USDA Natural Resources Conservation Service

Ecological site R081BY335TX
Loamy Bottomland 23-31 PZ

Last updated: 9/19/2023
Accessed: 05/15/2024

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.

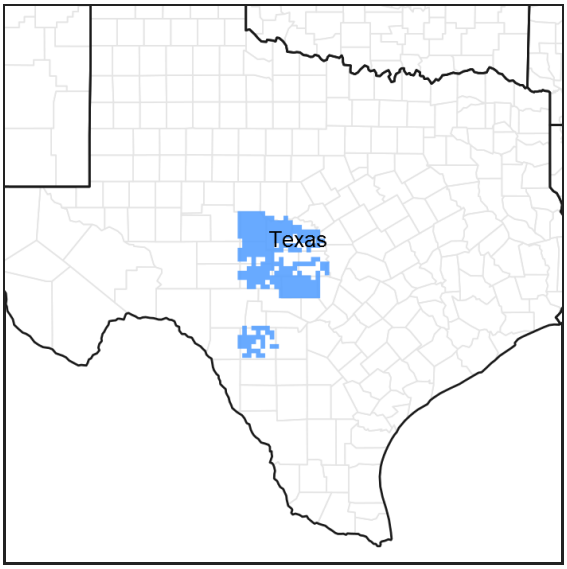


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 081B–Edwards Plateau, Central Part

This area is entirely in south-central Texas. It makes up about 11,125 square miles (28,825 square kilometers). The towns of Fredericksburg, Junction, Menard, Rocksprings, and Sonora are in this MLRA. Interstate 10 crosses the middle part of the area. A few State parks and State historic sites are in this MLRA.

Classification relationships

USDA-Natural Resources Conservation Service, 2006.
-Major Land Resource Area (MLRA) 81B

Ecological site concept

Loamy Bottomlands occupy the lowest setting on the landscape. They are comprised of flood plains formed from loamy alluvium. Flooding can occur on these sites.

Associated sites

R081BY343TX	**Shallow 23-31 PZ** The Shallow site may be encountered on adjacent slopes on stream terraces.
R081BY326TX	**Clay Loam 23-31 PZ** The Clay Loam site may be encountered on adjacent slopes on stream terraces.

Similar sites

R081BY326TX	**Clay Loam 23-31 PZ** The Clay Loam has deep soils but occurs on steam terraces.

Table 1. Dominant plant species

Tree	(1) *Carya illinoinensis* (2) *Quercus virginiana*
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Panicum virgatum*

Physiographic features

The site occupies narrow bands along the main watercourses and extends up draws away from the stream. This site occurs in stream flood plains or as stream terraces along major streams. Usually, they are intermittently flooded but are above the main stream channel. They occupy the lowest position on the landscape and receive runoff water from upland sites. Slopes are generally level to very gently sloping.

Table 2. Representative physiographic features

Landforms	(1) Plateau > Flood plain (2) River valley > Flood plain
Runoff class	Very low to low
Flooding duration	Very brief (4 to 48 hours) to brief (2 to 7 days)
Flooding frequency	Rare to frequent
Ponding frequency	None
Elevation	305–762 m
Slope	0–3%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Very low to medium
Flooding duration	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	Not specified
Slope	0–5%

Climatic features

The climate in the MLRA 81B is subtropical subhumid on the eastern portion and subtropical steppe on the western portion of the MLRA. Winters are dry, and the summers are hot and humid. The precipitation increases from west to east and the temperatures increase from north to south. The area usually receives 65 to 70 percent sunshine each year. The majority of the rainfall occurs during the warm months of April to October. Most precipitation comes from

thunderstorms that vary in the amount of water received and the areas covered. Spring is characterized by fluctuating patterns, but mild temperatures prevail. July and August are relatively dry and hot with little weather variability day-to-day. As summer progresses through fall, an increase of precipitation usually occurs in the eastern portions while a decrease of precipitation occurs to the west. Winter temperatures are mild, but polar Canadian air masses bring rapid drops in temperature. These cold spells last 2 or 3 days. Prevailing winds are southerly with March and April the windiest months.

Table 4. Representative climatic features

Frost-free period (characteristic range)	210-255 days
Freeze-free period (characteristic range)	240-280 days
Precipitation total (characteristic range)	635-711 mm
Frost-free period (actual range)	210-255 days
Freeze-free period (actual range)	240-280 days
Precipitation total (actual range)	610-762 mm
Frost-free period (average)	225 days
Freeze-free period (average)	260 days
Precipitation total (average)	686 mm

Climate stations used

- (1) BRADY [USC00411017], Brady, TX
- (2) EDEN [USC00412741], Eden, TX
- (3) FREDERICKSBURG [USC00413329], Fredericksburg, TX
- (4) FT MCKAVETT [USC00413257], Fort Mc Kavett, TX
- (5) HUNT 10 W [USC00414375], Hunt, TX
- (6) JUNCTION KIMBLE CO AP [USW00013973], Junction, TX
- (7) JUNCTION 4SSW [USC00414670], Junction, TX
- (8) MENARD [USC00415822], Menard, TX
- (9) ROCKSPRINGS 1S [USC00417706], Rocksprings, TX
- (10) SAN SABA [USC00417992], San Saba, TX

Influencing water features

Bottomland sites can be flooded occasionally to frequently for varying duration throughout the year. Hydric soils can occur in areas therefore an onsite inspection is required to determine wetland status.

Wetland description

Onsite determination is required.

Soil features

The soils consist of very deep, moderately alkaline silty clay loam to loam surface soils with silty clay to loam subsoils. Permeability of the subsoil ranges from slow to moderately rapidly permeable. Available water storage is high and the site receives runoff from adjacent uplands and occasional flooding. Available water holding capacity is high. Soil series correlated include: Boerne, Frio, Oakalla, and Rioconcho.

