USDA Natural Resources Conservation Service

Ecological site R051XY312CO
Sand Hummocks

Last updated: 9/07/2023
Accessed: 07/17/2024

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): 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

A large portion of the San Luis Valley, north of Alamosa is a closed basin. Drainages flowing into this closed basin include: irrigation diversions from the Rio Grande River; Carnero, La Garita, and Saguache Creeks from the west; San Luis Creek from the north; and North Crestone and Sand creeks from the east. This low area or "sump" extends from San Luis Lake to the Blanca wetlands. As water flows into the closed basin it spreads out across the valley floor where it evaporates or infiltrates, recharging the underground aquifer.

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

This site exists in the lowest reaches of a closed basin. It is intermingled with the alkali overflow site and is correlated to the playa dunes component of the basin floor. Because the soils were developed from coarse, wind-blown material on the leeward side of a playa and erosion and deposition are a constant issue, this site can develop "hummocks" and the plant community exists as a sparse, uneven cover of grass and shrubs.

The site also exists on the leeward side of drainages throughout the drained basin. This site occurs where sand has been lifted and deposited to form small dunes with heights ranging from 2-15 feet and an area from a few square yards to 10 acres.

Associated sites

R051XY314CO	**Alkali Overflow** The sand hummocks and the alkali overflow make up the major components of the playa system. The alkali overflow exists on the portions that is regularly flooded such as the playa floor, step, and slope. The sand hummocks exist on the playa dune.
R051XY263CO	**Salt Flats** The salt flats exists adjacent to the playa floor on the alluvial flat. It is not part of the playa complex and is an upland site that is more stable with a mix of grasses and shrubs.
R051XY264CO	**Chico Land** Chico land, like the salt flats exists on the alluvial flat, it is not part of the playa complex. Chico land is associated with the salt flats site where soils become higher in alkalinity and production is sparser.
R051XY267CO	**Salt Meadow** Salt Meadows occur as thin bands between the salt flats and the wet meadows. And sometimes the two are intermingled. Salt meadows support higher amounts of salt tolerant species such as alkali sacaton and inland saltgrass.

Similar sites

R051XY275CO	**Deep Sands 7-9 PZ** 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.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Sarcobatus vermiculatus*
Herbaceous	(1) *Distichlis spicata* (2) *Sporobolus airoides*

Physiographic features

This site also occurs adjacent to drainages along the valley floor where alluvial material has been scoured, uplifted and blown onto landscapes creating a small dunes or hummocks. These hummocks have slopes which range from 3-15%; heights which range from 2-15 feet; and area ranging from a few square yards to 10 acres in size.

The playa dune is the linear or curvilinear ridge of windblown, sands removed from the adjacent basin by wind erosion, and deposited on the leeward (prevailing downwind) margin of a playa, playa basin, or saline basin.

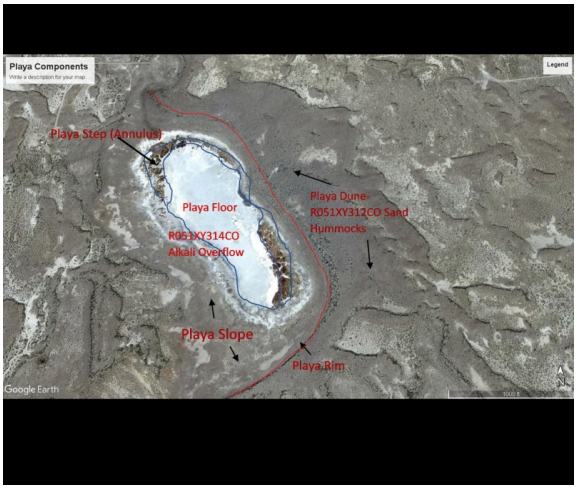


Figure 1. Sand Hummocks occurs on the playa dune landform

Figure 2. The Sand Hummocks on the playa dune in the foreground.

