USDA Natural Resources
Conservation Service

Ecological site R078CY067OK
Red Shale

Last updated: 9/15/2023
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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.

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): 078C–Central Rolling Red Plains, Eastern Part

MLRA 78C is characterized by moderately dissected, rolling plains with prominent ridges and valleys and numerous terraces adjacent to dissecting streams. Loamy and clayey

soils are generally deep, well drained, and developed in calcareous and gypsiferous sediments of Permian age.

LRU notes

NA

Classification relationships

This ecological site is correlated to soil components at the Major Land Resource Area (MLRA) level which is further described in USDA Ag Handbook 296.

Ecological site concept

This is a rolling, upland, mixed-grass prairie site. It occurs on shallow, very gently sloping to moderately steep loamy soils that have loamy subsoils. The plant community is a mixed community of midgrasses, and shortgrasses that will have a better showing of tallgrasses in the swales. The soils have low moisture holding capacity and very high runoff. Low red shale sandstone and shale hills are common. Canyons are common. There is some geologic erosion. Red Shale sites usually contain large areas of steep and rough, broken land with considerable areas where erosion has removed all of the soil material.

Similar sites

R078CY083OK	**Shallow Upland** Shallow loamy soils over sandstone

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Schizachyrium scoparium* (2) *Mimosa nuttallii*

Physiographic features

These sites are on ridgecrests of prairie uplands. Water runs off the surface medium to rapid. Slopes are 1 to 25 percent.

Table 2. Representative physiographic features

Landforms	(1) Upland > Hill
Runoff class	Medium to very high

Flooding frequency	None
Ponding frequency	None
Elevation	457–762 m
Slope	1–25%
Ponding depth	0 cm
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 78C lies within the subtropical sub-humid climate regime. This regime is characterized by rapid changes in temperature; marked extremes, both daily and annual; and rather erratic rainfall. The weather is alternately influenced by cold dry air from the Arctic Circle, and warm moist air from the Gulf of Mexico.

Seasonal changes are gradual. Spring is a season of variable weather and relatively high precipitation with prevailing winds from the southwest. Summers are generally hot with low humidity. Fall has long periods of pleasant weather interspersed with moderate to heavy rains. Winter is open and moderate to cold with winds from the north and infrequent snows.

Wind speeds average more than eleven miles an hour with prevailing southern winds. Rather strong winds can occur in all months of the year. While strong gusty winds occur, severe dust storms are rare.

Approximately 75 percent of the rainfall occurs during the warm season, and much of it comes in storms of high intensity and short duration in May and June. These rains can be particularly erosive on sites where vegetation is sparse. Occasional droughts are to be expected. Lack of rainfall and hot, dry winds often curtail forage production during July and August.

Table 3. Representative climatic features

Frost-free period (characteristic range)	167-181 days
Freeze-free period (characteristic range)	197-204 days
Precipitation total (characteristic range)	711-787 mm
Frost-free period (actual range)	155-183 days
Freeze-free period (actual range)	192-205 days
Precipitation total (actual range)	711-813 mm
Frost-free period (average)	173 days

Freeze-free period (average)	200 days
Precipitation total (average)	762 mm

Climate stations used

- (1) ELK CITY 4 W [USC00342849], Elk City, OK
- (2) CLINTON [USC00341909], Clinton, OK
- (3) HAMMON 3 SSW [USC00343871], Elk City, OK
- (4) HOBART MUNI AP [USW00093986], Hobart, OK

Influencing water features

NA

Wetland description

NA

Soil features

Soils are mapped for each county within the MLRA. Mapunits are representations of the major soil series component(s) and named accordingly. Each Mapunit is spatially represented on a digital soils map as polygons of different shapes and sizes. Within these Mapunits, there are often minor soil series components included. These minor components are soils that occur within a Mapunit polygon but are of small extent (15% or less of the Mapunit area). However, it is difficult to separate these minor soils spatially due to the scale of soil mapping.

Ecological sites are correlated at the component level of the soil survey. Therefore, a single Mapunit may contain multiple Ecological Sites just as it may contain multiple soil components. This is important to understand when investigating soils and Ecological Sites. A soil survey Mapunit may be correlated to a single Ecological Site based on the major component; however, there may be inclusional areas of additional Ecological Sites which are correlated to the minor components of that particular soil Mapunit.

Representative soil components for this site include:
Cordell

Soils are generally shallow with low hills of red shale or sandstone being common. Soil characteristics result in restricted root development and low forage production. Runoff is high and there is usually active geologic erosion. The major soils that are associated with this site are: Cordell silty clay loam and Cordell-Rock outcrop complex. These soils are well drained. Fertility is medium. Organic matter content is low to medium. Permeability is

moderately slow. Surface runoff is rapid. Available water holding capacity is low.