Table 5. Representative soil features

Parent material	(1) Alluvium–limestone
Surface texture	(1) Clay loam (2) Silty clay loam (3) Loam

Family particle size	(1) Fine (2) Fine-loamy (3) Coarse-loamy
Drainage class	Moderately well drained to well drained
Permeability class	Slow to moderately rapid
Soil depth	152–203 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	9.91–20.07 cm
Calcium carbonate equivalent (0-101.6cm)	15–65%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (10.2-101.6cm)	0–10%
Subsurface fragment volume >3" (10.2-101.6cm)	0–2%

Ecological dynamics

The plant community is a complex of tall grassland and bottomland hardwoods. The site is typically found in narrow bands along rivers or perennial streams but varies considerably across the area. Historically, the Loamy Bottomland evolved under grazing by white-tailed deer and occasional migratory bison. Grazing by wild animals was probably not as influential in shaping the reference vegetation, as were the intense and frequent fires. Fires would occur at 7 to 12-year intervals, killing all except protected trees along the stream terraces and scattered trees or mottes on the outlying bottomland. The deep productive soils allow a tallgrass woodland complex to develop. The characteristic baldcypress (*Taxodium distichum*), pecans (Carya illinioensis), black walnut (*Juglans nigra*) and chinkapin oak (*Quercus muehlenbergii*) are common throughout. Broadleaf woodoats (*Chasmanthium latifolium*), Eastern gamagrass (*Tripsacum dactyloides*), and purpletop (*Tridens flavus*) are common understory species. Tallgrasses dominate the open savannah away from the stream and the herbaceous understory. Forbs, vines, and shrubs were common throughout the landscape, but were generally held to low densities by frequent fires. The riparian vegetation immediately adjacent the stream is dominated by dense stands of trees with occasional breaks in the canopy and a dense understory of shade-tolerant, cool-season grasses and forbs.

The Tallgrass Hardwood Community (1.1) was relatively stable within the climate, soil, grazing and fire regime until European settlement and the advent of animal husbandry. Large numbers of free-roaming horses and cattle added to the impact of grazing by endemic game during the early and mid-1800’s. Although the bison had been mostly extirpated by 1860’s, cattle and horse populations continued to increase. With the introduction of barbed wire fencing and windmills during the 1880’s, cattle and sheep grazing became even more extensive. By the drought of the 1890’s, much of the Edwards Plateau was overgrazed. Because of the proximity to permanent water, bottomlands received heavy grazing use and manipulation by settlers. The sites provided lumber, firewood, and water for the pioneers and much of it was deforested and converted to cropland.

As overgrazing continued on the Tallgrass Hardwood Community (1.1), there was a reduction of late seral tallgrasses, a decline in plant litter, mulch, and organic matter, and the reduction in intensity and frequency of fires. The shift in plant composition and the decline in soil properties favored woody plant encroachment. The woody and grassland vegetation increasers were generally endemic species released from competition. As a result of continued overgrazing, the Tallgrass Hardwood Community (1.1) regressed to a Mixed-grass Hardwood Complex Community (1.2). In this phase, midgrasses such as sideoats grama (*Bouteloua curtipendula*), bristlegrass (Setaria

spp.), purpletop and low palatability forbs begin replacing the preferred tallgrasses and forbs. Grasses still dominate primary production, but the encroaching woody species are increasing in size and percentage herbage production.

If the Mixed-grass Hardwood Complex Community (1.2) is continually overgrazed and fire is excluded, the process of succession proceeds toward woody plant domination and replacement of the more preferred tallgrasses with midgrasses and shortgrasses that are either less palatable or more resistant to grazing. As grass cover declines, litter and soil organic matter continue to decrease, and bare ground, erosion and other desertification processes increase. The microclimate in the grassland areas becomes more arid. The site also becomes more susceptible to soil erosion during floods.

When the woody plant community exceeds 35 percent canopy, applications of prescribed burning and proper grazing practices generally will not restore the woodland back to a grassland community. The decline in herbaceous growth prevents fine fuel build up, reducing the ability of fires to control woody species. When this threshold occurs, the site develops into a new state, the Bottomland Hardwood Community (2.1), a hardwood woodland state. Continuous overgrazing by livestock causes the palatable tall and midgrasses and the more preferred forbs to decline further. They are replaced by less palatable midgrasses and forbs. The grazing reduces ground cover, litter, and mulch allowing previously suppressed plants to increase or invade from adjacent uphill sites. Ashe juniper (*Juniperus ashei*) and mesquite (*Prosopis glandulosa*) are common invaders, eventually becoming dominant understory species.

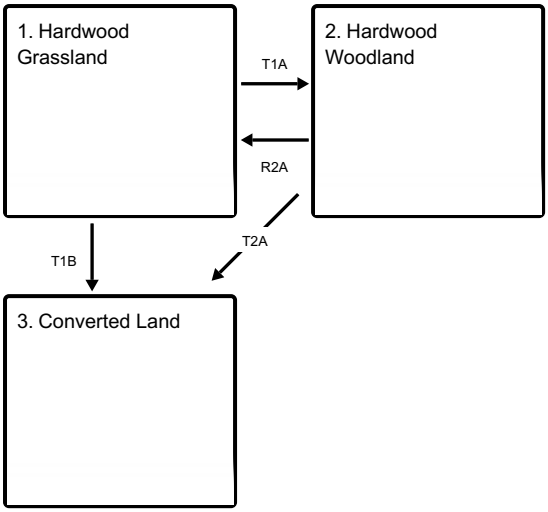
Oaks, pecans, baldcypress, hackberry (Celtis spp.), and elms (Ulmus spp.) dominate the hardwood overstory, eventually providing over 50 percent canopy. Ashe juniper, mesquite, and Texas persimmon (*Diospyros texana*) are the most aggressive invaders often forming almost closed canopies under the hardwood overstory. Midgrasses and cool-season grasses and forbs are in a weakened condition due to shading and competition for moisture and nutrients. Without management intervention, the potential canopy cover could exceed 90 percent, at which stage primary production is from low-quality trees, shrubs, forbs, and grasses. Desertification, including soil erosion, continues in the interspaces until maximum ground cover by woody species is approached. Once canopy cover reaches potential, the hydrologic processes, energy flow, and nutrient cycling stabilize under the woodland environment. In this condition, the woodland community is stable and provides only poor forage for livestock and low-quality deer habitat.