Table 2. Representative physiographic features

Landforms	(1) Playa dune (2) Dune
Runoff class	Very low to low
Flooding frequency	None
Ponding frequency	None
Elevation	2,286–2,408 m
Slope	0–25%
Aspect	Aspect is not a significant factor

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. Average annual precipitation ranges from 6 to 10 inches along the valley floor and throughout most of the resource area. Approximately 55-60 percent of the annual precipitation falls between May 1 and September 1. May and June are normally dry. Precipitation comes mostly from short duration high intensity thundershowers in July and August. Wide seasonal and yearly variations are common. 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. Mean average annual temperature ranges between 42 to 44 degrees F. July is the hottest month and January is the coldest. Summer temperatures range from highs in the upper 70’s and low 80’s and occasionally reach to the mid 90 degrees F. Summer nights are cool. Average frost-free period is 90-115 days, from late May or early June to September. There is a 50% probability that the first frost in the fall will occur near September 16, and the last frost in the spring on about June 9. Most major plant species initiate growth between mid May and late July, but growth may extend into September. Some cool season plants begin growth earlier and complete growth by mid June. There may be late re-growth on some of the plants.

Wind speeds average 7 miles per hour annually. Wind that often reaches high velocities are common, especially in the spring. Relative humidity is usually low. Even so, evaporation rates average lower than those of many dry regions because of the cooler climate. Snow cover is often light and is sometimes lacking through much of the winter. There is usually some snow, though, during the coldest weather.

Table 3. Representative climatic features

Frost-free period (characteristic range)	74-87 days
Freeze-free period (characteristic range)	95-115 days

Precipitation total (characteristic range)	152-254 mm
Frost-free period (actual range)	70-91 days
Freeze-free period (actual range)	93-122 days
Precipitation total (actual range)	152-254 mm
Frost-free period (average)	81 days
Freeze-free period (average)	106 days
Precipitation total (average)	203 mm

