USDA Natural Resources
Conservation Service

# Ecological site R058CY088ND
# Shallow Sandy

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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): 058C–Northern Rolling High Plains, Northeastern Part

MLRA 58C covers 2,320 square miles and encompasses approximately 1.8 million acres. MLRA 58C spans two states, with 96 percent located in North Dakota and the remaining 4 percent is in Montana. The MLRA 58C landscape is characterized by steeply sloping dissected badlands along the Little Missouri River and its tributaries. Primary land uses are of rangeland for grazing and wildlife habitat. Microclimates inherent in badlands landscapes influence both variety and abundance of vegetation in MLRA 58C. South- and west- facing exposures are dry, hot, and sparsely vegetated. More humid and cooler north- and east-facing exposures are favorable for abundant forage and woody vegetation.

MLRA 58C is known as the Little Missouri Badlands, which formed when the Little Missouri River was diverted along a shorter, steeper course by Pleistocene glaciers. Due to the resulting increased gradient after its eastward diversion by the glaciers, the Little Missouri River began rapidly downcutting into the soft, calcareous sedimentary shale, siltstone, and sandstone of the Fort Union and Hell Creek geological formations. This rapid downcutting eroded and carved the badlands of the MLRA. This cycle of erosion and deposition continues today.

Most of the soils in MLRA 58C developed from residuum weathered in place. As a result of constant erosion and deposition, the majority of soils in MLRA 58C are Entisols and Inceptisols. Mollisols formed on the high, stable drainageway divides and plateaus above the steeper, dissected hillslopes and fans that define the Little Missouri Badlands. Elevation ranges from 1,835 feet (560 meters) to 3,400 feet (1,036 meters). The Little Missouri River flows through the entire length of MLRA 58C and empties into Lake

Sakakawea that was formed by the Garrison Dam on the Missouri River.

## Classification relationships

Level IV Ecoregions of Conterminous United States: 43b-Little Missouri Badlands.

## Ecological site concept

The Shallow Sandy ecological site is located on hillslopes and ridges on sedimentary uplands. The soils are shallow (10 to 20 inches) to soft sedimentary sandstone which affects root growth. The texture above the sandstone is loamy fine sand or fine sandy loam. The soil either does not from a ribbon or forms a ribbon <1 inch long. Soil on this site is well drained or somewhat excessively drained. Slopes range from 3 to 70 percent. On the landscape, this site is above the Limy Sands, Sands, Sandy, Steep-sided Wooded Draw, and Badland ecological sites. In some steep and very steep areas, the Very Shallow site is on similar or slightly higher landscape positions; it is less than 10 inches to sedimentary bedrock. A few areas of Rock Outcrop may also occur in these areas.

To see a full copy of the ecological site description with all tables and the full version 5 rangeland health worksheet, please use the following hyperlink: https://efotg.sc.egov.usda.gov/references/public/ND/58C_Shallow_Sandy_Narrative_FINAL_Ref_FSG.pdf

## Associated sites

| | |
|---|---|
| R058CY095ND | **Limy Sands**<br>This site is somewhat lower on the landscape than the Shallow Sandy ecological site. It is >20 inches to sandstone bedrock. The soil does not form a ribbon and is highly calcareous within a depth of 12 inches. |
| R058CY103ND | **Badland**<br>This site is on the very steep, sparsely vegetated badland escarpments. The Badland site is characterized by exposed, soft, sedimentary siltstone and shale bedrock that is actively and constantly eroding. |
| R054XY025ND | **Sands**<br>This site occurs lower on the landscape. It is >20 inches to sandstone bedrock. The soil does not form a ribbon and is not highly calcareous. |
| R058CY077ND | **Sandy**<br>This site occurs lower on the landscape. It is >20 inches to sandstone bedrock. The soil forms a ribbon <1 inch long. |
| R058CY083ND | **Very Shallow**<br>This site occurs on similar landscape positions as the Shallow Sandy ecological site. In areas with porcelanite (scoria), the depth to hard, root restrictive porcelanite is less than 20 inches (Kirby soils). In areas with soft weathered bedrock which affects root growth, the depth to the bedrock is less than 10 inches. |

| | |
|---|---|
| R058CY101ND | **Steep-Sided Wooded Draw**<br>This site occurs on sideslopes of ridges. The aspect is typically north or east. The woodland canopy has influenced the understory plant community. |

