USDA Natural Resources
Conservation Service

Ecological site GX070A01X012
Low Terraces

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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): 070A–High Plateaus of the Southwestern Great Plains

This site is only applicable to the Canadian Plateaus LRU of MLRA 70A (LRU 70A.1).

LRU notes

This site is only applicable to the Canadian Plateaus LRU of MLRA 70A (LRU 70A.1). Please refer to the following key:

Land Resource Unit (LRU) Key for MLRA 70A
– High Plateaus of the Southwestern Great Plains
1a. The site exists on a landform of volcanic origin, such as a basalt plateau, or is part of an escarpment system that rises directly to a volcanic structure. These escarpments are included if they have volcanic alluvium or colluvium (i.e. basalt, rhyolite, tuff, cinders) overlying non-volcanic residuum or bedrock (i.e. sandstone, shale). → VOLCANIC PLATEAUS LRU (VP)
User tip: Other alluvial or colluvial landform features extending below the escarpments are not included unless they have a predominance of volcanic fragments at the surface. Also, note that playas atop volcanic plateaus are included within the VP-LRU.
1b. All other sites. → 2
2a. The site exists in the annulus or floor of a playa. → CANADIAN PLATEAUS LRU (CP)
User tip: Small islands of playas occur within large areas of HP-LRU. These sites may be far from the nearest CP landform but will still key-out to the CP-LRU. The playa rim components, however, may key out to either LRU, so it is important to properly identify their soil properties.
2b All other sites. → 3
3a. The site is part of an escarpment landscape complex (defined below) or is within a canyon, valley, or small basin confined by such escarpments. At the upper boundary of the LRU, the soil surface meets at least 4 of the following 5 criteria:
I. Shallow or very shallow soils are present in at least 50% of the landform area;
II. Soils are underlain by sandstone bedrock of the Cretaceous Dakota Formation or older;
III. Presence or historical evidence of a conifer stand (≥ 2% canopy cover);
IV. The ground surface has a slope of at least 10%;
V. The landforms drain towards steep-walled escarpments or canyons below the Dakota sandstone (older Jurassic and Triassic Formations underlie this sandstone mesa cap).
→ MESOZOIC CANYONS AND BREAKS LRU (MCB)
User tip: The MCB sites also occur on any colluvial or alluvial bottomlands confined within escarpments or canyons. Some valleys transition from CP to MCB, or back to CP, and the turning point can be difficult to determine. Generally, the landforms are part of the MCB when confined between Dakota sandstone breaks or escarpments on both sides. Much of the acreage in the MCB is aproned by colluvial debris fans—composed of sandy materials with large sandstone fragments visible on the soil surface, including large stones or boulders. The soils in the bottoms of these confined valleys will also be in the MCB. When the valley opens, or there is only a single escarpment opening

to the plains, the landforms below the steeper, rockier escarpments will be members of the CP-LRU.
3b. Fewer than 4 of the above criteria are met. → 4
4a. The soil is on a plateau summit position (tread) and is within 50 cm to contact with either plateau bedrock (non-soil bedrock of cemented sandstone, limestone, or shale) or strath terrace cobbles, but not a petrocalcic contact (caprock or caliche of cemented calcium carbonate). → CANADIAN PLATEAUS LRU (CP)
4b. No plateau bedrock or strath terrace cobbles within 50 cm. → 5
5a. Fragments (>2 mm) are visible within the soil profile and/or on the surface. If fragments cannot be found in the profile, it is acceptable to look nearby on ant mounds or around burrows. If site is in a drainageway, one can look for fragments on landforms immediately upslope.→ 6
5b. Fragments are entirely absent. → 7
6a. Fragments are mostly petronodes or High Plains gravels. → HIGH PLAINS LRU (HP)
6b. Fragments are mostly plateau bedrock fragments. → CANADIAN PLATEAUS LRU
7a. All horizons in the upper 100 cm of soil have textures of sandy clay loam or sandier.
→ CANADIAN PLATEAUS LRU (CP)
7b. At least one horizon in the upper 100 cm of soil has a texture that is less sandy than sandy clay loam. → HIGH PLAINS LRU (HP)

Classification relationships

NRCS and BLM: Low Terraces Canadian Plateaus LRU Major Land Resource Area 70A, High Plateaus of the Southwestern Great Plains Land Resource Region G, Western Great Plains Range and Irrigated Region (United States Department of Agriculture, Natural Resources Conservation Service, 2006).

USFS: Low Terraces Sandy Smooth High Plains Subsection Southern High Plains Section Great Plains-Palouse Dry Steppe Province (Cleland, et al., 2007).

EPA: Low Terraces <26l Upper Canadian Plateau<26 Southwestern Tablelands (Griffith, et al., 2006).

Ecological site concept

The Low Terraces ecological site occurs on stream terraces in river valleys in the CP-LRU. The CP occupies the western portion of MLRA 70A and extends from Las Vegas, NM at the southern end to beyond Raton, NM at its northern end. Elevation for the CP LRU ranges from 5,000 to 7,500 feet.

The central concept for the Low Terraces ecological site is a stream valley system that is entrenched into the Cretaceous Canadian Plateau with only subtle relief (Rosgen Valley Type VIII). Since these valleys are not carved down through Dakota Sandstone layers like the riparian sites of the Mesozoic Canyons and Breaks LRU, there are no steeper box canyons. There can be a seasonal water table within rooting depth for woody plants and shrubs as well as enhanced available soil moisture for herbaceous plants due to the run-on contributions of moisture from nearby uplands. During heavy rainfall events from intense summer storms, the Low Terraces ecological site can experience rare flooding for brief periods.

Soil depth for the Low Terraces ecological site is over 78 inches (200 centimeters) to root-restrictive layers. Slope gradient ranges from 0 to 5 percent, causing aspect to have very little effect on site dynamics. Surface texture ranges from sandy loam to silty clay.

Associated sites

GX070A01X002	**Clayey Uplands** This site occurs in soils that have high clay in subsurface horizons. These soils are found on upland positions which may contribute moisture and sediment to riparian systems and their stream terraces.
GX070A01X005	**Limy** This site occurs where soils surfaces have strong or violent effervescence and ≥ 5% calcareous rock fragments. These soils are found on upland positions which may contribute moisture and sediment to riparian systems and their stream terraces.

