USDA Natural Resources Conservation Service

Ecological site R051XY279CO
Foothill Sand 9-12 PZ

Last updated: 12/11/2024
Accessed: 05/14/2025

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): 051X–High Intermountain Valleys

This MLRA encompasses the San Luis Valley in south central Colorado and the Taos Plateau and Taos alluvial fans of north central New Mexico. As part of the northern portion of the Rio Grande Rift, the MLRA consists of large, alluvium filled basins washed down from adjacent mountain ranges. The Rio Grande River flows through this MLRA, continuing its long function of carrying mountain sediment down to the basin. Cenozoic volcanism is an extensive characteristic of the MLRA where large basalt flows with volcanic hills and domes are abundant. Ancient Lake Alamosa is a large feature within the MLRA.

LRU notes

The Foothill Sand site occurs on mountain front alluvial fans at the upper portion of the Piedmont slope, connected to the Sangre de Cristo Mountains. Most of the alluvial fans have been dissected, leaving erosional fan remnants as component landforms standing above wash channels or inset fans. The source of parent material is a mixing of both alluvial material from the Sangre de Cristo Mountains and eolian material blown in from the San Luis Valley's sand sheet and active dune field.

Classification relationships

NRCS:
Major Land Resource Area 51, High Intermountain Valleys (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS:
331J – Northern Rio Grande Basin M331Ic > 331Ja - San Luis Valley, 331Jb - San Luis Hills and 331C - Mogotes

EPA:
22 - Arizona/New Mexico Plateau > 22a - San Luis Shrublands and Hills ; 22b -San Luis Alluvial Flats and Wetlands ; 22c - Salt Flats; 22e - Sand Dunes and Sand Sheets and 22f -Taos Plateau (Griffith, 2006).

USGS:
Southern Rocky Mountain Province

Ecological site concept

Surface textures range from very cobbly sandy loam to loamy sand. Taxonomic particle size class ranges from loamy-skeletal to sandy. Soils are deep and slope commonly ranges from 4 to 15 percent. Vegetatively, the site is a mix of grasses and shrubs along a gradient from alluvium derived cobbly sandy-loam surface textures to eolian derived loamy-sand. There are stringers of pinyon and juniper extending down from the colluvial apron of the mountain-base and some scattered P-J throughout the site.

Associated sites

R051XY276CO	**Limy Bench** Limy bench are sometimes skeletal and have a fine-loamy particle size class. Limy bench is derived from igneous geology, and particular extrusive volcanic material that tends to break down into finer soils that are higher in pH.
R051XY263CO	**Salt Flats** The Salt Flats site can be found around some of the bottom fringes of the foothill sands site and occurs on the alluvial flat component of the basin floor. It is associated with vegetation that is tolerant of higher alkalinity.
R051XY317CO	**Foothill Loam** The Foothill Loam site does not have the eolian influence and textures are not as course.T he Foothill Loam Site is primarily a grassland community located a little higher up on the mountain front alluvial fans. It is located in the 12-16 inch precipitation zone.
R051XY294CO	**Valley Sand** The Valley Sand site occurs on the alkali flat of the basin floor. The soils are derived from course-textured alluvium which has been wind-worked over time. Often there is a deep water table which is accessible to deep-rooted shrubs.

Similar sites

R051XY275CO	**Deep Sands 7-9 PZ** The Deep Sands site is part of the sand sheet that surrounds the active dune field. This site is coarse loamy; deep to very deep in depth and is non-saline. It occurs on dunes and sand sheets. Sand Hummocks occur as dunes in the playa and are saline.
R051XY294CO	**Valley Sand** The Valley Sand site occurs on the alkali flat of the basin floor. The soils are derived from course-textured alluvium which has been wind-worked over time. Often there is a deep water table which is accessible to deep-rooted shrubs.
R051XY312CO	**Sand Hummocks** It essentially occupies the playa dune component where salts and sand accumulate on the leeward side of the playa.