## Similar sites

| | |
|---|---|
| R058CY083ND | **Very Shallow**<br>This site occurs on similar landscape positions as the Shallow Sandy ecological site. In areas with porcelanite (scoria), the depth to hard, root restrictive porcelanite is less than 20 inches (Kirby soils). In areas with soft weathered bedrock which affects root growth, the depth to the bedrock is less than 10 inches. |
| R058CY086ND | **Shallow Loamy**<br>This site is on similar landscape positions as the Shallow Sandy ecological site. The soil above the soft bedrock forms a ribbon >1 inch long. The soils have soft, sedimentary siltstone or mudstone at a depth of 10 to 20 inches. This bedrock affects root growth. |
| R058CY095ND | **Limy Sands**<br>This site is somewhat lower on the landscape than the Shallow Sandy ecological site. It is >20 inches to sandstone bedrock. The soil does not form a ribbon and is highly calcareous within a depth of 12 inches. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | Not specified |
| Shrub | Not specified |
| Herbaceous | Not specified |

## Physiographic features

This site occurs on hillslopes and ridges on sedimentary uplands. The parent material is weathered residuum (sandstone). Slopes range from 3 to 70 percent.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Hillslope<br>(2) Ridge |
| Runoff class | Low to high |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 1,835–3,400 ft |
| Slope | 3–70% |

| | |
|---|---|
| Water table depth | 80 in |
| Aspect | Aspect is not a significant factor |

## Climatic features

MLRA 58C is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are common and characteristic of the MLRA. The continental climate is the result of the location of this MLRA in the geographic center of North America. There are few natural barriers on the northern Great Plains, so air masses move unobstructed across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 14 to 17 inches per year. The normal average annual temperature is about 41° F. January is the coldest month with an average temperature of about 17° F. July is the warmest month with an average temperature of about 70° F. The range of normal average monthly temperatures between the coldest and warmest months is 53° F. This large temperature range attests to the continental nature of the MLRA 58C climate. Wind speeds average about 11 miles per hour, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime wind speeds are generally stronger than nighttime wind speeds, and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of native cool-season plants begins in late March and continues to early to mid-July. Native warm- season plants begin growth in mid-May and continue to the end of August. Greening up of cool-season plants can occur in September and October when adequate soil moisture is present.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 91-100 days |
| Freeze-free period (characteristic range) | 119-123 days |
| Precipitation total (characteristic range) | 15-16 in |
| Frost-free period (actual range) | 84-102 days |
| Freeze-free period (actual range) | 116-123 days |
| Precipitation total (actual range) | 14-16 in |
| Frost-free period (average) | 95 days |
| Freeze-free period (average) | 121 days |
| Precipitation total (average) | 15 in |