GX070A01X006	**Slopes** This site occurs on escarpments where soils are ≤ 50 cm to a root-restrictive layer, and on slopes > 10%. These soils are found on upland positions which may contribute moisture and sediment to riparian systems and their stream terraces.
GX070A01X008	**Ephemeral Drainageways** This site occurs on the channels and floodplains of ephemeral streams where salts have not accumulated. Drainageways may connect to low terraces in some places, and contribute moisture to the riparian system.
GX070A01X013	**Lithic Sandstone** This site occurs where soils are ≤ 50 cm to lithic contact with sandstone bedrock, and often supports oneseed juniper savannahs. These soils are found on upland positions which may contribute moisture and sediment to riparian systems and their stream terraces.
GX070A01X014	**Lithic Limestone** This site occurs where soils are ≤ 50 cm to lithic contact with limestone bedrock, and often supports oneseed juniper savannahs. These soils are found on upland positions which may contribute moisture and sediment to riparian systems and their stream terraces.
GX070A01X010	**Riparian** Occurs in perennial stream systems and related floodplains. These sites are situated below Low Terraces and receive run-on moisture from these sites.
GX070A01X019	**Gravelly Terraces** This site occurs on old stream terraces. Soils are skeletal, and contain well-developed argillic horizons. Gravelly Terrace sites typically occur right above the Riparian sites and contribute moisture to this site via overland-flow and through-flow.
GX070A01X021	**Sandy** This site occurs in soils that are > 50 cm to a root restrictive layer and have surface textures of sandy loam or coarser. Such sites typically occur on sand sheets and dunes adjacent to playas.

Similar sites

R070AY004NM	**Bottomland** This site was written for drainageways, alluvial fans, and floodplains, none of which are affected by stream hydrology. The soil systems that are impacted by stream hydrology are significantly different, and yet ecologically important enough from these other types of bottomland soils to differentiate into a separate site. Additionally, most acreage of Low Terraces are not considered significant run-on positions and are not in specifically in the bottom of the landscape.
R070AY001NM	**Loamy Upland** This site is not specific to Stream terraces and thus does not take into account the soil morphology or hydrology of these specific types of ecology. Thus, while the Loamy Upland site has been applied to areas that currently correlate to Low Terraces, the former is a poor fit for these areas.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	Not specified

Legacy ID

R070AA012NM

Physiographic features

The Canadian Plateaus LRU exists on a plateau unit of the Great Plains Province landscape. The landforms that occur on this landscape include both erosional and depositional surfaces of plateaus and consist of alluvial fans, ridges, benches, playas, drainageways, breaks, terraces, stream channels and floodplains. The Canadian River Valley, primarily to the east, is the base level towards which the entire LRU is eroding and draining. As plateaus grade towards the Canadian River, the elevation drops from above 7,500 feet to below 5,000 feet over a distance of

30 to 40 miles. Because of this erosional gradient, the exposed strata are generally older as you move from west to east across this LRU. In the west, the younger rocks, such as the late Cretaceous shales and limestones, remain intact, a testament to their distance from the Canadian River Valley. To the east, the early Cretaceous Dakota sandstone provides a caprock that serves as the plateau rim.

The Low Terraces ecological site occurs as stream valley features on plateau surfaces across the CP LRU. They are stream terraces of fairly gentle slope that align with the stream gradient. Though these terraces are adjacent to the active stream channel, they are not considered hydrologically active in that they are high enough to not participate in annual flooding events except on very rare occasions on the scale of 1 in 50 or 100 years cycle. These terraces often have permanent structures as well as agricultural infrastructure existing on their surfaces. In many cases, the current stream channel has been entrenched well below the floodplains due to hydrologic alteration of the landscape, causing the terrace to be even further removed from any potential flood stage.

This site is not extensive in terms of acreage, but it can be found throughout all portions of the CP where the plateau is not deeply dissected into Dakota Sandstone bedrock. This site is considered a run-on landform which receives additional moisture from surrounding uplands. This allows the site to behave as though in a wetter climate than expected based on rainfall alone.

Associated sites that occur on landforms and landform positions adjacent to the Low Terraces ecological site are the Sandy, Loamy Uplands, Clayey Uplands, Lithic Limestone, Lithic Sandstone, Limy, and Ephemeral Drainageways. For more detail on how the Low Terraces site contrasts with and relates to other sites in the CP, see the Ecological Site Key and Associated Sites section.

Geology:
The geology of the CP consists primarily of Cretaceous rocks: shale, limestone, and sandstone of the Dakota, Graneros, Greenhorn, Pierre, and Niobrara Formations. Being widely distributed across this LRU, the Low Terraces ecological site occurs on each of these formations. The stream valleys are filled with deep deposits of alluvium from the surrounding uplands which are typically composed of sedimentary rocks but may favor the shale, limestone, or sandstone depending on the surface geology of the nearest plateau surface. In areas closer to the foothills of the Rocky Mountains, gravelly or cobbly materials of mixed igneous or metamorphics can contribute significantly to the alluvial sediments.

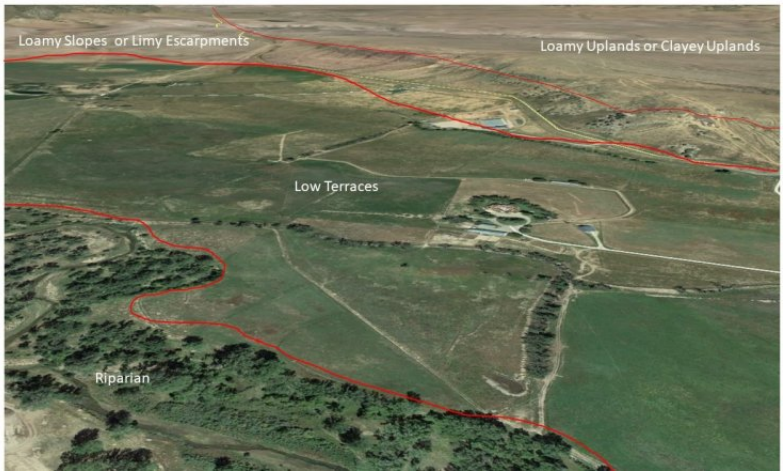


Figure 1. The Low Terrace and associated ecological sites on a typical CP landscape.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Flood plain (2) Plateau > Stream terrace
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to rare
Ponding frequency	None

Elevation	1,524–2,286 m
Slope	0–5%
Water table depth	51–251 cm
Aspect	Aspect is not a significant factor

Climatic features

The Canadian Plateaus are currently described as having an aridic-ustic and mesic soil climate regime. The estimated average annual soil temperature ranges from 49 to 58 F, supported by soil temperature measurements taken from May 2014 to July 2015. Rainfall occurs mostly during the summer months and ranges from 15 to 18 inches annually. An annual average range of 130 to 170 cumulative frost free days is common, with 150 days or fewer occurring above 7,000 feet.