Table 1. Dominant plant species

Tree	(1) *Pinus edulis* (2) *Juniperus osteosperma*
Shrub	Not specified
Herbaceous	(1) *Achnatherum scribneri* (2) *Hesperostipa comata*

Physiographic features

This site occurs on the east side of the San Luis Valley on gentle to moderately steep fans and slopes just below the steeper pinyon-covered lands. The site is positioned between the San Luis Valley's active dune field with surrounding sand sheet and the colluvial apron at the base of the Sangre de Cristo Mountains. Most of the fans have been dissected, leaving erosional fan remnants as component landforms standing above wash channels or inset fans.

Table 2. Representative physiographic features

Landforms	(1) Fan
Runoff class	Low
Flooding frequency	None
Ponding frequency	None

Elevation	2,377–2,591 m
Slope	9–15%
Aspect	W, NW, SW

Climatic features

The climate that typifies the High Intermountain Valley, ranges from arid to semi-arid, and is characterized by cold winters, moderate summers, and much sunshine. The San Juan mountain range to the west and the Sangre de Cristo Mountains to the east intercept much of the precipitation causing a two-way rain shadow effect. Cold air from the encompassing mountain ranges drain into the valley and settle. This phenomena results in long cold winters and moderate summer temperatures. Average annual precipitation is 9 to 12 inches. Of this, 55-60% falls between May 1 and September 1, mostly as hard, spotty thunder showers in July and August. May and June are normally dry. Winter snow is light but makes up a slightly higher percent of the total than in the San Luis Valley proper. Snow is usually present during the coldest weather. However, snow cover is light or patchy during much of some winters. Wide seasonal and yearly variations are common. Major native plants make most of their growth between early May and late July, sometimes extending through most of August. Some plants normally complete growth by mid-June and may make late growth.

Mean annual temperature is 41 degrees to 43 degrees F. Average frost-free period is 85 to 100 days, from late May to early June to September. Summer daytime temperatures are frequently in the low 80's, but rarely exceed 90 degrees F, and nights are cool. Temperatures of -20 degrees to -30 degrees F can be expected each year and are common some winters. Winds that often reach high velocities are common, especially in spring. Relative humidity is often low. Even so, evaporation rates average lower than those of many dry regions because of the cooler climate.

Table 3. Representative climatic features

Frost-free period (characteristic range)	81-89 days
Freeze-free period (characteristic range)	102-119 days
Precipitation total (characteristic range)	229-305 mm
Frost-free period (actual range)	79-91 days
Freeze-free period (actual range)	97-124 days
Precipitation total (actual range)	229-305 mm
Frost-free period (average)	85 days
Freeze-free period (average)	111 days
Precipitation total (average)	254 mm