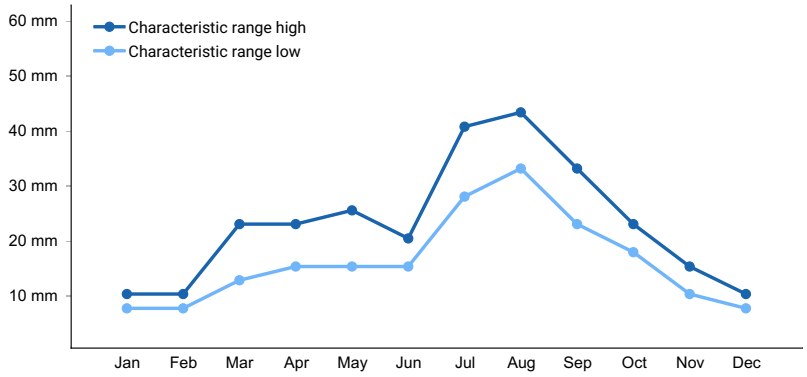


Figure 3. Monthly precipitation range

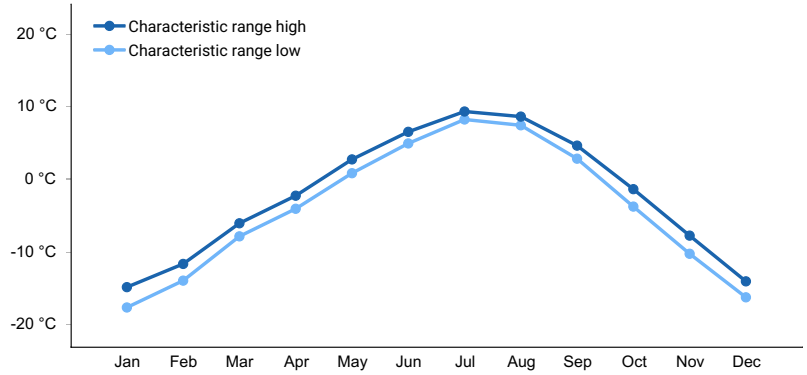


Figure 4. Monthly minimum temperature range

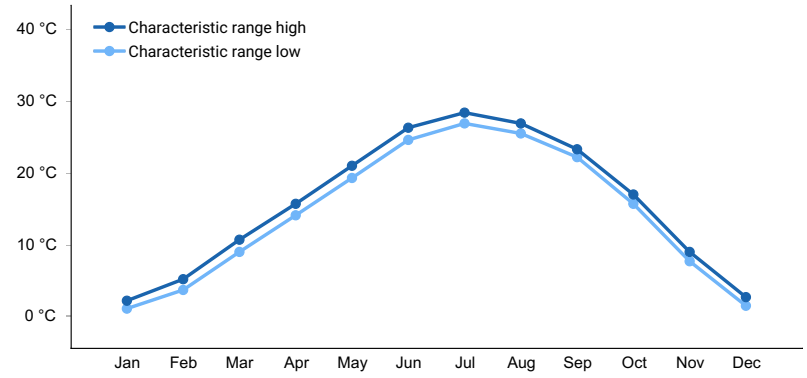


Figure 5. Monthly maximum temperature range

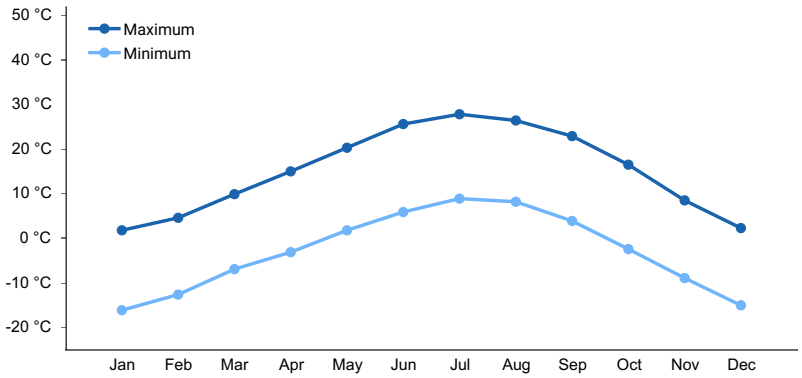


Figure 6. Monthly average minimum and maximum temperature

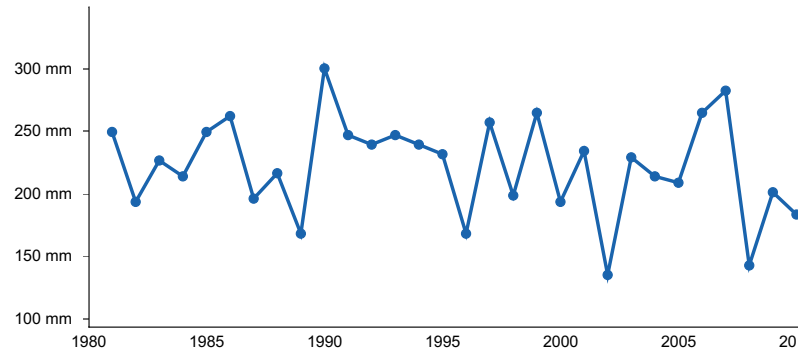


Figure 7. Annual precipitation pattern

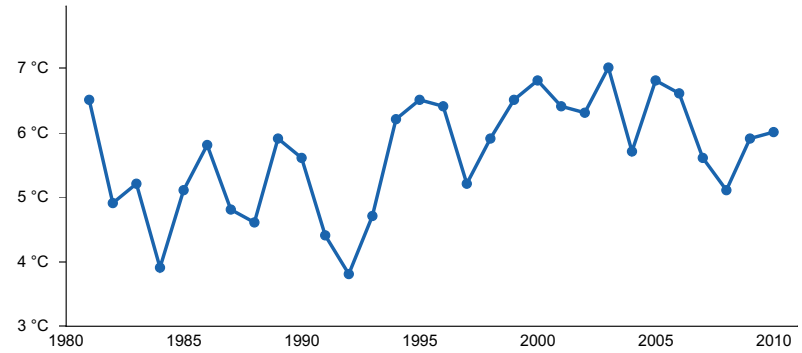


Figure 8. Annual average temperature pattern

Climate stations used

- (1) BLANCA 4 NW [USC00050776], Blanca, CO
- (2) GREAT SAND DUNES NM [USC00053541], Mosca, CO
- (3) ALAMOSA SAN LUIS AP [USW00023061], Alamosa, CO
- (4) CENTER 4 SSW [USC00051458], Center, CO

Influencing water features

Though this site is associated with the playa system the dune component is an upland position and does not receive the periodic flooding as the playa proper. A water table occurs occasionally on some sites in heavier material underlying the soil, but has little effect on plant growth, except for deep-rooted shrubs such as greasewood.

Soil features

The soils are deep, fine grained sands that are highly alkaline in reaction. Moisture enters the soil easily and moves down through the soil rapidly, favoring the fibrous-rooted bunchgrasses adapted to the sands of this climate. However, the high salt content and deep water table cause salt-tolerant grasses and shrubs to be predominant. The soils are loose and highly susceptible to damage from wind erosion. The typical taxonomic classification= Mixed,

frigid Typic Torripsamments.