Table 3. Representative climatic features

Frost-free period (average)	130 days
Freeze-free period (average)	170 days
Precipitation total (average)	406 mm

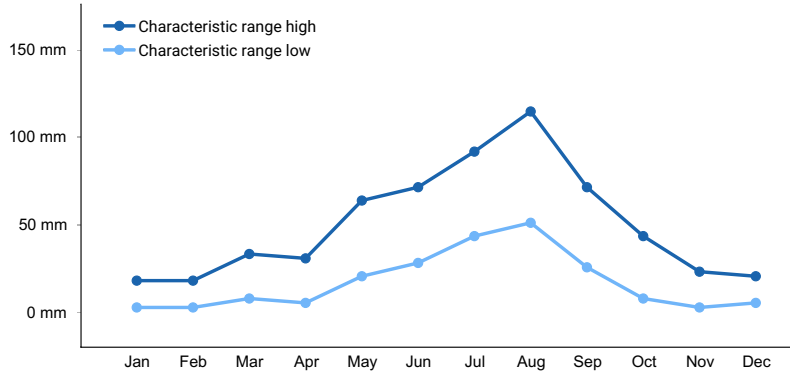


Figure 2. Monthly precipitation range

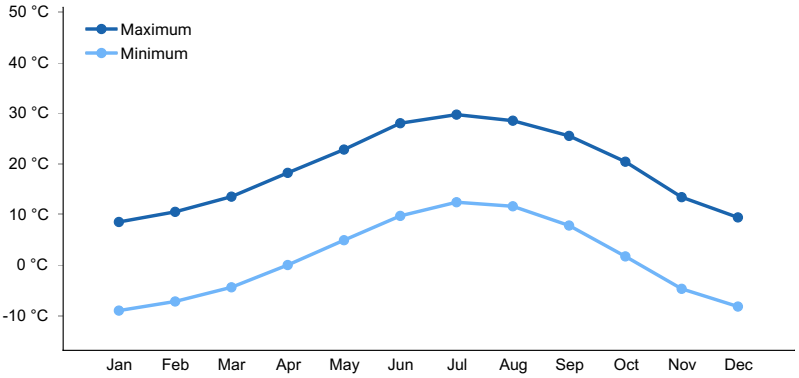


Figure 3. Monthly average minimum and maximum temperature

Climate stations used

- (1) MAXWELL 3 NW [USC00295490], Maxwell, NM
- (2) DES MOINES [USC00292453], Des Moines, NM
- (3) LAS VEGAS WWTP [USC00294862], Las Vegas, NM
- (4) ROY [USC00297638], Roy, NM
- (5) LAS VEGAS MUNI AP [USW00023054], Las Vegas, NM
- (6) SPRINGER [USC00298501], Springer, NM
- (7) CIMARRON 4 SW [USC00291813], Cimarron, NM
- (8) VALMORA [USC00299330], Valmora, NM

Influencing water features

Low Terraces ecological sites are adjacent to perennial, and larger ephemeral stream systems, and receive run-on water from surrounding uplands by means of overland flow and throughflow. On extremely wet years, the stream valley systems may experience brief periods of flooding that might overtop the lower stream terrace surfaces.

The Low Terraces ecological site is not typically associated with any wetlands, but some small isolated wetlands may occur near groundwater discharge seeps where the terrace adjoins upland escarpments at its periphery or in isolated microsites such as depressions or gulleys in the terraces. In addition, the stream-stage controlled groundwater tables are commonly within rooting depths for deep-rooting shrubs and trees such as cottonwood.

Soil features

Every ecological site and associated soil component has static soil properties that help define the physical, chemical, and biological characteristics that make the site unique. The following soil profile information is a description of those unique soil properties for the Low Terraces ecological site. To learn about the dynamic properties of the soil components tied to this site, refer to the "Plant Communities" section of this ESD.

The Low Terraces ecological site is tied to the components of numerous map units in the Canadian Plateaus LRU of 70A. These components are correlated to series from MLRA 70A such as the Manzano and La Brier soils. These soils typically form in alluvium from mixed sources.

In normal years these soils are driest during the winter. They may be dry in some or all parts for over 90 cumulative days, but are moist in some or all parts for either 180 cumulative days or 90 consecutive days, during the growing season. The effect of run-on water to this site can be significant and may increase the available water in both amounts and duration. The soil moisture regime is ustic bordering on aridic. The mean annual soil temperature is 49 to 55 degrees F; this range falls in the mesic soil temperature regime.

The soils of Low Terraces sites are characterized by stratified layers of alternating textures such as silt loams and sandy loams or even clay loams and gravelly sandy loams. Typically, the soil surface is loamy due to the sediments deposited during the last high stage flood event. Below this, a range of possible textures from cobbly loamy sands to clay loams may exist depending on the historic alluvial environment. Very minimal soil development is expected, perhaps some secondary carbonates or some subtle amounts of clay illuviation may exist.

TYPICAL PEDON: Pedon taken from stream terrace along Cimarron River on CR 12 (Miami Rd.), east of Cimarron, NM. 13S 0515019 4035949; elevation: 6,230 feet.

A -0 to 10 inches; brown (7.5YR 4/3) loam, very dark brown (7.5YR 2.5/3) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine interstitial pores; neutral; clear wavy boundary.

Bt -10 to 16 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard dry, friable moist, slightly sticky and plastic wet; many fine and very fine roots; common fine tubular pores; mildly alkaline; clear wavy boundary.