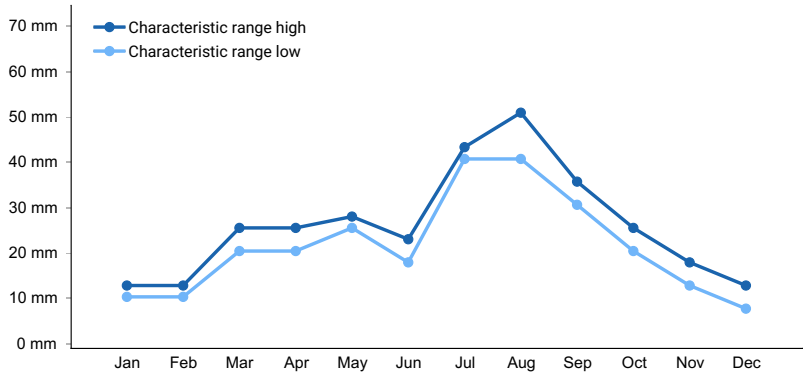


Figure 1. Monthly precipitation range

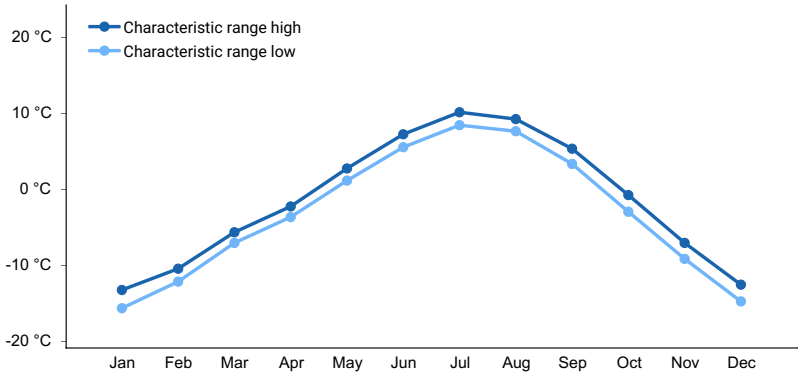


Figure 2. Monthly minimum temperature range

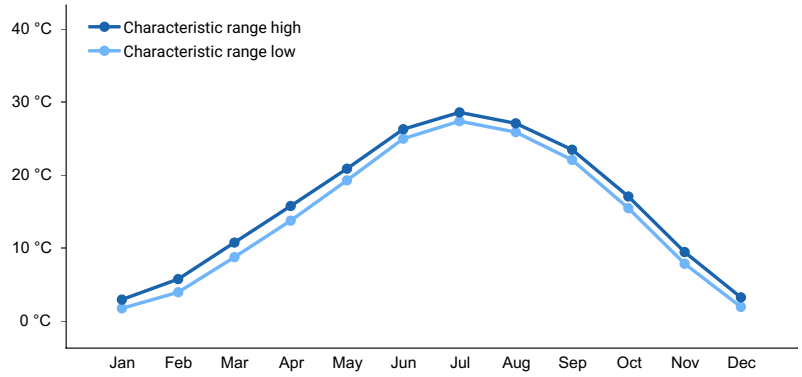


Figure 3. Monthly maximum temperature range

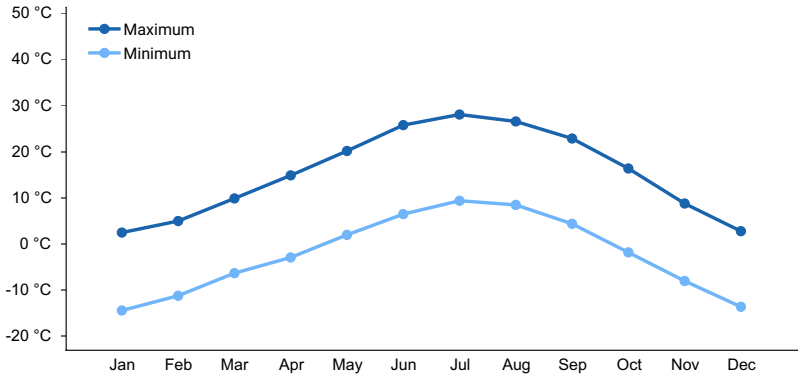


Figure 4. Monthly average minimum and maximum temperature

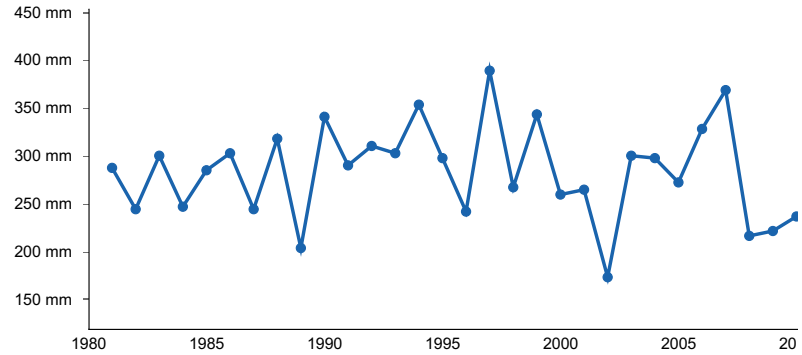


Figure 5. Annual precipitation pattern

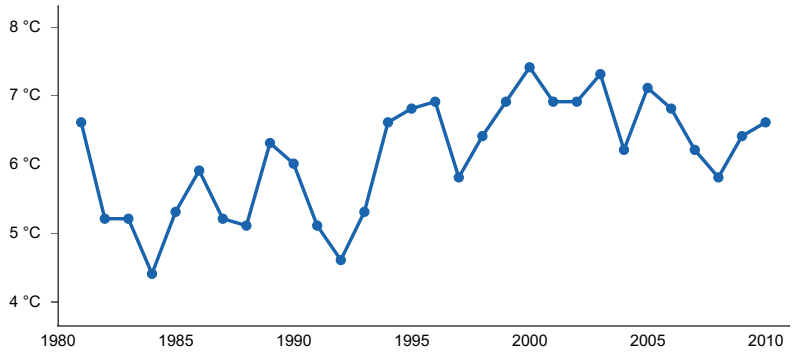


Figure 6. Annual average temperature pattern

Climate stations used

- (1) GREAT SAND DUNES NM [USC00053541], Mosca, CO
- (2) BLANCA 4 NW [USC00050776], Blanca, CO

Influencing water features

This is does not have a water table.

Soil features

The source of parent material is a mixing from both alluvial material from the Sangre de Cristo Mountains and material from the San Luis Valley's sand sheet and active dune field. Surface texture range is usually loamy sand. Taxonomic particle size class range is sandy. Soils are very deep.

Typical soil correlated to this site is Ouray.

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Loamy sand
Family particle size	(1) Sandy
Drainage class	Excessively drained
Permeability class	Rapid
Soil depth	152–305 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	6.1–7.87 cm
Calcium carbonate equivalent (Depth not specified)	0%
Electrical conductivity (Depth not specified)	0 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	6.6–7.3
Subsurface fragment volume <=3" (Depth not specified)	0%

Subsurface fragment volume >3" (Depth not specified)	0%