Major expense and energy are required to restore the Bottomland Hardwood Community (2.1) to the reference plant community. Generally, broadcast mechanical or herbicidal treatments, such as dozing and range planting followed by grazing deferment, prescribed grazing and prescribed burning are required for the site to return. Erosion during the retrogression process may preclude a return to the reference community.

During the settlement period of the 1800’s, the timber was cut for fuel and lumber and the site cultivated for food and fiber crops. Cultivation and cropping along with pasture planting creates a Converted Land State (3), greatly influenced by energy inputs by the land manager. Food and fiber crops were produced on many acres of the site for many years, generally depleting the soil of nutrients. During the last few decades, many acres of the Loamy Bottomland site have been converted from row crops to permanent pasture, creating a Pastureland Community. Some of the cropland has just been abandoned, left idle and let go back to native range. Those idled lands and pastures that have not been maintained with proper grazing and brush management are in various stages of re-infestation with invading species. The abandoned cropland areas are commonly called the Abandoned Land Community or Go Back Land Community (3.2).

State and transition model

Ecosystem states



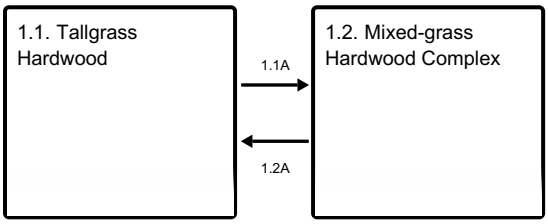
T1A - Absence of disturbance and natural regeneration over time, may be coupled with excessive grazing pressure

T1B - Extensive soil disturbance followed by seeding

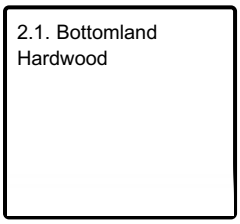
R2A - Reintroduction of historic disturbance return intervals

T2A - Extensive soil disturbance followed by seeding

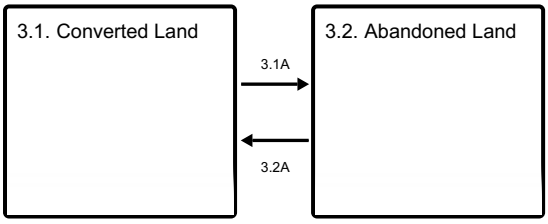
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Hardwood Grassland

Dominant plant species

- pecan (*Carya illinoinensis*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- switchgrass (*Panicum virgatum*), grass

Community 1.1
Tallgrass Hardwood

Figure 8. 1.1 Tallgrass Hardwood Community

The Loamy Bottomland is a tallgrass hardwood complex supporting trees, a mixture of tall and midgrasses, and excellent forb and shrub plant diversity. Pecan (Carya illinioensis), live oak (*Quercus virginiana*), Chinkapin oak (*Quercus muehlenbergii*), and bald cypress (*Taxodium distichum*) are found along the stream bank and bottom terrace. Elm (Ulmus spp.), hackberry (Celtis spp.), and American sycamore (*Platanus occidentalis*) are also common. Typical shrubs found at the site were bumelia (Sideroxylon spp.), elbowbush (*Forestiera pubescens*), brickellbush (Brickellia spp.), and Mexican buckeye (*Ungnadia speciosa*). Many vines such as grape (Vitis spp.) and greenbriar (Smilax spp.) are common in the woodland areas. Woody species decreases in density and canopy cover as the distance from the stream bank increases, taking on a savannah structure. Tallgrasses, shrubs, and forbs thrived in the open grassland and in the interspaces and beneath the trees, creating a complex of grassland and woodland. This pattern varies depending on soil, grazing regime of and fire frequency. Fires are postulated to have occurred at 7 to 12-year intervals in this region and are thought to have exerted the greatest influence in shaping the plant community. Little bluestem (*Schizachyrium scoparium*), Indiangrass (Sorgastrum nutans), switchgrass (*Panicum virgatum*), Eastern gamagrass (*Tripsacum dactyloides*), and wildryes (Elymus spp.) dominated the grassland. Maximilian sunflower (*Helianthus maximiliani*), bundleflower (Desmanthus spp.), and Engelmann's daisy (*Engelmannia peristenia*) are important forbs. Numerous perennial forbs, grasses, shrubs, and woody vines contribute to the diversity of the understory vegetation. Switchgrass and Eastern gamagrass, along with numerous sedges (Carex spp.), spikerushes (Eleocharis spp.), flatsedges (Cyperus spp.) and brush species occurr immediately adjacent to the watercourse. These species have a positive effect on stream bank stabilization during flooding events. The deep fertile soils and runoff from adjacent uplands and occasional flooding cause higher productivity than the surrounding ecological sites. Primary above ground production ranges from 2,500 to 6,000 pounds per acre annually depending on soils and precipitation events. The grassland component made up 80 to 90 percent of the herbage production. Continued overgrazing of this site with livestock will cause a vegetation transition (retrogression) from tallgrasses to midgrasses to woodland with lower seral species and lower forage production. The transition to a woodland state can be halted or reversed by applying moderately intensive management practices like prescribed grazing and prescribed burning until the woody canopy reduces burn effectiveness. The threshold for this occurrence is generally between 30 and 40 percent woody cover. It occurs when there is not enough fine fuel produced by the grass component to control or suppress the invading species. Once that threshold is breached, the plant community transitions to the Mixed-grass Hardwood Complex Community (1.2).