Table 4. Representative soil features

Parent material	(1) Residuum–calcareous siltstone
Surface texture	(1) Gravelly silty clay loam (2) Silt loam
Family particle size	(1) Clayey
Drainage class	Well drained to somewhat excessively drained
Permeability class	Very slow to moderately slow
Soil depth	25–51 cm
Surface fragment cover <=3"	0–12%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	3.05–10.67 cm
Calcium carbonate equivalent (0-101.6cm)	0–10%
Electrical conductivity (0-101.6cm)	0–5 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–8
Soil reaction (1:1 water) (0-101.6cm)	7.4–8.4
Subsurface fragment volume <=3" (Depth not specified)	8–49%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

The information contained in the State and Transition Diagram (STD) and the Ecological Site Description was developed using archeological and historical data, professional experience, and scientific studies. The information presented is representative of a very complex set of plant communities. Not all scenarios or plants are included. Key indicator plants, animals and ecological processes are described to inform land management decisions.

The reference plant community for this site is open grassland with very few woody species. The plant community is comprised of relatively equal mixes of tallgrasses, midgrasses and shortgrasses. Important grasses include little bluestem, sideoats grama, blue grama, dropseed species, and buffalograss. The midgrasses, and shortgrasses are tightly intermixed and pretty well distributed over the site. However, there will be a greater

abundance of tallgrasses found in the swales and other deeper soil areas. This site exhibits a good diversity of abundant forbs. The Red Shale plant community evolved under grazing by large herbivores and fire frequency of once every two to four years. Although Red Shale sites may not produce as well as some other prairie sites, they are well suited to grazing by domestic livestock. Soils typically are shallow, ranging from seven to twenty inches in depth over sandstone and shale. In areas where underlying bedrock is fragmented, roots of perennial grasses can penetrate deeply and significantly increase vegetative production. Under long term overgrazing scenarios, threeawn, western ragweed, silver bluestem, hairy tridens, and fragrant mimosa will make up the greater part of the annual production and total annual forage production will be reduced. Desirable legumes make up about 10% to 25% of the production. During favorable years, forage production on this site is approximately 1400 pounds per acre. In normal years, production will be about 950 pounds per acre. During unfavorable years, production will be reduced to around 700 pounds per acre.

In addition to the reference community, other relatively stable plant communities can exist on this site and are usually the result of historic management practices. Long term overgrazing by cattle on this site results in a decrease of the midgrasses and the more cattle-palatable forbs. If overgrazing continues, the site will move on to a probable, and eventual, community of silver bluestem, hairy tridens, sand dropseed, and annuals. The site may remain in a relatively stable shortgrass/midgrass plant community for many years. After the absence of fire for five or more years, shrub species may begin to increase, but not to any great extent, and shrub vegetative production will usually never amount to more than 5% of the total. This site is not associated with woody species.

State and Transition Diagram:
A State and Transition Diagram for the Red Shale (R078CY067OK) site is depicted below. Thorough descriptions of each state, transition, and pathway follow the model. Experts base this model on available experimental research, field observations, professional consensus, and interpretations. It is likely to change as knowledge increases.
Plant communities will differ across the MLRA because of the natural variability in weather, soils, and aspect. The Reference Plant Community is not necessarily the management goal; other vegetative states may be desired plant communities as long as the Range Health assessments are in the moderate and above category.

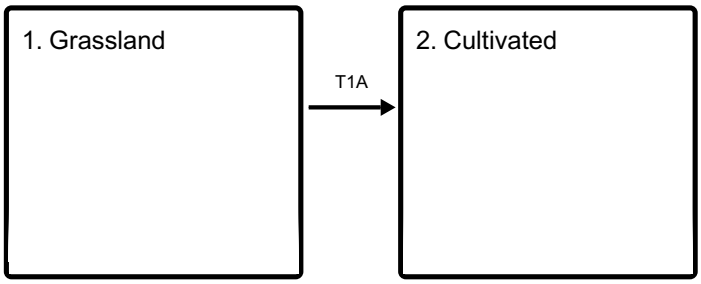
The biological processes on this site are complex. Therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are not intended to cover every situation or the full range of conditions, species, and responses for the site.

Composition by dry weight and percent canopy cover are provided to describing the functional groups. Most observers find it easier to visualize or estimate percent canopy for woody species (trees and shrubs).