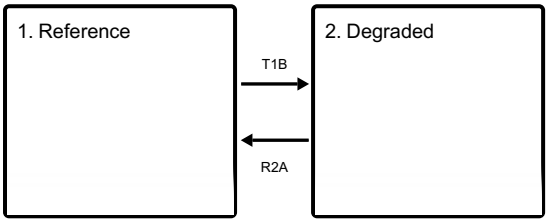
Ecological dynamics

A rather a open scattered and growth patchy of growth grasses of and pinyon shrubs pine and characterizes juniper mixed the site. Major grasses include Scribner needdlegrass, Indian ricegrass, Western and thickspike needlegrass, June grass and blue grama. Other common grasses are sand dropseed, squirreltail, blowout grass, muttongrass, littleseed ricegrass. Forbs such as buckwheat, paintbrush, locos, and pingue occur in small are amounts, but are conspicuous when in bloom. Dominant shrubs are mountain mahogany, skunkbush, wax currant, gooseberry, tall rabbitbrush, snowberry and serviceberry. Trace currant, amounts gooseberry, of four-wing saltbush, winterfat, horsebrush, yucca, prickly pear, and rock spirea are usually present.

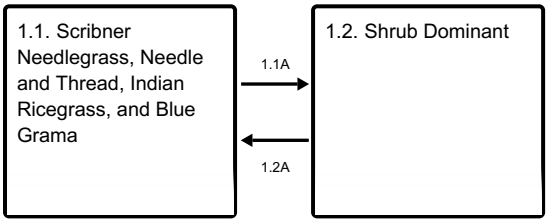
There is a gradient of vegetation with grasses being more prominent in the alluvium influenced areas and shrubs in the eolian influenced areas. Pinyon and juniper becomes more dense as one moves higher onto the colluvial apron of the bounding mountain range.

State and transition model

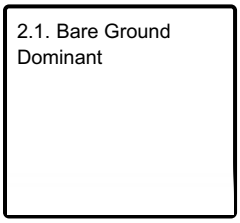
Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference

Figure 7. Loamy Sand Soils where an eolian cap exists

The reference state is mostly grasses with a few forbs, shrubs, and trees. As the site grades towards the sandier areas, shrubs increase. As the site grades toward the colluvial apron of the Sangre de Cristo Range, pinyon and juniper increase. Major grasses include Scribner needlegrass, needle-and-thread, Indian ricegrass, and blue grama.