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2242	3811	5380
Tree	280	476	673
Forb	140	238	336
Shrub/Vine	140	239	336
Total	**2802**	**4764**	**6725**

Figure 10. Plant community growth curve (percent production by month). TX3628, Grassland Hardwood Complex Community. Warm-season

grassland influenced by tree shading and additional water from runoff and flooding..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	5	10	20	15	5	3	15	12	5	4

Community 1.2
Mixed-grass Hardwood Complex

Figure 11. 1.2 Mixed-grass Hardwood Complex Community

The Mixed-grass Hardwood Complex Community (1.2) reflects the results of the suppression of fires and the effects of overgrazing on the more palatable species. Indigenous and invading woody plants have increased in density and stature. The hardwood overstory expands in size and density. Mesquite, Ashe juniper and Texas persimmon (*Diospyros texana*) are the more common invaders. The more palatable tall and mid grasses are being replaced by subdominants such as feathery bluestems (Bothriochloa spp.), bristlegrass (Setaria spp.), Texas wintergrass (*Nassella leucotricha*), and less palatable forbs and annuals. Forage production is not significantly affected but primary production is shifting to the less palatable or more grazing resistant species. Annual primary production ranges from 2,300 to 5,500 pounds per acre annually with approximately 65 percent being produced by the grassland component. Nutrient cycling and water use are shifting toward the deeper-rooted woody perennials. Soil organic matter and litter are slightly less than were present in the reference community. The Mixed-grass Hardwood Complex Community (1.2) is reversible with prescribed grazing management and prescribed burning practices until the woody canopy exceeds 35 percent. Once woody plant canopy exceeds 35 percent, the plant community crosses the threshold to the Bottomland Hardwood Community (2.1).

Table 7. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1547	2354	3363
Tree	516	785	1121
Shrub/Vine	387	588	841
Forb	129	196	280
Total	**2579**	**3923**	**5605**

Figure 13. Plant community growth curve (percent production by month). TX3628, Grassland Hardwood Complex Community. Warm-season grassland influenced by tree shading and additional water from runoff and flooding..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	5	10	20	15	5	3	15	12	5	4

Pathway 1.1A

Community 1.1 to 1.2

Tallgrass Hardwood

Mixed-grass Hardwood Complex

Heavy abusive grazing, no fire, no brush management, and invasion of brush species has shifted from the Tallgrass Hardwood Community to the Mixed-grass Hardwood Community.

Pathway 1.2A
Community 1.2 to 1.1

Mixed-grass Hardwood Complex

Tallgrass Hardwood

Prescribed grazing, prescribed burning, brush management, and IPT are several conservation practices that could be applied to revert back to the Tallgrass Hardwood Community from the Mixed-grass Hardwood Community.

Conservation practices

Brush Management
Prescribed Burning
Prescribed Grazing

State 2
Hardwood Woodland

Dominant plant species

- pecan (*Carya illinoinensis*), tree
- Ashe's juniper (*Juniperus ashei*), tree
- honey mesquite (*Prosopis glandulosa*), tree

Community 2.1
Bottomland Hardwood

Figure 14. 2.1 Bottomland Hardwood Community

Continued livestock overgrazing causes a shift from a Mixed-grass Hardwood Complex Community (1.2) with 15 to 35 percent woody cover to a Bottomland Hardwood Community (2.1) with over 40 percent cover. During this retrogression process, there is a decline in the grassland component. With decreasing amounts of grass, there is a corresponding decrease in ground cover, litter, mulch, and soil organic matter. Soil structure declines and the exposed soil surface is subject to crusting and erosion. Litter and soil losses occur during floods. Annual primary production of the Bottomland Hardwood Community (2.1) can range from as low as 2,000 per acre in dry years to over 5,000 pounds per acre in good moisture years. Grasses and forbs provide less than 35 percent of this production. If the Bottomland Hardwood Community is the result of long term overgrazing by livestock, the remaining grass, forb, and shrub species are generally low-quality forage plants, further reducing the value of this plant community as rangeland. With time and no tree or shrub control, the canopy can approach 100 percent cover. Bald cypress, pecan, oaks, hackberry, and elms dominate the overstory. Unless removed for lumber, bald cypress generally dominates along the stream edge. Pecan groves with inclusions of oaks, hackberry, and elm are typical on second and third terraces. Many sites have had trees removed for lumber. Ashe juniper and sometimes mesquite form dense thickets where the hardwoods are not too dense. Texas persimmon is found along the outer edges where the site meets Clay loam or Adobe sites. Common understory shrubs are yucca (Yucca spp.), elbowbush, Texas kidneywood (*Eysenhardtia texana*), ampelopsis (Ampelopsis spp.), grape (Vitis spp.), and Mexican buckeye. Mid and shortgrasses and low-quality forbs replace the most palatable species. Grasses that are common for this plant community include Texas wintergrass, Arizona cottontop (*Digitaria californica*), broadleaf woodoats (*Chasmanthium latifolium*), and buffalograss (*Bouteloua dactyloides*). The grasses and forbs in this plant community make up less than 25 percent of the annual biomass production. Common forbs include asters (Aster spp.), white crown-beard (*Verbesina virginica*), Ruellia (Ruellia spp.), orange zexmenia (Wedelia hispida), verbena (Verbena spp.), Western ragweed (*Ambrosia psilostachya*), prairie coneflower (*Ratibida columnifera*), and Western indigo (Indigofera spp.). The tree and shrub canopy acts to intercept rainfall and increase evapotranspiration losses creating a more xeric microclimate and reducing soil moisture and infiltration. Soil fauna and litter are reduced exposing more soil surface to erosion in interstitial spaces until the canopy closes. Without major brush management and grazing management inputs, the Bottomland Hardwood Community cannot be reversed into a grassland state. It will continue to become dense woodland until it stabilizes with the climate and soil. Although this state provides good habitat cover for wildlife, only limited preferred forage or browse is available for livestock or wildlife. Alternatives for restoration include, tree removal, brush management, and revegetation to return vegetation back to near reference condition followed by grazing management and prescribed fire to maintain the desired community.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	897	1681	2186
Grass/Grasslike	448	841	1093
Shrub/Vine	359	673	874
Forb	90	168	219
Total	**1794**	**3363**	**4372**

Figure 16. Plant community growth curve (percent production by month). TX3630, Bottomland Hardwood Community. Warm season grassland influenced by tree shading and additional water from runoff and flooding..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	3	10	15	20	18	5	4	10	7	4	2