Btk -16 to 24 inches; reddish brown (7.5YR 5/3) clay loam, dark reddish brown (7.5YR 3/3) moist; weak medium subangular blocky struc¬ture; slightly hard dry, friable moist, slightly sticky and plastic wet; common fine and very fine roots; common fine and very fine tubular pores; very slight effervescence; mildly alkaline; clear wavy boundary.

Bk -24 to 60+ inches; reddish brown (7.5YR 5/4) clay loam, reddish brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard dry, friable moist, sticky and plastic wet; very few fine and very fine roots; few very fine tubular pores; strong effervescence; slightly calcareous; mildly alkaline; clear wavy boundary.

Saturated Hydraulic Conductivity (Ksat): 0.01-10 µm/second.
Available Water Capacity (cm H20/cm soil):
A: 0.13 to 0.17
B: 0.06 to 0.17

Average total AWC in upper 60 inches (152 centimeters): 7 inches (19 centimeters)
Calcium Carbonate Equivalent:
A: 0 to 1
B: 0 to 5

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Sandy loam (2) Loam (3) Silty clay loam
Family particle size	(1) Fine-loamy (2) Fine
Drainage class	Well drained to moderately well drained
Permeability class	Very slow to moderate
Soil depth	152–508 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	16.51–21.59 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0–1 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–2
Soil reaction (1:1 water) (0-101.6cm)	7.2–7.8
Subsurface fragment volume <=3" (Depth not specified)	0–50%
Subsurface fragment volume >3" (Depth not specified)	0–30%

Ecological dynamics

Ecological Dynamics of the Site:
Plant tables have not been developed for this site. Until such time as they can be updated, use the plant tables in the referenced literature that correlates to this concept (refer to Other Information within the Interpretations section, and to Legacy Site Information below in this narrative). With respect to the imperfect alignment of such correlations, be aware of these shortcomings in their applicability to conservation planning.

Early work by Kuchler (1964) identified the potential natural vegetation type for the Canadian Plateaus LRU as that of the grama/buffalograss short grass prairie. The Low Terraces ecological site is dominated by short grasses, but also contains a mix of shrubs, forbs, and succulents. As is typical of plant communities, pronounced annual variations in precipitation translate to considerable short-term fluctuations in annual production within a given plant community phase.

There are numerous variables which affect the range of characteristics for this ecological site. Variables such as elevation, latitude, and orographic effects create a climatic gradient which influence the distribution of C3 and C4 plants. Soil properties such as surface texture, depth to clay layer, parent material, and accumulated salts affect species diversity and composition. Natural disturbances such as drought and wildfire affect species density and cover.

The climate gradient across the CP LRU shows a greater distribution of C3 plants such as western wheatgrass and

bottlebrush squirreltail where temperatures are cooler, and moisture is more abundant. Where surface texture trends toward clay loam, western wheatgrass, galleta, and vine mesquite grass increase. Where the plateau bedrock is Cretaceous shale and the site trends toward a surface texture of clay loam with an increase in salt in the profile, alkali sacaton and four-wing saltbush increase. Refer to Appendix C to see scientific names and plant codes alongside common names.

Fire is a disturbance regime that reduces succulents and shrubs while stimulating grasses and forbs. Not all fires are equal. According to Gebow (2001), fire effects in the same location will vary, especially with fire timing, both seasonally and within the scheme of year-to-year moisture variation. Precipitation during seasons before and after fire has a major effect on recovery of plants. Fire promotes rhizomatous plant species, such as western wheatgrass, that can take advantage of below-ground rhizomes from which tillering is rapidly initiated.

Correlation to Current Ecological Sites:
Bottomland- R070AY004NM: This site was written for drainageways, alluvial fans, and floodplains, none of which are affected by stream hydrology. The soil systems that are impacted by stream hydrology are significantly different, and yet ecologically important enough from these other types of bottomland soils to differentiate into a separate site.

Loamy Upland- R070AY001NM: This site is not specific to stream terraces and thus does not take into account the soil morphology or hydrology of these specific types of ecology. Thus, while the Loamy Upland ecological site has been applied to areas that currently correlate to Low Terraces, the former is a poor fit for these areas.

Most components of the Low Terraces ecological site are currently tied to the Bottomland ecological site (R070AY004NM). The bottomland site was established for all broad drainageways, floodplains, and alluvial fans. In addition, the Bottomland ecological sites are described as “not influenced by water from a stream”.

Historic Climax Plant Community:

Grasses dominate this site. Mid-grasses such as western wheatgrass, alkali sacaton, and sideoats grama are dominant with a variety of short grasses. Forbs and shrubs are only a minor portion of the plant community. This site occurs in elongated drainages that transport surface runoff from adjoining upland sites and swales. Because of the extra water received by this site, the grass is denser, stands higher and is one of the most productive sites in the resource area.

Grazing:
This site can be grazed any season of the year by all classes and kinds of livestock. Because of the forage produced by alkali sacaton, cattle and horses may best be suited. Continuous grazing during the growing season will cause the more desirable forage plants such as western wheatgrass, vine-mesquite, sideoats grama, Canada wildrye, and fourwing saltbush to decrease. Species most likely to invade this site are buffalograss, ring muhly, cholla cactus, plains pricklypear, and rubber rabbitbrush. Species most likely to increase are blue grama, galleta, alkali sacaton, and desert saltgrass. As the ecological condition deteriorates, it is accompanied by a loss of vegetative cover causing channeling of the water, and the productivity is greatly reduced. The plant community may be dominated either by blue grama/galleta or alkali sacaton/galleta as deterioration advances. Where alkali sacaton dominates the site, livestock should be concentrated into small pastures to fully utilize the forage. Livestock should be rotated in the summer or pasture should be rested in alternate years. A system of deferred grazing, which varies the time of grazing and rest in a pasture during successive years, is needed to maintain or improve the plant community. Spring deferment is beneficial to western wheatgrass and allows alkali sacaton sufficient time to green up.