Resilience management. The reference community phase has the greatest resilience to disturbance. A diversity of root systems from deep tap roots to abundant fibrous hold the soil in place and take advantage of moisture and nutrients throughout the profile.

Dominant plant species

- twoneedle pinyon (*Pinus edulis*), tree
- Utah juniper (*Juniperus osteosperma*), tree
- alderleaf mountain mahogany (*Cercocarpus montanus*), shrub
- Scribner needlegrass (*Achnatherum scribneri*), grass

Community 1.1
Scribner Needlegrass, Needle and Thread, Indian Ricegrass, and Blue Grama

The reference community phase is primarily a grassland community with forbs, shrubs, and scattered pinyon-juniper. Major grasses include Scribner needlegrass, needle-and-thread, Indian ricegrass, and blue grama.

Resilience management. The reference community phase has the greatest resilience to disturbance. A diversity of root systems from deep tap roots to abundant fibrous hold the soil in place and take advantage of moisture and nutrients throughout the profile.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	493	678	863
Shrub/Vine	224	308	392
Tree	90	123	157
Forb	90	123	157
Total	**897**	**1232**	**1569**

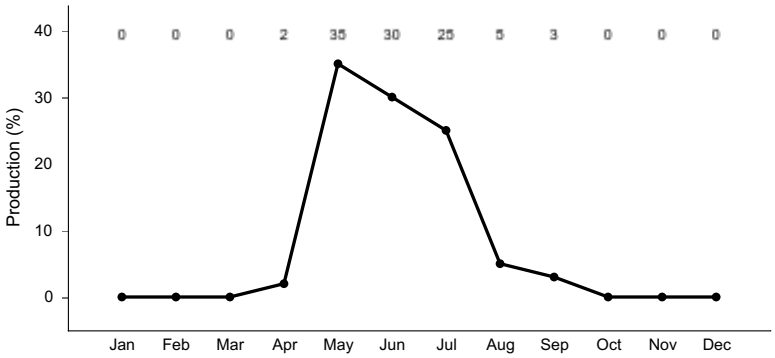


Figure 9. Plant community growth curve (percent production by month). CO5109, Cool-season/Warm-season co-dominant, coarse textured soils, alluvial fans and benches. Located in LRU 51-5 on fans and fan remnants above valley floor, pre-dominantly in Saguache County, Villa Grove and Saguache area..

Community 1.2
Shrub Dominant

Figure 10. Grasses have decreased and shrubs have the greater percentage of species composition.

This is an "at risk" community phase where palatable grass species, especially cool-season bunch grasses, have been greatly reduced leaving lesser palatable grasses, shrubs, and forbs. Common plants in this community include blue grama, sand dropseed, purple threeawn, slimstem muhly, sandhill muhly, snakeweed, pingue, rabbitbrush, Apache plume, yucca, and prickly pear. Reference cool-season species are still present within protected places.

Resilience management. This site is at risk to crossing a threshold to a degraded state. Drought is often the trigger, causing the site to cross a threshold. Important soil stabilizing features such as healthy grass cover and root systems have been reduced making the A horizon susceptible to erosion.

Pathway 1.1A
Community 1.1 to 1.2

Scribner Needlegrass, Needle and Thread, Indian Ricegrass, and Blue Grama

Shrub Dominant

Long term repetitive defoliation with high utilization rates on cool-season palatable species without rest or recovery, especially throughout the growing season, will eventually weaken root systems and cause plant mortality. Less palatable warm-season species remain.

Pathway 1.2A
Community 1.2 to 1.1

Shrub Dominant

Scribner Needlegrass, Needle and Thread, Indian Ricegrass, and Blue Grama

By applying a grazing management strategy that allows critical cool season species such as Indian ricegrass, Scribner needlegrass, and needle-and-thread to grow without repetitive defoliation. Grass species will begin to colonize within the inter-spaces between shrubs.