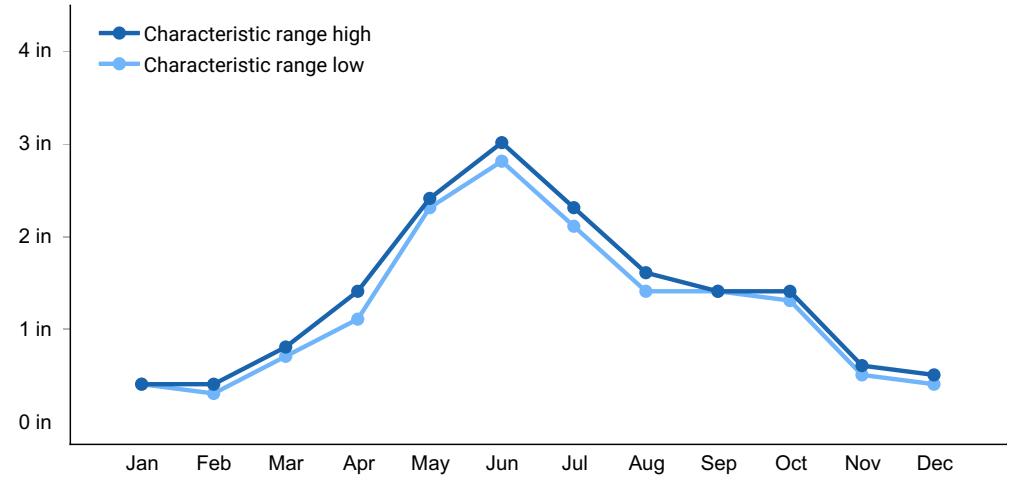


**Figure 1. Monthly precipitation range**

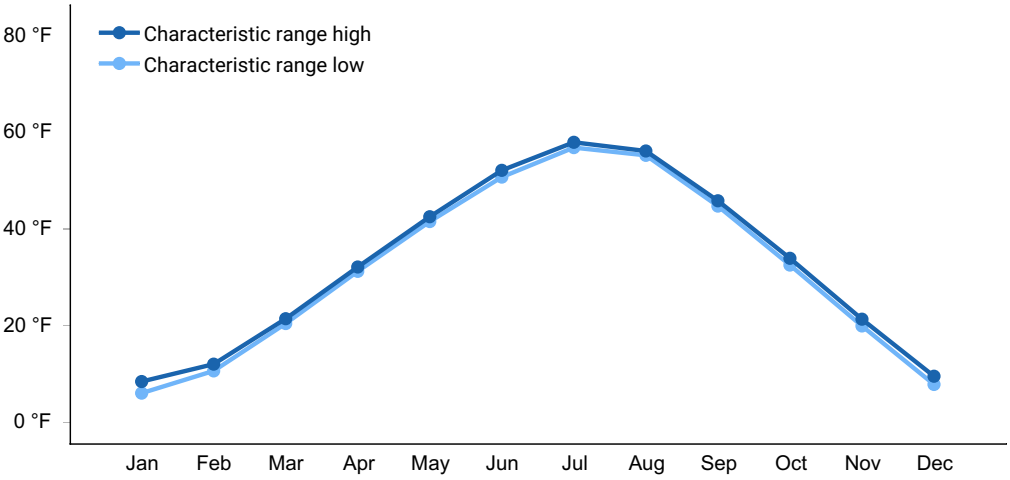


**Figure 2. Monthly minimum temperature range**

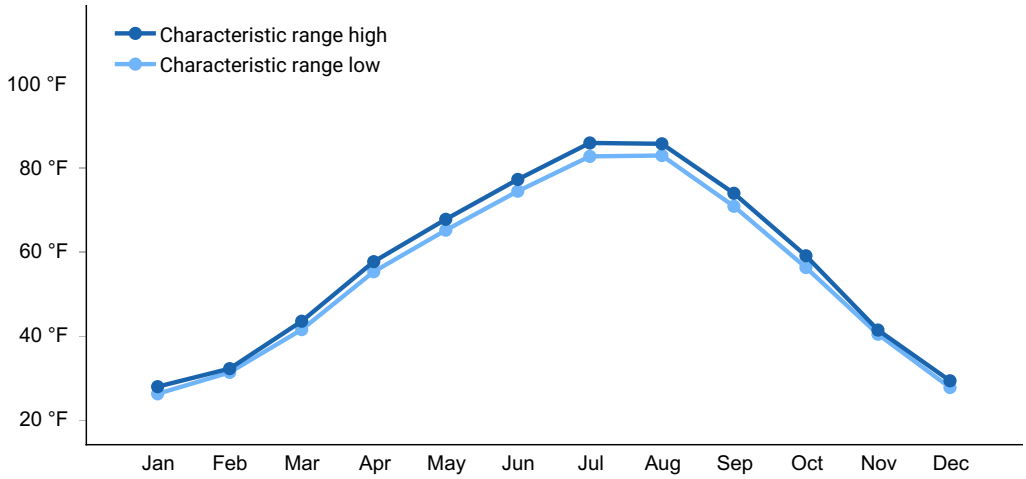


**Figure 3. Monthly maximum temperature range**

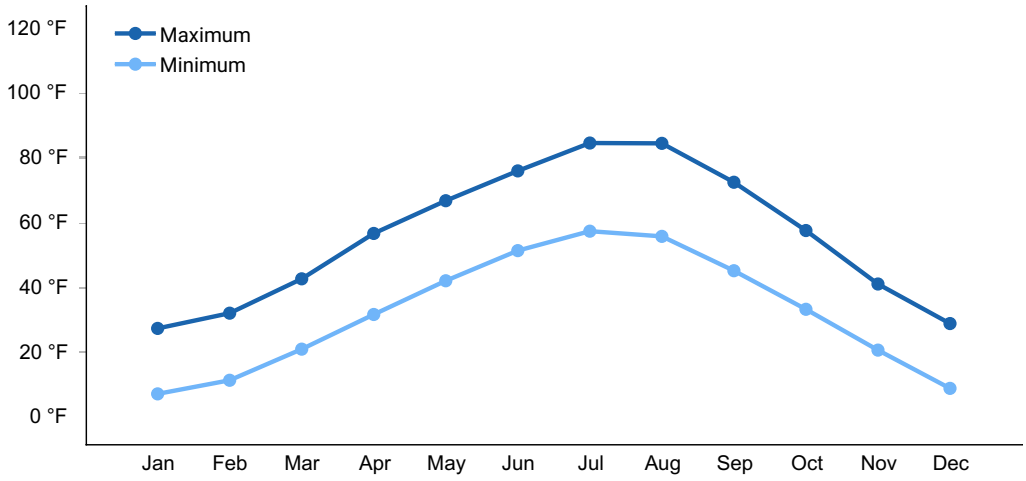


**Figure 4. Monthly average minimum and maximum temperature**

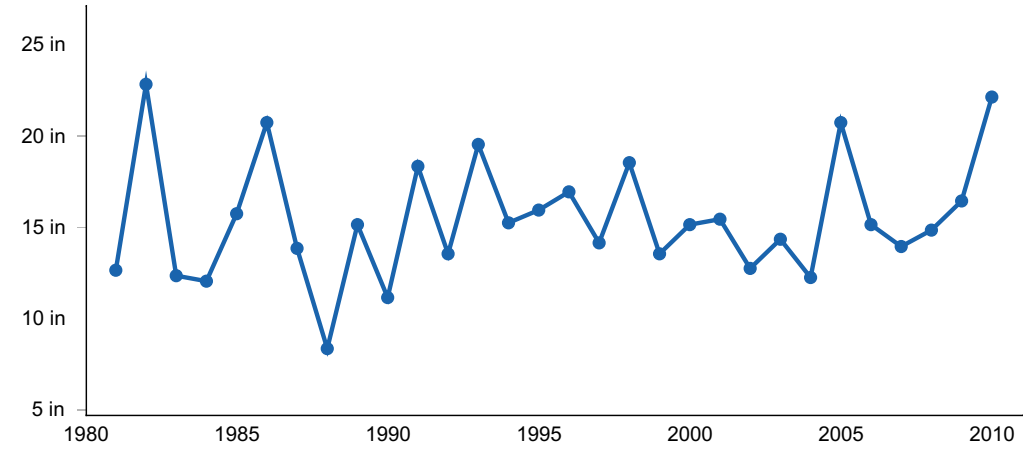


**Figure 5. Annual precipitation pattern**

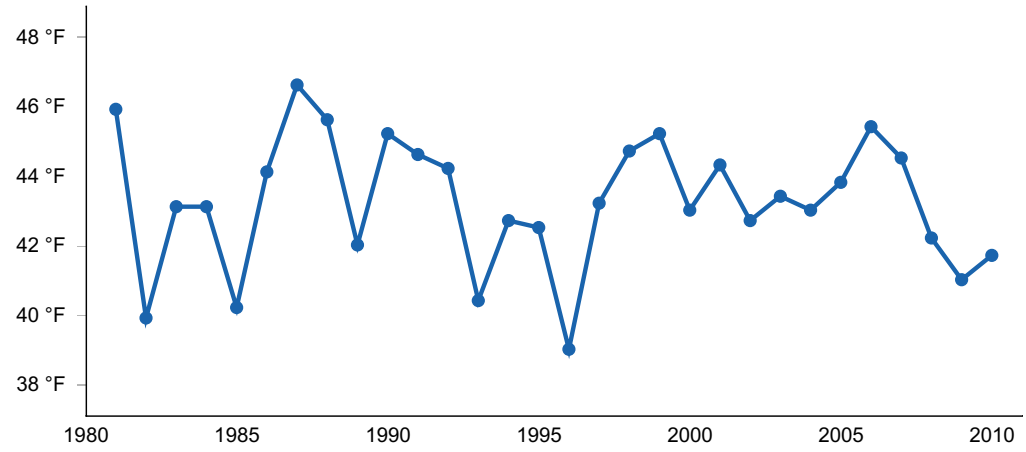


**Figure 6. Annual average temperature pattern**

## Climate stations used

- (1) WATFORD CITY 14S [USC00329246], Grassy Butte, ND
- (2) MEDORA 7 E [USW00094080], Fairfield, ND
- (3) TROTTERS 3 SSE [USC00328812], Beach, ND
- (4) AMIDON [USC00320209], Amidon, ND

- (5) CARLYLE 13 NW [USC00241518], Wibaux, MT

## Influencing water features

This site does not receive additional water as runoff from adjacent slopes; it is on a run-off landscape position. Neither does it receive significant additional water from a seasonal high-water table. Depth to the water table typically exceeds 6 feet throughout the growing season. Surface infiltration is moderately rapid or rapid. Permeability above the sandstone is moderately rapid or rapid. Water loss is through evapotranspiration and percolation below the root zone.