State 3
Converted Land

Dominant plant species

- kleingrass (*Panicum coloratum*), grass
- Bermudagrass (*Cynodon dactylon*), grass

Community 3.1
Converted Land

Figure 17. 3.1 Converted Land Community - Cropland

Figure 18. 3.1 Converted Land Community - Pastureland

Many acres have been converted to cropland and pastureland in the past. Historically, most were cut for timber, posts, poles, or firewood. Cropping small acreages is still practiced for grain, hay, or winter small grain, either for livestock grazing, grain harvesting, or planting for wildlife food plots. Irrigation is practiced where water is available. Abandoned cropland areas, or cleared areas, are often seeded to introduced species, such as bermudagrass (Cynodon spp.) or Kleingrass (*Panicum coloratum*). Herbage production on those seeded to adapted introduced grasses or native grasses reach peak production within a few years, if a full stand is established. In this case, herbage production will equal reference conditions if species such as big bluestem or switchgrass are seeded. The practice of including adapted legumes or other forbs will enhance productivity and usefulness, especially for wildlife. Irrigation will boost forage production where available. Invasion of the seeded fields by brush species such as mesquite, pricklypear (Opuntia spp.), condalia (Condalia spp.), willow baccharis (Baccharis spp.), Texas persimmon and juniper are common. Drought and reduced soil cover due to cropping or grazing coupled with a nearby seed source trigger the invasions. The shrubs are established by seeds brought in by animals, water, or wind. The invading brush must be controlled with grazing management, prescribed burning, or other brush management methods. Many fields, however, have been abandoned and let go back to native range or planted to introduced grasses for pasture.

Table 9. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2802	4483	5604
Total	**2802**	**4483**	**5604**

Figure 20. Plant community growth curve (percent production by month). TX3600, Cool Season Crops. Cool season species are planted in the fall for winter and spring growth. Species include wheat and oats..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	5	10	10	5	0	0	0	20	25	15	5

Figure 21. Plant community growth curve (percent production by month). TX3601, Warm Season Crops. Warm season species are planted in early spring. Their peak growth is in late May with a lesser peak in September. Forage and Grain sorghum that are planted during the warm season months..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	8	20	25	20	10	10	5	2	0	0

Figure 22. Plant community growth curve (percent production by month). TX3602, Warm Season Perennial Pasture. Depends on planted species, but most production will be in April, May and June with a lesser peak in September and October..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2	2	18	23	17	6	4	16	6	3	2

Community 3.2
Abandoned Land

Abandoned or go back land is a local name used to describe cropland fields that have been abandoned and are undergoing secondary succession. Many areas of Loamy Bottomland cleared of timber and cultivated by settlers in conjunction with the associated uplands. The abandoned cropland will be invaded by brush from the adjacent rangelands. The initial composition of abandoned fields are annual, biennial, and weak perennial grasses and forbs. The species depends on the seed source from adjacent rangeland or flood deposition. Willow baccharis, mesquite, Texas persimmon and juniper are common early invaders. The rate of succession depends on grazing management and drought frequency. Without grazing management and brush management, brush species such as mesquite and juniper will dominate before a reference grass community can be established. Brush management and grazing management are required if the goal is restoration of the reference community. Annual production ranges from 1,500 to 3,500 pounds per acre. Without management inputs to control woody plants, most of the herbage produced in early stages of succession is from annual grasses and forbs, while in the latter stages of succession by woody invaders.

Table 10. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	925	1541	2158
Forb	504	841	1177
Shrub/Vine	168	280	392
Tree	84	140	196
Total	**1681**	**2802**	**3923**

Figure 24. Plant community growth curve (percent production by month). TX3629, Shortgrass-Mixedbrush Community. Shortgrass and mixed-brush summer growth with some cool-season grass growth..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	7	13	20	15	7	5	10	7	5	5

Pathway 3.1A
Community 3.1 to 3.2

Abusive grazing, no fires, no brush management, no pasture/cropland management, abandonment, and idled land are some contributing factors in the shift from the Converted Land Community to the Abandoned Land Community.

Pathway 3.2A
Community 3.2 to 3.1

Prescribed grazing, pasture planting, range planting, and crop cultivation conservation practices can help shift the Abandoned Land Community back to the Converted Land Community.

Conservation practices

Brush Management
Prescribed Burning
Range Planting
Prescribed Grazing

Transition T1A
State 1 to 2

Heavy abusive grazing, no brush management, and no fire have contributed to the shift from the Hardwood Grassland State to the Hardwood Woodland State.

Transition T1B
State 1 to 3

Brush management, pasture planting, range planting, and crop cultivation conservation practices can ease the transition from the Hardwood Grassland State to the Converted Land State.

Restoration pathway R2A
State 2 to 1

The Hardwood Woodland State can revert back to the Hardwood Grassland State through the application of brush management, prescribed grazing, IPT, range planting, and prescribed burning conservation practices.

Conservation practices

Brush Management
Prescribed Burning
Range Planting
Prescribed Grazing

Transition T2A
State 2 to 3

The Hardwood Woodland State can transition to the Converted Land State through the implementation of various conservation practices including brush management, pasture planting, range planting, and crop cultivation.