Tables from Bottomland ecological site (R070AY004NM)
Annual production by plant type
Plant Type----------Low(Lb/Acre) ----------Representative Value(Lb/Acre) ----------High(Lb/Acre)
Grass/Grasslike----------880----------2200----------3520
Forb----------80----------200----------320
Shrub/Vine----------30----------75----------120
Total----------990----------2475----------3960

Community 1.1 plant community composition

Common Name----------Symbol----------Scientific Name----------Annual Production (Lb/Acre)
GRASS/GRASSLIKE
1 alkali sacaton----------SPAI----------*Sporobolus airoides*----------625–750
2 western wheatgrass----------PASM--------*Pascopyrum smithii*----------500–625
3 vine mesquite----------PAOB--------*Panicum obtusum*----------500–625
4 blue grama----------BOGR2-------*Bouteloua gracilis*----------375–500
5 James' galleta----------PLJA----------*Pleuraphis jamesii*----------250–375
6 sideoats grama----------BOCU---------*Bouteloua curtipendula*-------250–375
7 silver bluestem----------BOSA----------Bothriochloa saccharoide----25–125
8 cane bluestem----------BOBA3---------*Bothriochloa barbinodis*------25–125
9 saltgrass----------DISP----------*Distichlis spicata*----------25–125
10 Canada wildrye----------ELCA4----------*Elymus canadensis*----------25–125
11 *Graminoid (grass or grass-like)*-2GRAM-*Graminoid (grass or grass-like)*-25–125
FORB
12 globemallow----------SPHAE----------Sphaeralcea----------25–125
13 Cuman ragweed----------AMPS----------*Ambrosia psilostachya*--------25–125
14 upright prairie coneflower-RACO3-------*Ratibida columnifera*----------25–125
15 *Forb, perennial*----------2FP---------- *Forb, perennial*----------25–125
16 *Forb, annual*----------2FA---------- *Forb, annual*----------25–125
SHRUB/VINE
17 fourwing saltbush---------ATCA2----------*Atriplex canescens*----------0–125
18 Apache plume----------FAPA----------*Fallugia paradoxa*----------0–125
19 *Shrub, deciduous*---------2SD---------- *Shrub, deciduous*----------25–125

Components tied to the Loamy Upland ecological site (R070AY001NM).
Historic Climax Plant Community:

This site is a grassland characterized by mid and short-grasses. Blue grama is the dominant warm-season species. Western wheatgrass is the dominant cool-season species.

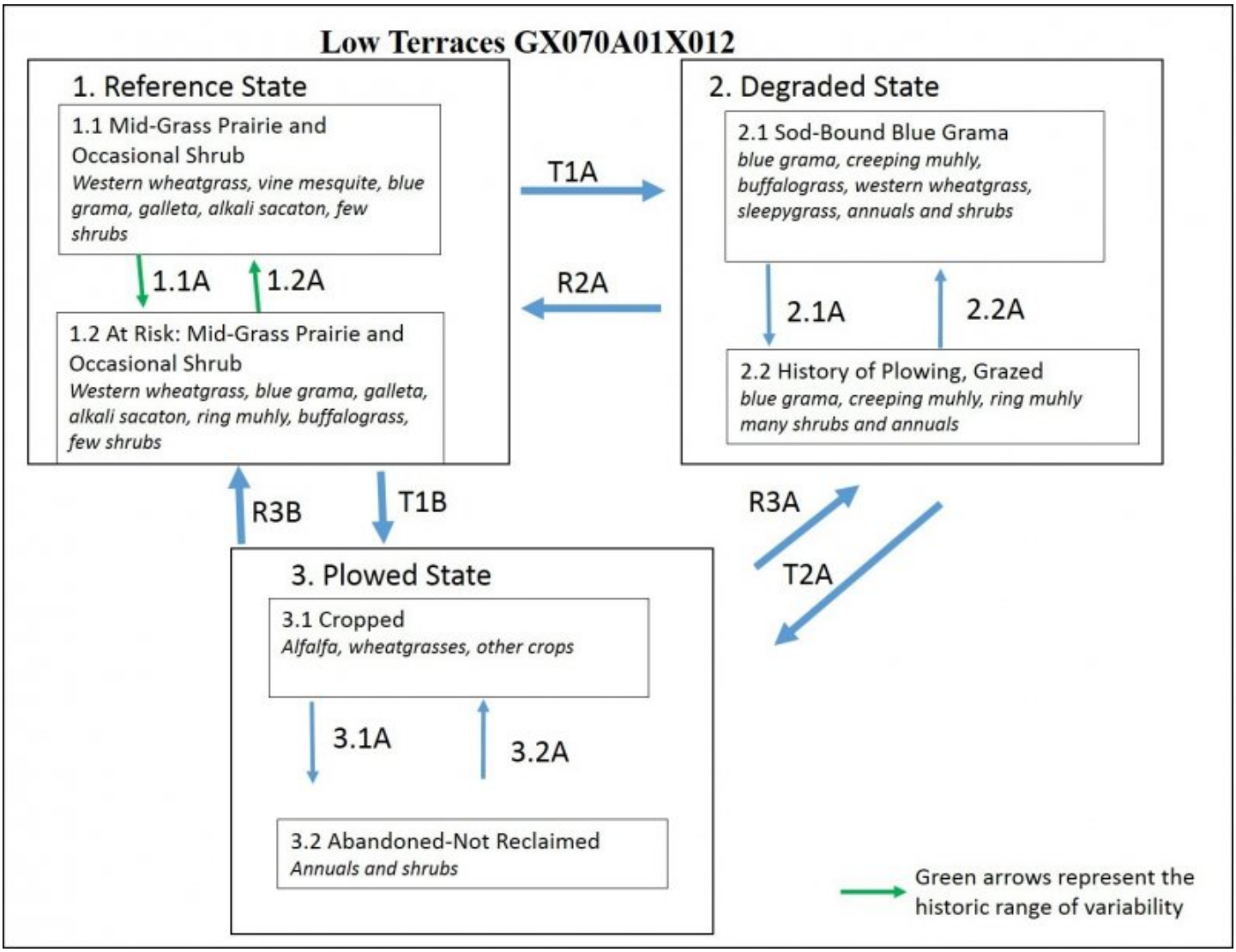
Grazing:
This site can be used by all classes of livestock during any season of the year. Because of the occasional severe winter storms, emergency feed may be necessary. Yearling calves grazing from May to October may be favored because of these winter storms. Approximately 90 percent of the total yield is from species that furnish forage for grazing. Continuous grazing during the growing season will cause the more desirable forage plants such as western wheatgrass, bottlebrush squirreltail, galleta, sideoats grama, and winterfat to decrease. Species most likely to increase are blue grama, ring muhly and buffalograss. As the ecological condition deteriorates, it is accompanied by a sharp increase of blue grama. Continuous heavy grazing will cause blue grama to form a low, dense turf, which is low in productivity. A system of deferred grazing, which varies the time of grazing and rest in the pastures during successive years in needed to maintain or improve the plant community. Grazing western wheatgrass during the months of May and June will cause a sharp decrease; therefore, rest during this period will allow western wheatgrass to grow and reproduce.
Tables from Loamy Upland ecological site (R070AY001NM):
Annual production by plant type
Plant Type-------Low(Lb/Acre) -------RV(Lb/Acre)-------High(Lb/Acre)
Grass/Grasslike -------610----------860----------1100
Forb----------130----------130----------140
Shrub/Vine----------130----------130----------130
Total----------870----------1120----------1370