Typical soils correlated to this site is Corlett.

Table 4. Representative soil features

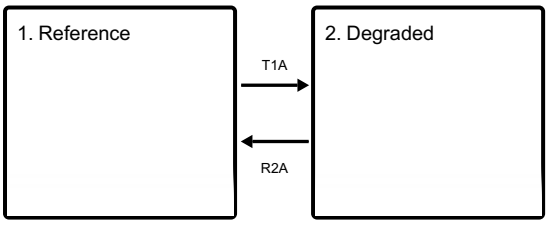
Parent material	(1) Eolian deposits–igneous and metamorphic rock (2) Eolian sands
Surface texture	(1) Fine sand (2) Loamy fine sand
Family particle size	(1) Not used
Drainage class	Moderately well drained to somewhat excessively drained
Permeability class	Moderately rapid to rapid
Soil depth	152–305 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	3.81–7.62 cm
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–4 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–10
Soil reaction (1:1 water) (Depth not specified)	8.5–9.8
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

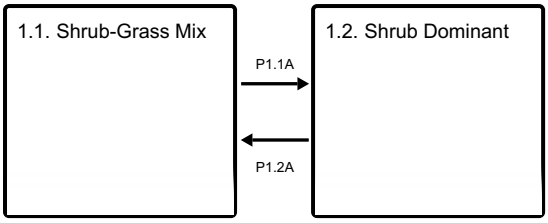
As wind and water move soils into areas of erosion and deposition, the site forms sandy hummocks or small dunes. A diversity and density of plants is key to maintaining ecological function and soil stability. Shrubs with deep tap roots that can reach to water and nutrients during drought anchors the site. Grasses provide surface cover which protects the soil from erosion and are sustained by fibrous root systems that take advantage of flash precipitation events. This site can erode quickly if adequate cover is not maintained and organic matter is lost from the soil.

State and transition model

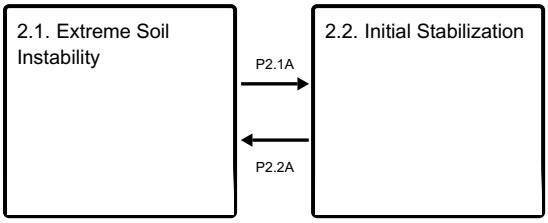
Ecosystem states



State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference

Figure 9. Reference state with shrubs and grasses

The reference state has a mix of shrubs, grass and forbs. It provides the greatest soil stability and ecological services. Bare ground is minimal, creating maximum protection against soil erosion processes.

Resilience management. As occupying a playa dune landform this site is a sink for windblown material and must therefore have a healthy plant community to withstand both erosion and deposition. A high diversity of shrubs, grass, and forbs with minimal bare soil will help sustain ecosystem process and keep the soil stable. Shrubs with deep tap roots that can extend to water and nutrients anchor the site and helps it sustain droughts. Grasses provide litter and cover to help protect the soil surface from wind and soil erosion. Their fibrous root systems also takes advantage of flash precipitation events and provides a valuable source of organic material which stores water and strengthens aggregate stability.

Community 1.1
Shrub-Grass Mix

Figure 10. Shrub-Grass Mix

Figure 11. A mix of bunch and rhizomotous grass species

This plant community has a shrub-grass mix where the production scales vary between exhibiting greater amounts of shrubs, and at times greater amounts of grasses. Bare areas are minimal and plants stabilize the soil.

Resilience management. This plant community provides the greatest number of ecosystem services and stability to the site.

Dominant plant species

- greasewood (*Sarcobatus vermiculatus*), shrub
- saltgrass (*Distichlis spicata*), grass
- alkali sacaton (*Sporobolus airoides*), grass
- Indian ricegrass (*Achnatherum hymenoides*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- alkali cordgrass (*Spartina gracilis*), grass
- alkali wildrye (*Leymus simplex*), grass
- lemon scurfpea (*Psoralidium lanceolatum*), other herbaceous

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	219	325	420
Shrub/Vine	101	151	202
Forb	17	28	50
Total	**337**	**504**	**672**