The following diagram suggests some pathways that the vegetation on this site might take. There may be other states not shown on the diagram. This information is intended to show what might happen in a given set of circumstances. It does not mean that this would happen the same way in every instance. Local professional guidance should always be sought before pursuing a treatment scenario.

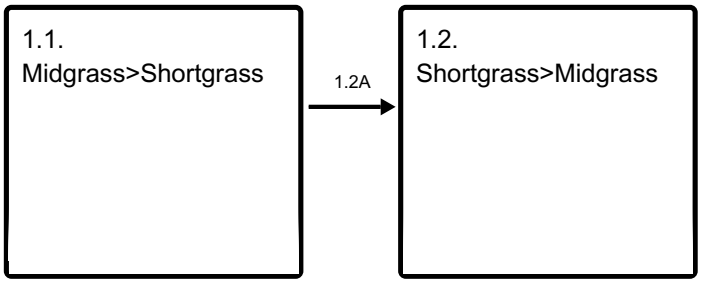
State and transition model

Ecosystem states



T1A - Extensive soil disturbance followed by seeding

State 1 submodel, plant communities



State 1
Grassland

This is the reference or diagnostic community for the site. The description is based on early range site descriptions, clipping data, professional consensus of experienced range specialists, and analysis of field work.

Community 1.1
Midgrass>Shortgrass

Figure 8. Cordell soils Washita County OK

This is the interpretative plant community description for this site. It is a mixed-grass prairie, dominated by a mixture of little bluestem, sideoats grama, blue grama, hairy grama, dropseed, buffalograss. Palatable perennial forbs are well represented over the site. These forbs include western ragweed, halfshrub sundrop, daisy fleabane, dotted gayfeather, Nutall's sensitive-brier, Illinois bundleflower, compassplant, prairie coneflower, leadplant, and others. Shrub species including skunkbush sumac, fragrant mimosa, and prickly pear are usually present in small amounts. The amount of woody species on site can be minimized by occasional fire (prescribed burning). This plant community is very durable. With proper grazing management and prescribed burning, the proportions of major grasses and forbs in this community can be maintained indefinitely. Although this site is usually described as a "Mixed Grass Prairie", it is very obvious that tallgrasses can dominate some inclusional areas of deeper soils. There are also areas that are almost barren.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	460	689	919
Forb	78	118	157
Shrub/Vine	22	34	45
Total	**560**	**841**	**1121**

Figure 10. Plant community growth curve (percent production by month). OK0009, Native Warm-Season Grasses. The growing season for warm season(C4) grasses in this region runs from last frost to first frost with peak production from mid April through mid July. The curve listed below is intended to be a representative of normal growing conditions. The monthly production pecentages can vary from year to year deopending upon temperature and rainfall variatioins..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	9	25	28	15	5	10	5	0	0

Community 1.2
Shortgrass>Midgrass

Figure 11. Cordell soils Washita County, OK

Red Shale sites have a long history of severe overgrazing by cattle and this plant community phase is common. Shortgrasses make up most of the forage production and include blue grama, buffalograss, hairy grama, Carolina crabgrass, Scribner's panicum, windmillgrass and tumblegrass. Most of the palatable forbs have been eliminated. Forbs that have increased include white heath aster, Missouri goldenrod, western ragweed, slimflower scurfpea, and blue wild indigo. The tallgrasses, especially big bluestem and Indiangrass, are present throughout the site on the areas of deeper soils, but are preferred by livestock and therefore remain in a state of relatively low vigor as grazing occurs. Grazing drives the site towards this community, and essentially keeps the site in this state. Annuals common to the site are western ragweed, common broomweed, prairie threeawn and broom snakeweed. Shrubs, including buckbrush and fragrant mimosa usually increase in abundance where prescribed burning is not practiced. Prescribed grazing, involving deferment during all or a part of the growing season will revive the vigor and stature of the taller grasses. This practice used in conjunction with prescribed burning can restore the vegetation to near reference proportions in two to five years.

Pathway 1.1A
Community 1.1 to 1.2

Midgrass>Shortgrass Shortgrass>Midgrass

If abusive grazing that exceeds carrying capacity persists for multiple growing seasons, the site may be shifted to community phase 1.2.

Pathway 1.2A
Community 1.1 to 1.2

Midgrass>Shortgrass Shortgrass>Midgrass

With adequate rest from grazing and adequate growing season moisture, the site may be shifted back to community phase 1.1.

State 2
Cultivated

Some of these sites have been cultivated in the past to facilitate the planting of commodity crops. Once cultivated, the soil properties are altered and changes occur in hydrology and soil biology.

Transition T1A
State 1 to 2

Some of these sites were cultivated in the past and have been transitioned to the cultivated state(2).

