecting water. These sites may also contain aspen within the protected areas.

Similar sites

R039XA142AZ	**Cinders-Lava Flow Upland 17-22"** This site differs only due to the increased amounts of lava flows on the site and the resulting change of hydrology at the site of the lava flows.

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa*
Shrub	(1) *Fallugia paradoxa*
Herbaceous	Not specified

Physiographic features

This site occurs in the San Francisco Volcanic Field on the edge of the Mogollon Rim/Colorado Plateau Region of northern Arizona. This site is dominated by volcanic cinders on upland sites below cindercones (R039XA143AZ). Lava flow sites also occur in the area.

Table 2. Representative physiographic features

Landforms	(1) Cinder cone
Elevation	2,134–2,164 m
Slope	15–60%
Aspect	Aspect is not a significant factor

Climatic features

The type location for this ecological site is on Sunset Crater National Monument near Flagstaff, Arizona. Average maximum temperature is 63.3 degrees F; average minimum temperature is 28.4 degrees F. The average total precipitation is 16.75 inches and it receives 60.3 inches of snowfall on average.

Table 3. Representative climatic features

Frost-free period (average)	120 days
Freeze-free period (average)	
Precipitation total (average)	559 mm

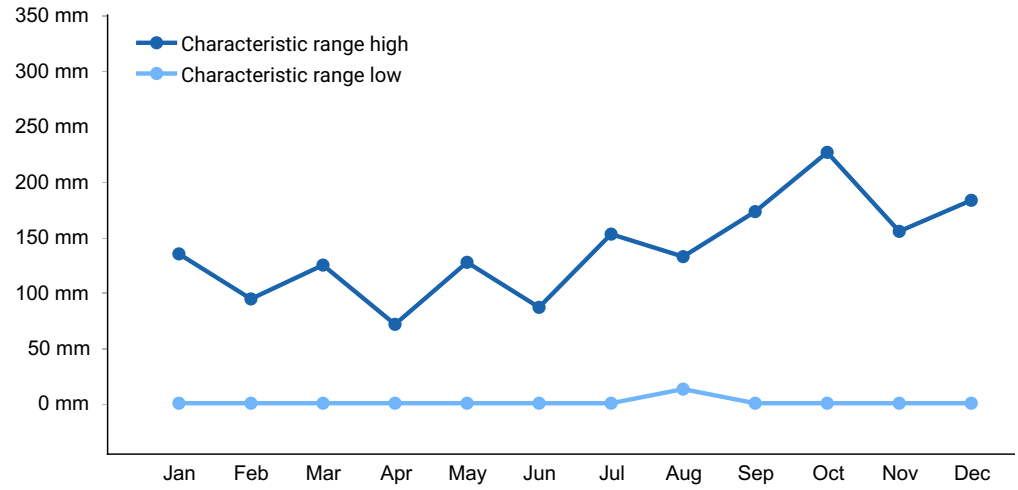


Figure 1. Monthly precipitation range

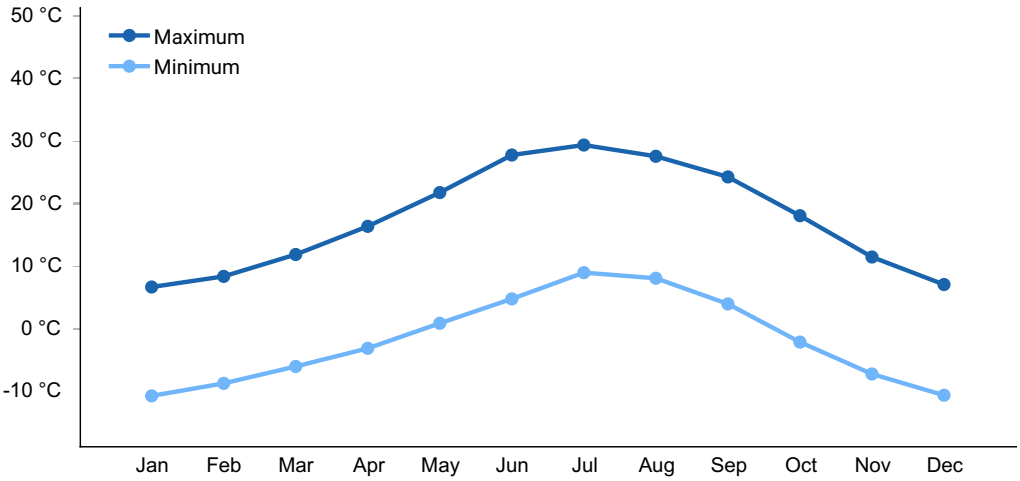


Figure 2. Monthly average minimum and maximum temperature

Influencing water features

There are no influential water features on this site.

Soil features

Typical mapunits for this site are located in Sunset Crater National Monument Soil Survey.