Additional community tables

Table 11. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
0	**tallgrass**			280–673	
1	**tallgrass**			981–2354	
	big bluestem	ANGE	*Andropogon gerardii*	981–2354	–

	plains lovegrass	ERIN	*Eragrostis intermedia*	981–2354	–
	switchgrass	PAVI2	*Panicum virgatum*	981–2354	–
	Indiangrass	SONU2	*Sorghastrum nutans*	981–2354	–
	eastern gamagrass	TRDA3	*Tripsacum dactyloides*	981–2354	–
2	**midgrasses**			420–1009	
	sideoats grama	BOCU	*Bouteloua curtipendula*	420–1009	–
	Arizona cottontop	DICA8	*Digitaria californica*	420–1009	–
	Texas cupgrass	ERSE5	*Eriochloa sericea*	420–1009	–
	vine mesquite	PAOB	*Panicum obtusum*	420–1009	–
	southwestern bristlegrass	SESC2	*Setaria scheelei*	420–1009	–
	plains bristlegrass	SEVU2	*Setaria vulpiseta*	420–1009	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	420–1009	–
	Drummond's dropseed	SPCOD3	*Sporobolus compositus var. drummondii*	420–1009	–
	purpletop tridens	TRFL2	*Tridens flavus*	420–1009	–
3	**midgrasses**			140–336	
	cane bluestem	BOBA3	*Bothriochloa barbinodis*	140–336	–
	silver beardgrass	BOLAT	*Bothriochloa laguroides ssp. torreyana*	140–336	–
	green sprangletop	LEDU	*Leptochloa dubia*	140–336	–
	crowngrass	PASPA2	*Paspalum*	140–336	–
	white tridens	TRAL2	*Tridens albescens*	140–336	–
4	**shortgrasses**			140–336	
	buffalograss	BODA2	*Bouteloua dactyloides*	140–336	–
	fall witchgrass	DICO6	*Digitaria cognata*	140–336	–
	curly-mesquite	HIBE	*Hilaria belangeri*	140–336	–
	Hall's panicgrass	PAHA	*Panicum hallii*	140–336	–
5	**cool-season grasses**			280–673	
	sedge	CAREX	*Carex*	280–673	–
	Indian woodoats	CHLA5	*Chasmanthium latifolium*	280–673	–
	flatsedge	CYPER	*Cyperus*	280–673	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	280–673	–
	Canada wildrye	ELCA4	*Elymus canadensis*	280–673	–
	spikerush	ELEOC	*Eleocharis*	280–673	–
	Virginia wildrye	ELVI3	*Elymus virginicus*	280–673	–
	threeflower melicgrass	MENI	*Melica nitens*	280–673	–
	Texas wintergrass	NALE3	*Nassella leucotricha*	280–673	–
	western wheatgrass	PASM	*Pascopyrum smithii*	280–673	–
	Texas bluegrass	POAR	*Poa arachnifera*	280–673	–
Forb					
6	**forbs**			140–336	
	peppervine	AMPEL3	*Ampelopsis*	140–336	–
	aster	ASTER	*Aster*	140–336	–
	spurred butterfly pea	CEVI2	*Centrosema virginianum*	140–336	–

	leather flower	CLEMA	*Clematis*	140–336	–
	prairie clover	DALEA	*Dalea*	140–336	–
	zarzabacoa comun	DEIN3	*Desmodium incanum*	140–336	–
	bundleflower	DESMA	*Desmanthus*	140–336	–
	Engelmann's daisy	ENPE4	*Engelmannia peristenia*	140–336	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	140–336	–
	Gregg's tube tongue	JUPI5	*Justicia pilosella*	140–336	–
	dotted blazing star	LIPU	*Liatris punctata*	140–336	–
	Florida mimosa	MIQUF	*Mimosa quadrivalvis var. floridana*	140–336	–
	narrowleaf Indian breadroot	PELI10	*Pediomelum linearifolium*	140–336	–
	snoutbean	RHYNC2	*Rhynchosia*	140–336	–
	awnless bushsunflower	SICA7	*Simsia calva*	140–336	–
	amberique-bean	STHE9	*Strophostyles helvola*	140–336	–
	vervain	VERBE	*Verbena*	140–336	–
	creepingoxeye	WEDEL	*Wedelia*	140–336	–
Shrub/Vine					
7	**shrubs/vines**			140–336	
	brickellbush	BRICK	*Brickellia*	140–336	–
	eastern redbud	CECA4	*Cercis canadensis*	140–336	–
	hawthorn	CRATA	*Crataegus*	140–336	–
	Texas kidneywood	EYTE	*Eysenhardtia texana*	140–336	–
	stretchberry	FOPU2	*Forestiera pubescens*	140–336	–
	plum	PRUNU	*Prunus*	140–336	–
	bully	SIDER2	*Sideroxylon*	140–336	–
	greenbrier	SMILA2	*Smilax*	140–336	–
	poison oak	TOXIC	*Toxicodendron*	140–336	–
	Mexican buckeye	UNSP	*Ungnadia speciosa*	140–336	–
	mustang grape	VIMU2	*Vitis mustangensis*	140–336	–
	grape	VITIS	*Vitis*	140–336	–
Tree					
8	**trees**			280–673	
	hybrid hickory	CARYA	*Carya*	280–673	–
	hackberry	CELTI	*Celtis*	280–673	–
	walnut	JUGLA	*Juglans*	280–673	–
	Texas mulberry	MOMI	*Morus microphylla*	280–673	–
	American sycamore	PLOC	*Platanus occidentalis*	280–673	–
	cottonwood	POPUL	*Populus*	280–673	–
	chinquapin oak	QUMU	*Quercus muehlenbergii*	280–673	–
	bottomland post oak	QUSI2	*Quercus similis*	280–673	–
	live oak	QUVI	*Quercus virginiana*	280–673	–
	black willow	SANI	*Salix nigra*	280–673	–
	western soapberry	SASAD	*Sapindus saponaria var. drummondii*	280–673	–
	bald cypress	TADI2	*Taxodium distichum*	280–673	–

	elm	ULMUS	*Ulmus*	280–673	–

Animal community

This site is used to produce domestic livestock and to provide habitat for native wildlife. Cow-calf operations are the primary livestock enterprise, although stocker cattle are also grazed. Sheep, Angora goats, and Spanish goats were formerly raised in large numbers. Sheep are still present in reduced numbers, while meat goats are now present in fairly high numbers. Boer goats have been introduced, either purebred or crossed with Spanish goats, to obtain a larger meat animal. Reports indicate that Boers do not browse as heavily as earlier breeds.

Sustainable stocking rates have declined drastically over the past 100 years due to deterioration of the reference plant community. An assessment of vegetation is needed to determine the site's current carrying capacity. Calculations used to determine livestock stocking rate should be based on forage production remaining after determining use by resident wildlife, then refined by frequent careful observation of the plant community's response to animal foraging.