Community 1.1 plant community composition
Common Name----------Symbol-------Scientific Name-------Annual Production (Lb/Acre)
GRASS/GRASSLIKE
1-------blue grama----------BOGR2-------*Bouteloua gracilis*---------312–357
2-------western wheatgrass-PASM--------*Pascopyrum smithii*-------178–223
3-------squirreltail----------ELEL5--------*Elymus elymoides*---------89–133
4-------James' galleta----------PLJA---------*Pleuraphis jamesii*----------43–89
5-------sideoats grama----------BOCU-------*Bouteloua curtipendula*---43–89

6-------threeawn----------ARIST---------Aristida----------25–44
7-------ring muhly----------MUTO2------*Muhlenbergia torreyi*-----25–44
8-------buffalograss----------BODA2------*Bouteloua dactyloides*-----25–44
9-------common wolfstail--------LYPH---------*Lycurus phleoides*----------25–44
10-------sand dropseed----------SPCR---------*Sporobolus cryptandrus*----25–44
FORB
12-------*Forb, annual*----------2FA---------- *Forb, annual*----------10–48
13-------*Forb, perennial*----------2FP---------- *Forb, perennial*----------10–48
14-------Cuman ragweed----------AMPS---------*Ambrosia psilostachya*------10–25
15-------scurfpea----------CULLE---------Cullen----------5–25
16-------prairie clover----------DALEA---------Dalea----------5–25
17-------dotted blazing star---------LIPU----------*Liatris punctata*----------5–25
18-------locoweed----------OXYTR---------Oxytropis----------5–25
19-------upright prairie coneflower-RACO3------*Ratibida columnifera*-------5–25
20-------scarlet globemallow--------SPCO--------*Sphaeralcea coccinea*-------5–25
SHRUB/VINE
21-------winterfat----------KRLA2----------*Krascheninnikovia lanata*--29–48
22-------prairie sagewort----------ARFR4-------*Artemisia frigida*----------29–48
23-------*Shrub, deciduous*----------2SD--------- *Shrub, deciduous*----------29–48

From the San Miguel Soil Survey Manuscript (NM630), map unit Md-Manzano clay loam, 1 to 3 percent slopes
This unit is used for irrigated crops, mainly alfalfa, small grain, vegetables, and orchards. Among the other crops grown are corn, grain sorghum, and legumes. This unit is also used for livestock grazing and for wildlife habitat.
If this unit is used for irrigated crops, the main limitations are moderately slow permeability and moderate hazards of soil blowing and water erosion.
Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop. Water should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. Soil blowing can be reduced by using all crop residue and practicing minimum tillage. Yield can be maintained or increased by applying fertilizer. Most crops, except for legumes, respond to nitrogen. Legumes respond to phosphate. Rotation grazing helps to maintain the quality and quantity of forage. Timely harvesting of crops improves their quality.
The potential plant community on the Manzano soil is mainly western wheatgrass, blue grama, alkali sacaton, and vine-mesquite. As the range deteriorates, the proportion of these forage plants decreases and the proportion of galleta, ring muhly, and broom snakeweed increases. Grazing management should be designed to increase the productivity and reproduction of western wheatgrass, blue grama, and buffalograss. Forage production is reduced in areas where gullies have formed. This unit is suited to such range improvement practices as mechanical treatment, earthen ponds, and seeding.
Adapted from the Rangeland Productivity table in the NM630 Manuscript
Manzano component of map unit Md (correlated here to the “Loamy” range site – not to be confused with R070AA001NM) -- The approximate species composition of the potential plant community is as follows:
Blue Grama----------45
Western Wheatgrass----------25
Galleta----------10
Buffalograss----------5
Mat muhly----------5
Total production in pounds per acre for unfavorable, normal, and favorable years: 350, 800, and 1,450.

State and transition model



State 1
Reference State

This diagnostic reference state is characterized by a variety of mid- and short-prairie grasses such as western wheatgrass, blue grama, alkali sacaton, and vine mesquite with some lesser amounts of shrubs such as fringed sagebrush, fourwing saltbush, and forbs. When the site is stressed due to grazing or animal pressure, the proportion of these grasses decreases and the proportion of galleta, ring muhly, fringed sagebrush, and broom snakeweed increases along with annuals and weedy species such as field bindweed, Russian thistle, kochia, and scarlet globemallow. Diversity of plant species and density of foliar and basal cover encourages the cycling of organic matter and therefore nutrients in what is functionally a positive feedback loop of fertility. In these conditions, infiltration is high, allowing more moisture to be absorbed and thus retained in the landscape, and which further encourages resilience to drought periods. High amounts of vegetative canopy cover shades the ground, keeping it cooler, armored from rain-splash erosion, water erosion during overland flow events, and wind erosion. Long-term rates of erosion and organic matter cycling are in equilibrium and only fluctuate slightly year-to-year due to normal climatic variability. Fire is a natural cycle that also encourages recycling of nutrients and maintains a grass and forb advantage over shrub encroachment.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- blue grama (*Bouteloua gracilis*), grass
- alkali sacaton (*Sporobolus airoides*), grass
- vine mesquite (*Panicum obtusum*), grass