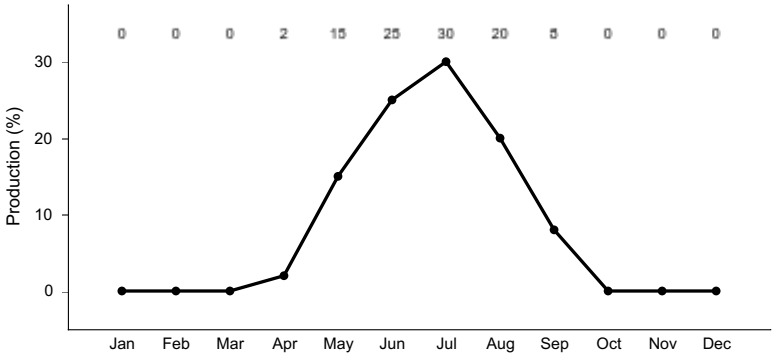


Figure 13. Plant community growth curve (percent production by month). CO5102, Warm season dominant, cool season sub-dominant; MLRA-51; coarse textured soils.

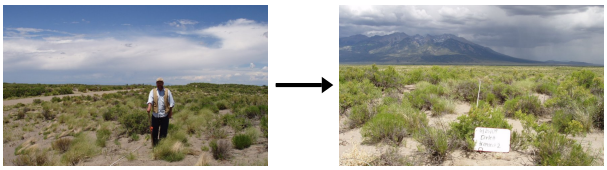
Community 1.2
Shrub Dominant

Figure 14. Shrubs dominant with grasses and forbs minor components

Figure 15. Area of soil instability due to deposition. The shrubs keep the site from further erosion.

This plant community is heavy on the shrubs and light on the grass. Over time shrubs have increased due to their competitive advantage when disturbances occur.

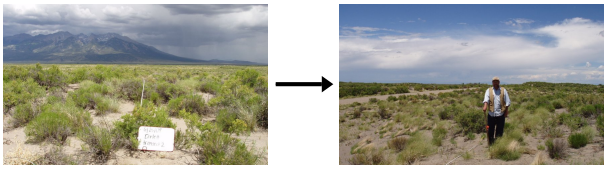
Pathway P1.1A
Community 1.1 to 1.2



Shrub-Grass Mix Shrub Dominant

A slow increase in shrubs and a decrease in grass. This can be due to natural or man caused disturbance. Shrubs have the natural competitive advantage to withstand drought with its deep tap root, ability to capture snow drift, and shade cover for the soil surface.

Pathway P1.2A
Community 1.2 to 1.1



Shrub Dominant Shrub-Grass Mix

There is a set back in shrubs and a favorable environment for an increase in grasses.

State 2
Degraded

Figure 16. Accelerated soil loss

This site has very low soil stability manifesting in recent areas of erosion and deposition. Plant species diversity and production is low with a few hardy species hanging on. Sandy hills can be "blown out" when cover is lost.

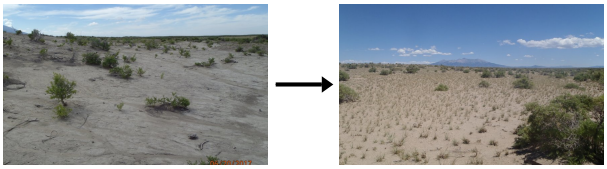
Community 2.1
Extreme Soil Instability

This community is very low in diversity, cover, and production. There is evidence of extreme soil movement. Ecological services are lowest with this community.

Community 2.2
Initial Stabilization

Soil is starting to stabilize with colonization of remnant shrubs and grasses.

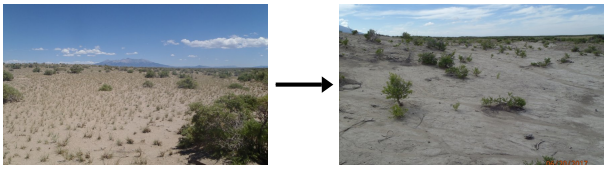
Pathway P2.1A
Community 2.1 to 2.2



Extreme Soil Instability **Initial Stabilization**

Colonization of remnant shrubs and grasses. Alkali sacaton and saltgrass has been observed to survive through harsh, unstable degradation, only to respond with a strong precipitation season.