A large diversity of wildlife is native to this site. In the reference plant community, migrating bison, grazing primarily during wetter periods, pronghorn, white-tailed deer and turkey were the more predominant herbivore species. With the subsequent transformation of the plant community, due primarily to the influence of man and climate change, the kind and proportion of wildlife species have been altered.

Except for a few domestic herds, bison have been eliminated. With the eradication of the screwworm fly, increase in woody vegetation and man-suppressed natural predation, deer numbers have increased and are often in excess of carrying capacity. Where deer numbers are excessive, overbrowsing and overuse of preferred forbs causes deterioration of the plant community. Progressive management of deer populations through hunting can keep populations in balance and provide an economically important ranching enterprise. Achieving a balance between brushy cover and more open plant communities on this and adjacent sites is important to deer management. Competition among deer, sheep, and goats must be a consideration in livestock and wildlife management to prevent damage to the plant community.

Various species of exotic wildlife have been introduced on the site, including deer such as axis, sika, fallow, and red; antelope such as sable, oryx, blackbuck, and nilgai, and sheep such as barbados (mouflon) and aoudad with various degrees of success. Their numbers must be included along with livestock and native wildlife, primarily white-tailed deer, in any management plan. Feral hogs may feed on the site. They can be damaging to the plant community if their numbers are not managed. Smaller mammals include many kinds of rodents, jackrabbit, cottontail, raccoon, ringtail, skunk, and armadillo. Mammalian predators include coyote, red fox, gray fox, bobcat, and mountain lion. Wolves were common in earlier times, bears resided in some areas, and an occasional jaguar or ocelot was encountered. Many species of snakes and lizards are native to the site.

Many species of birds are found on this site including game birds, songbirds, and birds of prey. Major game birds that are economically important are turkey, bobwhite quail, scaled (blue) quail and mourning dove. Turkeys prefer plant communities with substantial amounts of shrubs and trees interspersed with grassland. Quail prefer a combination of low shrubs, bunch grass (critical for nesting cover), bare ground, and low successional forbs. The different species of songbirds vary in their habitat preferences. Habitat on this site that provides a large diversity of grasses, forbs, and shrubs will support a good variety and abundance of songbirds. Birds of prey are important to keep the numbers of rodents, rabbits, and snakes in balance. Different species of raptors benefit from a diverse plant community as well.

Hydrological functions

Most soils are moderately to slowly permeable, but runoff is slow due to gentle slopes. Extra moisture is received from runoff from adjacent sites and occasional flooding. Under reference conditions, the grassland vegetation intercepts and utilizes much of the incoming rainfall and protects the stream bank from erosion. Only during extended rains or heavy thunderstorms is there much runoff or litter movement. Litter and soil movement is slight except during heavy rains or floods.

Plant cover, litter, and organic matter decrease while surface runoff increases as State 1 transitions into State 2.

Once the canopy surpasses 50 percent, the hydrology, ecological processes, nutrient cycling and energy flow stabilize within the woody plant canopy. Evaporation and interception losses are higher resulting in less moisture reaching the soil. Overgrazing will cause a decrease in grass production and an increase in woody overstory. The deeper-rooted woody plants are able to extract water from greater depths than grasses, so less water will be available for aquifer recharge. Decreased litter and more bare ground allow erosion from soils in openings between trees. The process will continue until the woody species completely dominate the community. If a mature woodland canopy develops, leaf litter and duff build up, increasing the organic matter of the soil, builds structure, improves infiltration and retards erosion.

Recreational uses

The site is well suited for many outdoor recreational uses including recreational hunting, hiking, camping, and bird watching. Most streams associated with the site provide water related recreational opportunities. The site, along with adjacent upland sites, provides diverse scenic beauty and many opportunities for recreating.

Wood products

Many kinds of lumber and wood products are made from the trees of the site. Bald cypress lumber is especially prized for its strength and durability. Pecan, juniper, mesquite, and oak are used for lumber, furniture, firewood, and charcoal.

Other products

Pecan production is often a profitable commercial enterprise. Seeds are harvested from many native plants for commercial sale. Many grasses and forbs are harvested by the dried-plant industry for sale in dried flower arrangements. Honeybees are utilized to harvest honey from flowering plants.

Inventory data references

Information presented here is derived from literature, limited NRCS clipping data (417s), field observations, and personal contacts with range-trained personnel.

Other references

Archer, S. 1994. Woody plant encroachment into southwestern grasslands and savannas: Rates, patterns, and proximate causes. Ecological implications of livestock herbivory in the West, 13-68.

Archer, S. and F. E. Smeins. 1991. Ecosystem-level processes. Grazing Management: An Ecological Perspective. Edited by R.K. Heischmidt and J.W. Stuth. Timber Press, Portland, OR.

Bestelmeyer, B. T., J. R. Brown, K. M. Havstad, R. Alexander, G. Chavez, and J. E. Herrick. 2003. Development and use of state-and-transition models for rangelands. Journal of Range Management, 56(2):114-126.

Bracht, V. 1931. Texas in 1848. German-Texan Heritage Society, Department of Modern Languages, Southwest Texas State University, San Marcos, TX.

Bray, W. L. 1904. The timber of the Edwards Plateau of Texas: Its relations to climate, water supply, and soil. No. 49. US Department of Agriculture, Bureau of Forestry.

Briske, D. D., S. D. Fuhlendorf, and F. E. Smeins. 2005. State-and-transition models, thresholds, and rangeland health: A synthesis of ecological concepts and perspectives. Rangeland Ecology and Management, 58(1):1-10.

Brothers, A., M. E. Ray Jr., and C. McTee. 1998. Producing quality whitetails, revised edition. Texas Wildlife Association, San Antonio, TX.

Brown, J. K. and J. K. Smith. 2000. Wildland fire in ecosystems, effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: US Department of Agriculture, Forest Service, Rocky Mountain Research Station, 257:42.