State 2
Degraded

Resilience management. This state has low resilience to disturbance as is prone to excessive soil erosion and deposition.

Community 2.1
Bare Ground Dominant

The degraded state is anchored by a few shrubs but have lost the majority of grasses. This state has crosses a threshold to where bare ground is prominent along with a few species that have defensive biological and chemical responses to grazing. Annuals are common following moisture events. The A horizon is mostly gone and soil loss due to erosion has accelerated.

Transition T1B
State 1 to 2

A major long-term driver is repetitive, high utilization without rest or recovery of plant species throughout the growing season for multiple years, or during drought, which has caused die-off of preferred grasses, forbs, and shrubs. As more plants die, bare ground increases and overall ecosystem function and health decrease to a degree that the site crosses a threshold.

Restoration pathway R2A
State 2 to 1

Long term management where ecosystem processes are restored, such as soil organic matter, aggregate stability, plant colonization, and cover.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				560–785	
	Scribner needlegrass	ACSC11	*Achnatherum scribneri*	269–471	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	135–235	–
	needle and thread	HECO26	*Hesperostipa comata*	135–235	–
	blue grama	BOGR2	*Bouteloua gracilis*	90–157	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	45–78	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	45–78	–
	blowout grass	REFL	*Redfieldia flexuosa*	45–78	–
	squirreltail	ELELE	*Elymus elymoides ssp. elymoides*	22–39	–
	purple threeawn	ARPU9	*Aristida purpurea*	22–39	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	0–22	–
	roughleaf ricegrass	ORAS	*Oryzopsis asperifolia*	0–22	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–6	–
	pine dropseed	BLTR	*Blepharoneuron tricholepis*	0–6	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–6	–
	Arizona fescue	FEAR2	*Festuca arizonica*	0–6	–
	ring muhly	MUTO2	*Muhlenbergia torreyi*	0–6	–
Forb					
2				101–146	
	snowball sand verbena	ABFR2	*Abronia fragrans*	0–16	–
	fragrant snakeroot	AGHE5	*Ageratina herbacea*	0–16	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	0–16	–
	Wyoming Indian paintbrush	CALI4	*Castilleja linariifolia*	0–16	–
	hairy clematis	CLHI	*Clematis hirsutissima*	0–16	–
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–16	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–16	–
	pingue rubberweed	HYRI	*Hymenoxys richardsonii*	0–16	–
	scarlet gilia	IPAG	*Ipomopsis aggregata*	0–16	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	0–16	–

	hoary tansyaster	MACA2	*Machaeranthera canescens*	0–16	–
	lacy tansyaster	MAPI	*Machaeranthera pinnatifida*	0–16	–
	oblongleaf bluebells	MEOB	*Mertensia oblongifolia*	0–16	–
	Colorado four o'clock	MIMU	*Mirabilis multiflora*	0–16	–
	beardtongue	PENST	*Penstemon*	0–16	–
	Rocky Mountain penstemon	PEST2	*Penstemon strictus*	0–16	–
	broom-like ragwort	SESP3	*Senecio spartioides*	0–16	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–16	–
Shrub/Vine					
3				252–364	
	alderleaf mountain mahogany	CEMO2	*Cercocarpus montanus*	135–235	–
	wax currant	RICE	*Ribes cereum*	90–157	–
	skunkbush sumac	RHTR	*Rhus trilobata*	45–78	–
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	45–78	–
	whitestem gooseberry	RIINI	*Ribes inerme var. inerme*	22–39	–
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	22–39	–
	mountain snowberry	SYOR2	*Symphoricarpos oreophilus*	11–24	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	0–16	–
	rockspirea	HODU	*Holodiscus dumosus*	0–16	–
	winterfat	KRLA2	*Krascheninnikovia lanata*	0–16	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–16	–
	chokecherry	PRVI	*Prunus virginiana*	0–16	–
	soapweed yucca	YUGL	*Yucca glauca*	0–16	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–16	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–16	–
Tree					
4				95–151	
	Utah juniper	JUOS	*Juniperus osteosperma*	45–78	–
	twoneedle pinyon	PIED	*Pinus edulis*	45–78	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–39	–

Inventory data references

Location of Typical Example of the Site:
East side of Pinyon Pasture on Baca Gran in Saguaches County Foothill Area Just east of Sand Dunes National Monument in Alamosa County.