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Little Bluestem/Sideoats Grama**			224–448	
	little bluestem	SCSC	*Schizachyrium scoparium*	140–280	–
	sideoats grama	BOCU	*Bouteloua*	112–224	–

	[illegible]	[illegible]	*curtipendula*	[illegible]	
2	**Tallgrass**			56–336	
	big bluestem	ANGE	*Andropogon gerardii*	0–280	–
	switchgrass	PAVI2	*Panicum virgatum*	0–140	–
	Indiangrass	SONU2	*Sorghastrum nutans*	0–140	–
3	**Other grasses**			112–448	
	blue grama	BOGR2	*Bouteloua gracilis*	112–224	–
	buffalograss	BODA2	*Bouteloua dactyloides*	56–112	–
	dropseed	SPORO	*Sporobolus*	28–84	–
	purpletop tridens	TRFL2	*Tridens flavus*	11–45	–
	slim tridens	TRMU	*Tridens muticus*	11–45	–
	longspike tridens	TRST2	*Tridens strictus*	11–45	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	22–45	–
	silver beardgrass	BOLA2	*Bothriochloa laguroides*	11–45	–
	tumble windmill grass	CHVE2	*Chloris verticillata*	22–45	–
	Heller's rosette grass	DIOL	*Dichanthelium oligosanthes*	22–45	–
	threeawn	ARIST	*Aristida*	22–45	–
4	**Cool Season**			11–22	
	sedge	CAREX	*Carex*	11–22	–
	Texas bluegrass	POAR	*Poa arachnifera*	11–22	–
Forb					
5	**Forbs**			78–157	
	Nuttall's sensitive-briar	MINU6	*Mimosa nuttallii*	17–34	–
	yellow sundrops	CASE12	*Calylophus serrulatus*	17–34	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	17–34	–
	prairie fleabane	ERST3	*Erigeron strigosus*	17–34	–
	dotted blazing star	LIPU	*Liatris punctata*	17–34	–
	littleleaf sensitive-briar	MIMI22	*Mimosa microphylla*	11–22	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	11–22	–

			ludoviciana		
	wild indigo	BAPTI	*Baptisia*	11–22	–
	partridge pea	CHFA2	*Chamaecrista fasciculata*	11–22	–
	prairie clover	DALEA	*Dalea*	11–22	–
	Illinois bundleflower	DEIL	*Desmanthus illinoensis*	11–22	–
	plantain	PLANT	*Plantago*	11–22	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	11–22	–
	azure blue sage	SAAZ	*Salvia azurea*	11–22	–
	compassplant	SILA3	*Silphium laciniatum*	11–22	–
	goldenrod	SOLID	*Solidago*	11–22	–
	white heath aster	SYER	*Symphyotrichum ericoides*	11–22	–
	leadplant	AMCA6	*Amorpha canescens*	11–22	–
Shrub/Vine					
6	**Shrub**			0–45	
	fragrant mimosa	MIBO2	*Mimosa borealis*	0–17	–
	twistspine pricklypear	OPMA2	*Opuntia macrorhiza*	0–17	–
	fragrant sumac	RHAR4	*Rhus aromatica*	0–17	–
	soapweed yucca	YUGL	*Yucca glauca*	0–17	–

Inventory data references

Information presented has been derived from NRCS clipping data, research from Oklahoma State University, field observations and measurements by trained range personnel. Most of the clipping data was gathered by a team consisting of a range conservationist and a soil scientist and was site/soil specific. Yields were taken at the end of the growing season and, as near as possible, were obtained from areas that were un-grazed that year. Clipping data repository is in the NRCS State Office in Stillwater, OK. The original information presented here was derived from field observations by Dr. Jack Eckroat, in the summers of 2007 and 2008, correlated to office files and old Range Site Technical Descriptions (1961 USDA/SCS). Species compositions are as complete as possible. Production will vary by species from within years, from year to year, and from site to site. Production figures are based on limited clipping data, but believed to be the best estimates to date. Production figures are intended to show best estimates of the relationships between the total biomass and hierarchy of the different species.

Other references

USDA-NRCS (Formerly Soil Conservation Service) Range Site Descriptions (1960s)

USDA-NRCS (Formerly Soil Conservation Service) Ag Handbook 296 (2006)

Contributors

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PES Edits by Tyson Morley, MLRA Soil Scientist, Altus, Oklahoma

Approval

Bryan Christensen, 9/15/2023

Acknowledgments

Site Development and Testing Plan

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.

Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

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	05/20/2025
Approved by	Bryan Christensen

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:**

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

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

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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

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):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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:**

17. **Perennial plant reproductive capability:**