Community 1.1

Mid-Grass Prairie and Occasional Shrub

This reference plant phase has a presence of most of the grass species listed above. Though it likely had some history of crop agriculture, there has been sufficient time and consideration to recovery of a self-sustaining plant community dynamic. The recovery to reference conditions requires that the soil has a deep surface layer of high organic matter content which provides resilience to stressors such as plowing, overgrazing, or hydrologic impairment. In addition, the site retains its native seed bank, or is or in proximity to a seed source to resupply the plant community diversity. This plant community phase has the highest species diversity which optimizes energy flow, hydrologic function, and nutrient cycling. The diverse root systems take advantage of moisture from both close to the surface as well as deep in the profile, thus maintaining organic matter within the soil in a larger range of depths. Decomposition is active, cycling the labile soil organic matter pools which enhances nutrient availability, and creating humus which adds to the retention of plant available nutrients and water needed for plant vigor. A mix of grasses, forbs shrubs and possibly a few succulents are present. Total foliar cover is greater than 90 percent with less than 15 percent bare ground. Annual production ranges from 1000 pounds per acre in unfavorable years following a period of drought, or after a fire, to 3500 pounds per acre in favorable years when rainfall has been timely and plentiful.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- alkali sacaton (*Sporobolus airoides*), grass
- vine mesquite (*Panicum obtusum*), grass

Community 1.2
At Risk: Mid-Grass Prairie and Occasional Shrub

Figure 4. Community phase 1.2

This community phase is characterized by a mix of grasses, forbs, shrubs and possibly a few succulents. Total foliar cover is greater than 80 percent. Decreasers are reduced, possibly an absence of vine mesquite and fewer fourwing saltbush. However, it is still within the reference state, meaning it has not crossed a threshold, and that intensive management (i.e., accelerating practices) is not yet required to push the system back into the historic range of variability (Bestelmeyer, et al., 2010).

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- alkali sacaton (*Sporobolus airoides*), grass
- vine mesquite (*Panicum obtusum*), grass
- blue grama (*Bouteloua gracilis*), grass

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a period of time following fires or drought, perhaps coupled with some minor grazing activity, either by wildlife and/or livestock.

Pathway 1.2A
Community 1.2 to 1.1

This pathway represents a longer period since drought, with maybe a favorable year or two in the recent past. It could also represent a rest period or significant decrease in grazing pressure in both frequency and intensity.

State 2
Degraded State

This plant community state exists after some period of plowing or extended periods of continuous grazing and favors increasers such as blue grama, which is commonly growing in its low productivity sod form. A noticeable increase in shrubs such as fringed sage and broom snakeweed and annuals such as scarlet globemallow, curlycup gumweed, and field bindweed has also occurred. The resulting increase in bare ground has allowed undesirable species to establish, with a higher amount of annuals. This causes a decrease in rooting density, especially the permanent rooting which leaves the topsoil more susceptible to erosion, both wind and water. It also decreases the amount of organic matter storage and cycling, which in turn limits annual nutrient cycling. The annuals and shrubs do, however, help to remediate any dense plow pans that have formed, helping to increase permeability and storage of moisture.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- blue grama (*Bouteloua gracilis*), grass

Community 2.1
Sod-Bound Blue Grama

Figure 5. Community Phase 2.1 in San Miguel County, November 2017. Blue grama is in sod-bound habit. Cottonwood trees occupy a Riparian site in the background.

The plant community phase is typically recovering from a period of crop agriculture, with or without irrigation, and likely had been plowed for some period. Alternatively, it has experienced prolonged continuous grazing. The dominant grasses here are blue grama and western wheatgrass as low species diversity becomes characteristic. Vine mesquite becomes extirpated from the site while annuals and shrubs increase in coverage. Total foliar cover is between 60 and 85 percent with low grass diversity and greater than 20 percent shrubs and annuals.

Dominant plant species

- blue grama (*Bouteloua gracilis*), grass
- western wheatgrass (*Pascopyrum smithii*), grass

Community 2.2

History of Plowing, Grazed

Figure 6. Site on formerly cropped stream terrace along the Rio Mora. It is basically a sod-bound blue grama grassland with some mat muhly and about 20 percent bare ground. Note the fleabane daisy flowers.

This phase has been historically plowed, or is in close proximity to cropped fields as to have a compacted layer similar to a plow pan. This alters the permeability of the soil, encouraging more runoff during heavy rain events, whicht can lead to loss of topsoil. Total foliar cover is between 50 and 80 percent, with low species diversity, and greater than 20 percent shrubs and annuals.

Pathway 2.1A
Community 2.1 to 2.2

Sod-Bound Blue Grama **History of Plowing, Grazed**

This pathway represents an increase in the intensity and/or duration of grazing, coupled with periods of drought.

Pathway 2.2A
Community 2.2 to 2.1

History of Plowing, Grazed **Sod-Bound Blue Grama**

This pathway represents an implementation of deferred grazing or rested periods so that species diversity and/or density can recover.

State 3
Cropland State

This state exists in areas with histories of plowing and cropping. A plowpan (compacted zone) is usually present within the upper 10 inches (25 centimeters) of the soil profile. Thickness of topsoil and the concentration of organic matter therein is often diminished.

Characteristics and indicators. A plowpan (compacted zone) is usually present within the upper 10 inches (25 centimeters) of the soil profile. Thickness of topsoil and the concentration of organic matter therein is often diminished. Plant species are quite variable--consisting of either crops or early-seral species, depending on whether the site is actively cultivated.

Community 3.1
Cropped

This plant phase exists where the terraces are currently cropped. With the exception of orchards, these areas are gennerally plowed at least once annually, and planted in a monoculture crop. The common crops grown in this area include mainly alfalfa, small grain, vegetables, and tree orchards. At a given time, the field may be 100 percent bare ground or 100 percent covered by crop foliage.

Community 3.2
Post-Cropped

When a field that has been plowed for decades is abandoned and not reclaimed, it has lost all of its seed bank and will recover in weedy species with few native grasses. Foliar cover may vary from 20 to 80 percent.

Pathway 3.1A
Community 3.1 to 3.2

Abandonment of the field without having attempted to restore it to some semblance of a historic plant community through seeding practices or an irrigation plan.