MU 20 Cinderhill-Blackash complex, 15 to 60 percent slopes
MU 21 Cinderhill-Kana'a complex, 3 to 15 percent slopes
MU 24 Kana'a extremely gravelly sand, 1 to 3 percent slopes

MU 29 Sunsetcrater extremely gravelly loamy sand, 1 to 15 percent slopes

Table 4. Representative soil features

Parent material	(1) Cinders–pyroclastic rock
Surface texture	(1) Very gravelly coarse sand
Drainage class	Excessively drained
Permeability class	Rapid to very rapid
Soil depth	152 cm
Surface fragment cover <=3"	54%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	4.57 cm

Ecological dynamics

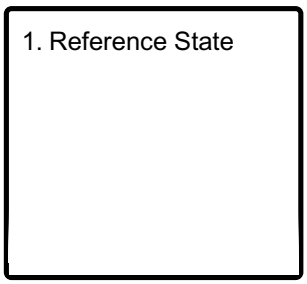
This site is in an early successional sere, beginning with the eruption and subsequent formation of the Sunset Crater in the San Francisco Volcanic Field. This site fluctuates over time from a Ponderosa pine overstory with a shrub layer consisting of almost exclusively Apache plume to a site with a Ponderosa pine overstory and an herbaceous layer dominated by either sand bluestem or blue grama. In another state, this site may also have large amounts of bare ground, with sparse amounts of herbaceous and shrub understory. This site in general has between 15-22 percent tree canopy cover. This places it in a Rangeland site rather than a Forested site. Twenty-five percent minumum canopy cover is required for a Forested site.

This site is marginal for 39.1. The ponderosa pine are on this site due to the presence of cinders which hold in moisture and increase water holding capacity. A small change in climate to the warmer drier side would cause shrubs to come in and the ponderosas to decline.

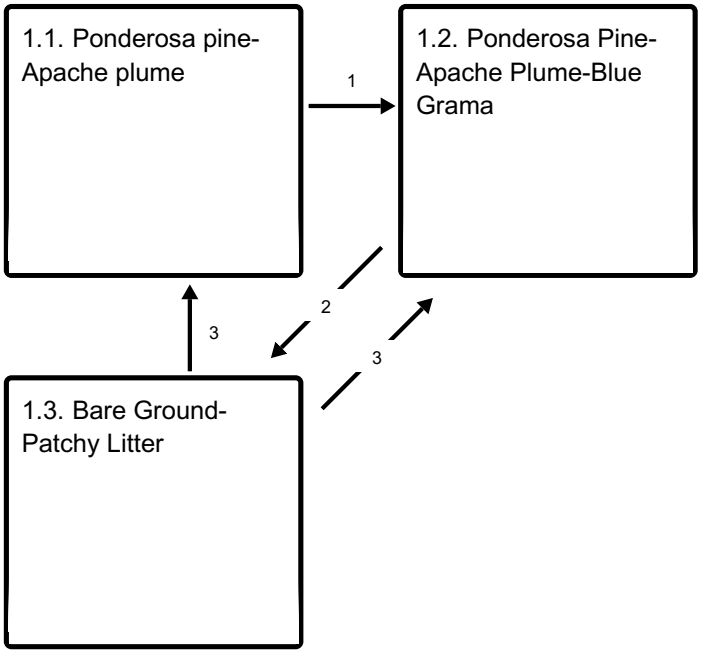
There are some issues with Ips spp., bark beetle, on selected areas of this site. Prolonged drought and crowding has caused pinyon pines to weaken and become susceptible to insect attack. The trees have weakened and died or are in decline. Since the conditions are so unnaturally crowded, the insect can spread easily from tree to tree.

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 1
Reference State

This state is representative of the relatively undisturbed state of this ecosite. This site occurs on relatively young cinder cones and ash flows of Sunset Crater. All of the vegetation on this site is in early succession. There is slight variation within the different phases of this state, differing slightly from Ponderosa pine overstory with warm-season grasses and shrub understory to nearly bare cinders with only sparse shrubs and patchy herbaceous litter.

Community 1.1
Ponderosa pine-Apache plume

This phase is dominated by Ponderosa pine with Apache plume understory. Blue grama may occur in the understory. This phase is slightly more developed soil with micro-sites which allow water to remain longer and allow the blue grama to establish.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	112	448	897
Tree	224	336	448
Grass/Grasslike	–	11	17
Total	**336**	**795**	**1362**

Table 6. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	–	–
>0.15 <= 0.3	–	–	0-6%	–
>0.3 <= 0.6	–	0-10%	–	–
>0.6 <= 1.4	–	–	–	–
>1.4 <= 4	0-18%	–	–	–
>4 <= 12	0-12%	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2
Ponderosa Pine-Apache Plume-Blue Grama

In the absence of heavy disturbance and plenty of moisture, there is an increase in herbaceous understory. Sand bluestem is the first to appear, then as time goes on blue grama will begin to colonize in areas of adequate reliable moisture.

Community 1.3
Bare Ground-Patchy Litter

This site is naturally occurring due to a number of possibilities such as a formerly treed site cleared out by a crown fire, insects, drought. This site may also be naturally treeless. The soils in this volcanic field are relatively young and have had little time to develop. Given time, this site may be able to develop trees, shrubs, and an herbaceous understory.