Davis, W. B. 1974. The Mammals of Texas. Texas Parks and Wildlife Department, 41.

Foster, J. H. 1917. The spread of timbered areas in central Texas. Journal of Forestry 15(4):442-445.

Frost, C. C. 1998. Presettlement fire frequency regimes of the United States: A first approximation. Fire in ecosystem management: Shifting the paradigm from suppression to prescription. Tall Timbers Fire Ecology Conference Proceedings, 20:70-81.

Gould, F. W. 1975. The grasses of Texas. The Texas Agricultural Experiment Station, Texas A&M University Press, College Station, TX.

Hatch, S. L. and J. Pluhar. 1993. Texas Range Plants. Texas A&M University Press, College Station, TX.

Hamilton, W. and D. Ueckert. 2005. Rangeland woody plant control--past, present, and future. Texas A&M University Press. College Station, TX.

Hart, C. R., A. McGinty, and B. B. Carpenter. 1998. Toxic plants handbook: Integrated management strategies for West Texas. Texas Agricultural Extension Service, The Texas A&M University, College Station, TX.

Heitschmidt, R. K. and J. W. Stuth. 1991. Grazing management: An ecological perspective. Timberline Press, Portland, OR.

Loughmiller, C. and L. Loughmiller. 1984. Texas wildflowers. University of Texas Press, Austin, TX.

Milchunas, D. G. 2006. Responses of plant communities to grazing in the southwestern United States. Gen. Tech. Rep RMRS-GTR-169. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station, 126:169.

Niehaus, T. F. 1998. A field guide to Southwestern and Texas wildflowers (Vol. 31). Houghton Mifflin Harcourt, Boston, MA.

Ramsey, C. W. 1970. Texotics. Texas Parks and Wildlife Department, Austin, TX.

Roemer, F. translated by O. Mueller. 1995. Roemer’s Texas, 1845 to 1847. Texas Wildlife Association, San Antonio, TX.

Scifres, C. J. and W. T. Hamilton. 1993. Prescribed burning for brushland management: The South Texas example. Texas A&M Press, College Station, TX.

Smeins, F. E., S. Fuhlendorf, and C. Taylor, Jr. 1997. Environmental and land use changes: A long term perspective. Juniper Symposium, 1-21.

Taylor, C. A. and F. E. Smeins. 1994. A history of land use of the Edwards Plateau and its effect on the native vegetation. Juniper Symposium, 94:2.

Thurow, T. L. 1991. Hydrology and erosion. Grazing Management: An Ecological Perspective. Edited by R.K. Heitschmidt and J.W. Stuth. Timber Press, Portland, OR.

Tull, D. and G. O. Miller. 1991. A field guide to wildflowers, trees and shrubs of Texas. Texas Monthly Publishing, Houston, TX.

USDA-NRCS. 1997. National range and pasture handbook. Washington, DC: United States Department of Agriculture. Natural Resources Conservation Service, Grazing Lands Technology Institute.

Weniger, D. 1997. The explorers’ Texas: The animals they found. Eakin Press, Austin, TX.

Weniger, D. 1984. The explorers’ Texas: The lands and waters. Eakin Press, Austin, TX.

Vines, R. A. 1984. Trees of Central Texas. University of Texas Press, Austin, TX.

Vines, R. A. 1960. Trees, shrubs and vines of the Southwest. University of Texas Press, Austin, TX.

Contributors

Dr. Joseph Schuster, Range & Wildlife Habitat Consultants, LLC, Bryan, TX
Edits by Travis Waiser, MLRA Leader, NRCS, Kerrville, TX

Approval

Bryan Christensen, 9/19/2023

Acknowledgments

Technical Review:
Charles Anderson, RMS, NRCS, San Angelo, TX
Justin Clary, RMS, NRCS, Temple, TX
Mark Moseley, RMS, NRCS, Boerne, TX

QC/QA completed by:
Bryan Christensen, SRESS, NRCS, Temple, TX
Erin Hourihan, ESDQS, NRCS, Temple, TX

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)	Joe Franklin, Zone RMS, NRCS, San Angelo, TX
Contact for lead author	325-944-0147
Date	12/01/2005
Approved by	Bryan Christensen
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 to slight. Site may receive runoff from adjacent sites.

---

3. **Number and height of erosional pedestals or terracettes:** None to slight. Minimal pedestals or terracettes due to erosion.

---

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 10 percent bare ground. Small and non-connected areas.

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to slight. Wind erosion hazard of soil is slight.

7. **Amount of litter movement (describe size and distance expected to travel):** Minimal movement of fine litter for short distances.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Erosion stability values estimated at 5 to 6. Water erosion hazard of soil is slight.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil are dark grayish brown silty clay to 8 inches and dark grayish brown clay loam to 22 inches. The surface layer is weak, fine, granular, and subangular blocky. Many fine roots and worm casts. SOM is high.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The reference community provides good plant distribution and soil cover which then provides excellent infiltration. Under normal rainfall, runoff is essentially nil but when rainfall exceeds sites ability to hold water the runoff is can cause erosive action.

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

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: Warm-season tallgrasses

    Sub-dominant: Warm-season midgrass Warm-season shortgrasses Cool-season grasses Trees

    Other: Forbs Shrubs/Vines

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal. Grasses will almost always show some mortality and decadence, especially during drought conditions.

14. **Average percent litter cover (%) and depth (in):** Interspaces between plant canopies essentially covered with various sizes of litter and mulch.

---

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 2,000 pounds per acre in years with below average moisture, 3,800 pounds per acre in years of average moisture, and 4,400 pounds per acre in above average moisture years. Site may receive extra moisture from upslope sites and be highly productive in wet years.

---

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:** Mesquite, pricklypear, juniper, broom snakeweed, agarito, acacia, condalia, and annual broomweed.

---

17. **Perennial plant reproductive capability:** All species should be capable of reproducing except during periods of prolonged droughts, heavy natural herbivory or intense fires. Recovery from these disturbances will take 2 to 5 years.