Pathway 3.2A
Community 3.2 to 3.1

Return of irrigation and regular cropping cycle. Perhaps limited till or no till.

Transition T1A
State 1 to 2

Season-long grazing providing little rest and recovery for preferred grazed plants during critical growing periods, coupled with high utilization, and followed by a single drought event, can cause a state shift to the degraded condition. Selective grazing pressure on palatable species such as western wheatgrass, alkali sacaton, and vine mesquite leads to a decrease in the vigor and abundance of these species, and advantages less-palatable species such as galleta, fringed sage, and broom snakeweed. Accelerated erosion depletes soil organic matter and reduces the seedbank.

Constraints to recovery. The persistence of a continuous grazing regime and/or unfavorable weather patterns (i.e. drought).

Transition T1B
State 1 to 3

Plowing and cropping of the terraces, typically with a monoculture of alfalfa, hay, wheat, or perhaps corn or beans.

Constraints to recovery. Loss of soil organic matter and seedbank, as well as the establishment of infrastructure such as roads and ditches.

Restoration pathway R2A
State 2 to 1

Changing management strategies to favor native plant diversity and production, via deferred grazing with periods of rest, especially during droughts. Restoration through seeding practices may be necessary to reestablish the desired plant community diversity. If reseeding is to be successful, an irrigation plan for a period of several seasons may be required to ensure plants germinate and establish to prevent recidivism back to its degraded state. The site may require gully restoration activities such as installation of small rock grade control structures, or other engineered methods designed for the specific site and issues. In addition, some consideration for the condition of adjacent sites with respect to concentrating runoff waters or proximity to weed sources may be prudent for long term success.

Context dependence. Specific practices required will depend on which desired species remain in the seedbank, on weather conditions, and on the presence/abundance of gullies.

Conservation practices

Range Planting
Improved Water Application
Prescribed Grazing
Grazing Management Plan - Applied
Intensive rotational grazing

Transition T2A
State 2 to 3

Conversion of the terraces from a naturally vegetated rangeland condition to a planted crop of alfalfa, hay, wheat, or perhaps corn or beans. The process requires plowing, which has the effect of disturbing natural soil structure, thereby exposing the topsoil to enhanced decomposition which burns off the native soil organic matter content and releases carbon dioxide to the atmosphere. These practices are shown to reduce the total amounts of soil organic carbon and soil organic nitrogen (Wilfred and Mann, 2005; Miller et al., 2004). It also exposes bare soil to water and wind erosion and an intense period of moisture loss from the soil. This process can be minimized by adopting no till or low till (conservation tillage) practices that limit the amount of damage to soil health by conventional tilling practices.

Restoration pathway R3B
State 3 to 1

Intensive restoration beginning with a seeding practice utilizing a historic native plant mix that aims to break up the plow pan with a mix of deep rooting annuals and shrubs. If reseeding is to be successful, an irrigation plan for a period of several seasons will be required to ensure plants germinate and establish to prevent a return to a degraded state. Several years to decades of close management following conversion of cropped fields to a native grassland state may be required to restore the topsoil organic matter content to a level that sustains natural organic matter cycling processes. In addition, some remediation of roads and other farming infrastructure will help prevent other sources of erosion or weed establishment.

Context dependence. Whether or not this restoration pathway is practical remains to be seen. Practices required will depend on dynamic soil properties, and on the presence of infrastructure.

Restoration pathway R3A
State 3 to 2

Restoration through seeding practices may be necessary to reestablish the desired plant community diversity. If reseeding is to be successful, an irrigation plan for a period of several seasons may be required to ensure plants germinate and establish to prevent a return back to a degraded state. Several years to decades of close management following conversion of cropped fields to a native grassland state may be required to restore the topsoil organic matter content to a level that sustains natural organic matter cycling processes. In addition, some remediation of roads and other farming infrastructure will help prevent other sources of erosion or weed establishment.

Context dependence. Required practices will depend on dynamic soil properties prior to restoration, and on the presence of infrastructure.

Additional community tables

Animal community

Habitat for Wildlife:

(From Bottomlands-R070AY004NM) This site provides habitats which support a resident animal community that is characterized by coyote, badger, black-tailed jackrabbit, plains pocket gopher, marsh hawk, horned lark, magpie, western racer, and Great Plains skunk. The pronghorn antelope and mule deer will make seasonal use of these habitats. Red-wing blackbirds breed in these habitats.

(From Loamy Upland-R070AY001NM)This site provides habitats which support a resident animal community that is characterized by pronghorn antelope, badger, black-tailed jackrabbit, black-tailed prairie dog, thirteen-lined ground squirrel, prairie pocket gopher, marsh hawk, burrowing owl, horned lark, meadowlark, scaled quail, prairie rattlesnake, Great Plains toad, and ornate box turtle. The prairie falcon hunts year round over these habitats. These short grass sites are breeding areas for the long-billed curlew, upland plover, and lark bunting

Hydrological functions

SOIL HYDROLOGY AND INFLUENCING WATER FEATURES
Low Terraces ecological sites are adjacent to perennial, and larger ephemeral stream systems, and receive run-on water from surrounding uplands by means of overland flow and throughflow. This effect can be higher near to the upland interface where landscape water may discharge during some parts of the year. Though this site is not typically associated with any wetlands, some small isolated patches of hydric soils may occur near groundwater discharge seeps where the terrace adjoins upland escarpments at its periphery. On extremely wet years, the stream valley systems may experience brief periods of flooding that might overtop the lower stream terrace surfaces. In addition, the stream-stage controlled groundwater tables are commonly within rooting depths for deep-rooting shrubs and trees such as cottonwood or box elder.

Wood products

Where this site is not under cultivation, it often supports stands of cottonwoods.

Other information

Future Work:
Much data needs to be collected to complete tier 1 sampling and data analysis before tier development can begin. A complete pedon for this ecological site needs to be collected and used for the representative.
Several of the components that are linked to the Loamy Upland ESD, such as the 630MC, are mapped on stream terraces both in the CP and the Mesozoic Canyons and Breaks (MCB) LRU, thus a need for separation of concepts in the update mapping.

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Contributors

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Approval

Curtis Talbot, 10/05/2021

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	05/13/2025
Approved by	Curtis Talbot
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:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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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):**

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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:

---

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:**