Pathway 1

Community 1.1 to 1.2

Ponderosa pine-Apache plume

Ponderosa Pine-Apache Plume-Blue Grama

This pathway relies on time and lack of disturbance to allow the soils time to develop, increase moisture holding capacity, and develop an herbaceous understory.

Pathway 2
Community 1.2 to 1.3

Ponderosa Pine-Apache Plume-Blue Grama

Bare Ground-Patchy Litter

This community pathway is caused by natural fluctuations in the environment changing from tree dominated to bare ground; this is a pathway and not a state change because in time this site can return to a treed state. No thresholds are crossed.

Pathway 3
Community 1.3 to 1.1

Bare Ground-Patchy Litter

Ponderosa pine-Apache plume

This site can fluctuate in a natural disturbance regime from a treeless site to a site with trees. The fluctuation of these sites is a natural occurrence due to fires, drought, insect damage to increased water and increased soil development over time.

Pathway 3
Community 1.3 to 1.2

Bare Ground-Patchy Litter

Ponderosa Pine-Apache Plume-Blue Grama

This site may move given time and only light natural disturbance to a site with trees and shrubs, eventually developing a herbaceous understory.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Native Grasses**			0–17	
	blue grama	BOGR2	*Bouteloua gracilis*	0–17	–
	squirreltail	ELEL5	*Elymus elymoides*	0–1	–
Shrub/Vine					
2	**Shrubs**			112–897	
	Apache plume	FAPA	*Fallugia paradoxa*	112–897	–
Tree					
3	**Native Trees**			224–448	
	ponderosa pine	PIPO	*Pinus ponderosa*	224–448	–

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Native Grasses**			34–67	
	blue grama	BOGR2	*Bouteloua gracilis*	34–67	–
	sand bluestem	ANHA	*Andropogon hallii*	0–11	–
	squirreltail	ELEL5	*Elymus elymoides*	0–6	–
Forb					
2	**Invasive Forbs**			0–6	
	Dalmatian toadflax	LIDA	*Linaria dalmatica*	0–6	–
Tree					
3	**Trees**			0–22	
	ponderosa pine	PIPO	*Pinus ponderosa*	0–22	–
Shrub/Vine					
4	**Shrubs**			56–112	
	Apache plume	FAPA	*Fallugia paradoxa*	45–112	–
	rabbitbrush	CHRYS9	*Chrysothamnus*	0–28	–

Table 9. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Shrub/Vine					
1	**Shrub**			0–392	
	Apache plume	FAPA	*Fallugia paradoxa*	0–392	–

Type locality

Location 1: Coconino County, AZ	
UTM zone	N
UTM northing	3913468
UTM easting	455157

General legal description	The type location for this site is located on Sunset Crater National Monument and has limited public access.

Contributors

Jennifer Puttere

Approval

Scott Woodall, 4/06/2020

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)	Jennifer Puttere
Contact for lead author	Flagstaff MLRA Soil Survey Office, Flagstaff Arizona
Date	07/18/2011
Approved by	Scott Woodall
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None due to extensive armor of volcanic gravels and cinders on the surface.

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2. **Presence of water flow patterns:** Expect 2 or 3 on a 150-ft tape; this only happens occasionally in a major hydrologic event as the surface is covered in volcanic gravels and cinders.

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3. **Number and height of erosional pedestals or terracettes:** None due to protection of the soil surface by gravels and cinders.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Generally there is no unprotected surfaces on this site. It is covered with gravels and cinders of volcanic origin.

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5. **Number of gullies and erosion associated with gullies:** None

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Some small areas at the base of small cindery hills that have little to no vegetation may have deposition of cinders and ash at the base and have a slight increase in the amount of vegetation. No areas of wind scour or blowouts.

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7. **Amount of litter movement (describe size and distance expected to travel):** There is very little litter movement on this site. Most of it remains where it falls. There is commonly pine needle and other herbaceous litter from grasses and shrubs.

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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):** All of the soil samples here rank as a 1 or 2. However due to the coverage of gravel and volcanic cinders on the surface, this site is resistant to erosion.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Th soil surface on this site is weak and poorly developed. There is low organic matter throughout the soil profile on this site.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** There are large clumps of vegetation on this site of trees and shrubs, with very few grasses and grasslike plants. This vegetation normally would promote low infiltration and high runoff. There is an extensive

cover of cinders on the site, however, which allows for the rapid infiltration and low runoff which allows for the growth of ponderosa pines on such a low production site and soil.

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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):** None

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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: Shrubs>Trees>>Herbaceous

    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):** Some tree die-off expected on this site as the area has been hard hit by drought and insects.

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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):** Dalmation toadflax is an invader which may increase with lack of fire and/or other managed treaments.

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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: Dalmation toadflax and broom snakeweed may invade this site.

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17. **Perennial plant reproductive capability:** Scattered throughout this park are infestations of Ips beetles which may slow down reproduction of the ponderosa pine trees during drought and heavy infestation and also crowded conditions. Other shrubby and herbaceous species are not affected and are able to reproduce normally.