Field Offices in Colorado where the site occurs:
Alamosa, and Center

References

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Other references

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Cleland, D.T.; Freeouf, J.A.; Keys, J.E.; Nowacki, G.J.; Carpenter, C.A.; and McNab, W.H. 2007. Ecological Subregions: Sections andSubsections for the conterminous United States. Gen. Tech. Report WO-76D [Map on CD-ROM] (A.M. Sloan, cartographer). Washington,DC: U.S. Department of Agriculture, Forest Service, presentation scale 1:3,500,000; colored.

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Contributors

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Approval

Kirt Walstad, 12/11/2024

Acknowledgments

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--Site Development and Testing Plan--:
Future work to validate and further refine the information in this Provisional Ecological Site Description is necessary. This will include field activities to collect low-, medium-, and high-intensity sampling, soil correlations, and analysis of that data.

Additional information and data are required to refine the Plant Production and Annual Production tables for this ecological site. The extent of MLRA 51 must be further investigated.

Field testing of the information contained in this Provisional ESD is required. As this ESD is moved to the Approved ESD level, reviews from the technical team, quality control, quality assurance, and peers will be conducted.

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)	C. Villa, H. Garcia
Contact for lead author	
Date	12/15/2004
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None

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2. **Presence of water flow patterns:** Typically none on gentle slopes. Expect flow paths on steeper slopes (>10%), following intense storms. Flow patterns are short and not connected. Debris obstructions present.

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3. **Number and height of erosional pedestals or terracettes:** Pedestalled plants are common near or in flow paths and on windward positions where wind scouring is more likely to naturally occur.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 30% or less bare ground, with bare patches ranging from 8-12 inches in diameter. Prolonged drought or wildfire events will cause bare ground to increase upwards to 25-40% with bare patches ranging from 12-20 inches in diameter.

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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:** Wind scouring is inherent to this site. Soil movement can intensify with disturbances such as wildfire, repeated grazing, or extended drought.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter will move on this site. Litter movement consists of re-distribution of fine litter in flow patterns and on leeward side of bunchgrasses/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):** Stability class rating anticipated to be 3-4 in interspaces at soil surface.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** These soils have a high infiltration rate, low water holding capacity and moderately rapid to rapid permeability. Surface soil texture are usually a loamy sand. The A-horizon averages 0-13 inches in depth with a grayish brown or brown color. Structure ranges from a weak medium subangular blocky structure parting to weak fine granular structure.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The composition/distribution of bunchgrasses and shrub/tree tends to slow overland flow and moderate runoff. Diverse canopy structure reduces raindrop impact allowing for increased time for infiltration.

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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: cool season bunchgrass >

    Sub-dominant: shrubs > trees > warm season bunchgrass >

    Other: forbs = cool season rhizomatous grass

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal. Extreme drought will increase plant mortality. Decadence can occur on areas void of grazing disturbance.

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14. **Average percent litter cover (%) and depth (in):** 20-30% litter cover at 0.25 inch depth. Litter depth will increase under shrubs and trees. Litter cover during and following drought can range from 10-15% and 5-10% following wildfire.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 800 lbs./ac. low precipitation years; 1100 lbs./ac. average precipitation years; 1,400 lbs./ac. high precipitation years. After extended drought, production will be reduced by 200 – 400 lbs./ac. or more.

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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:** Juniper and rabbitbrush species.

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17. **Perennial plant reproductive capability:** The only limitations are weather-related, wildfire, natural disease, inter-species competition, wildlife, and insects that may temporarily reduce reproductive capability.