Pathway P2.2A
Community 2.2 to 2.1



Initial Stabilization **Extreme Soil Instability**

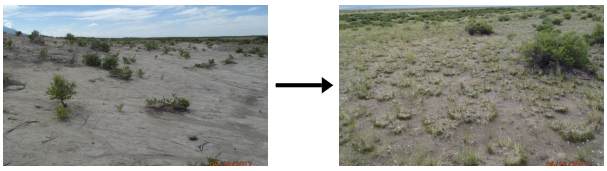
Initial colonization is set back with further disturbance.

Transition T1A
State 1 to 2

Reference **Degraded**

The major long-term driver is repetitive defoliation at high utilization, especially during drought. Plants lose vigor, become stressed and die. The reduction of cover and root systems causes feedback loops which weaken ecological processes and exacerbates soil loss.

Restoration pathway R2A
State 2 to 1



Degraded **Reference**

The soil needs to re-stabilized through increased organic matter from the re-establishment of plants. This can begin to occur during a favorable precipitation season where remnant grasses can quickly expand and start to stabilize the soil. Great care must be taken to minimize grazing during the critical early stage of recovery.

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				224–392	
	saltgrass	DISP	*Distichlis spicata*	50–101	–
	alkali sacaton	SPAI	*Sporobolus airoides*	34–67	–
	western wheatgrass	PASM	*Pascopyrum smithii*	34–67	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	34–67	–
	blue grama	BOGR2	*Bouteloua gracilis*	34–67	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	17–34	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	1–11	–
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	1–11	–
	blowout grass	REFL	*Redfieldia flexuosa*	1–11	–
	alkali cordgrass	SPGR	*Spartina gracilis*	1–11	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	1–11	–
Forb					
2				17–56	
	aster	ASTER	*Aster*	1–6	–
	snowball sand verbena	ABFR2	*Abronia fragrans*	0–3	–
	Rocky Mountain beeplant	CLSE	*Cleome serrulata*	0–3	–
	annual buckwheat	ERAN4	*Eriogonum annuum*	0–3	–
	tenpetal blazingstar	MEDE2	*Mentzelia decapetala*	0–3	–
	crownleaf evening primrose	OECO2	*Oenothera coronopifolia*	0–3	–
	lemon scurfpea	PSLA3	*Psoralidium lanceolatum*	0–3	–
Shrub/Vine					
3				112–196	
	greasewood	SAVE4	*Sarcobatus vermiculatus*	50–101	–
	fourwing saltbush	ATCA2	*Atriplex canescens*	34–67	–
	rubber rabbitbrush	ERNAC2	*Ericameria nauseosa ssp. consimilis*	34–67	–
	Greene's rabbitbrush	CHGR6	*Chrysothamnus greenei*	17–34	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–7	–

Inventory data references

Location of Typical Example Site:
San Luis Lakes and Dry Lakes area northeast of Alamosa, 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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United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.

Approval

Kirt Walstad, 9/07/2023

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.

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Contact for lead author	Rachel Meade, CO NRCS State Rangeland Management Specialist

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

2. **Presence of water flow patterns:** None

3. **Number and height of erosional pedestals or terracettes:** Pedestalled plants are common at or near wind scoured areas.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 45-60% bare ground, with bare patches ranging from 18-24 inches in diameter. Prolonged drought will cause bare ground to increase upwards to 75% with bare patches ranging from 24-36 inches in diameter.

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

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 grazing disturbance and extended drought.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter will move on this site. Interspaces can be void of litter. Litter collects around base of established vegetation.

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 2-3 in interspace at soil surface.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soils are deep, excessively drained with a low water holding capacity and rapid permeability. Surface soils are fine sand to loamy fine sand. The A-horizon averages 0-7 inches in depth with a light brownish gray to dark grayish brown color. Single grain and loose granular structure.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community composition and spatial distribution of functional groups has little effect on infiltration and runoff on this site. Soil features control hydrologic characteristics.

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 >

    Sub-dominant: warm season bunchgrass = cool season rhizomatous grass > warm season rhizomatous >

    Other: cool season bunchgrass > forbs

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal. Extended drought will cause mortality and decadence to increase above what naturally occurs.

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14. **Average percent litter cover (%) and depth (in):** 10-15% litter cover or less at 0.25 inch depth. Litter cover during and following drought can range from 0-10%.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 300 lbs./ac. low precipitation years; 450 lbs./ac. average precipitation years; 600 lbs./ac. high precipitation years. After extended drought, production will be reduced by 150 – 200 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:** Foxtail barley

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