## Soil features

Soils associated with Shallow Sandy ES are in the Entisols order and are classified further as Typic Ustorthents and Typic Ustipsamments. These soils formed in weathered residuum (sandstone). They are well drained to excessively drained. The common features of soils in this site are a coarse or moderately coarse texture (either does not form a ribbon or forms a ribbon <1 inch long) and a shallow depth (10 to 20 inches) to sandstone which affects root growth. The texture above the sandstone is loamy fine sand or fine sandy loam.

Above the sandstone, soil salinity is none or very slight (E.C. <2 dS/m); sodicity is typically none. Soil reaction is neutral to moderately alkaline (pH 6.6 to 8.4) in most soils and calcium carbonate content is none to high (0- 30%).

The sandstone bedrock is limiting to water movement and root penetration. These soils are mainly susceptible to wind erosion and, to a lesser degree, water erosion. The hazard of erosion increases where vegetative cover is not adequate; the hazard of water erosion increases where the slope is greater than 15 percent. Low available water capacity and, in some soils, high accumulations of lime strongly influence the soil-water-plant relationship. Loss of the soil surface layer can result in a shift in species composition and/or production.

The major soil series correlated to the Shallow Sandy site are Blacksheep and Fleak.

Access Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) for specific local soils information.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Residuum–sandstone |

| | |
|---|---|
| Surface texture | (1) Very stony, very bouldery loamy fine sand<br>(2) Very stony, very bouldery loamy fine sandVery stony, very bouldery fine sandy loam<br>(3) Fine sandy loam<br>(4) Loamy fine sand |
| Family particle size | (1) Sandy |
| Drainage class | Well drained to excessively drained |
| Permeability class | Moderately rapid to rapid |
| Depth to restrictive layer | 10–20 in |
| Surface fragment cover <=3" | 0–5% |
| Surface fragment cover >3" | 0–5% |
| Available water capacity (0-20in) | 1–3 in |
| Calcium carbonate equivalent (0-20in) | 1–30% |
| Electrical conductivity (0-20in) | 0–2 mmhos/cm |
| Sodium adsorption ratio (0-20in) | 0–1 |
| Soil reaction (1:1 water) (0-20in) | 6.6–8.4 |
| Subsurface fragment volume <=3" (0-20in) | 0–10% |
| Subsurface fragment volume >3" (0-20in) | 0–25% |

## Ecological dynamics

This ecological site description is based on nonequilibrium ecology and resilience theory and utilizes a State- and-Transition Model (STM) diagram to organize and communicate information about ecosystem change as a basis for management. The ecological dynamics characterized by the STM diagram reflect how changes in ecological drivers, feedback mechanisms, and controlling variables can maintain or induce changes in plant community composition (phases and/or states). The application of various management actions, combined with weather variables, impact the ecological processes which influence the competitive interactions, thereby maintaining or altering plant community

structure.

Prior to European influence, the historical disturbance regime for MLRA 58C included frequent fires, both anthropogenic and natural in origin. Most fires, however, were anthropogenic fires set by Native Americans. Native Americans set fires in all months except perhaps January. These fires occurred in two peak periods, one from March-May with the peak in April and another from July-November with the peak occurring in October. Most of these fires were scattered and of small extent and duration. The grazing history would have involved grazing and browsing by large herbivores (such as American bison, elk, pronghorn, mule deer, and whitetail deer). Herbivory by small mammals, insects, nematodes, and other invertebrates are also important factors influencing the production and composition of the communities. Grazing and fire interaction, particularly when coupled with drought events, influenced the dynamics discussed and displayed in the following state and transition diagram and descriptions.

Following European influence, this ecological site generally has had a history of grazing by domestic livestock, particularly cattle which, along with other related activities (e.g., fencing, water development, fire suppression), has changed the disturbance regime of the site. Changes will occur in the plant communities due to these and other factors.

Weather fluctuations coupled with managerial factors may lead to changes in the plant communities and may, under adverse impacts, result in a slow decline in vegetative vigor and composition. However, under favorable conditions the botanical composition may resemble that prior to European influence.

Five vegetative states have been identified for the site (Reference, Native/Invaded, Invaded, Conifer Invaded, and Go-Back). Within each state, one or more community phases have been identified. These community phases are named based on the more dominant and visually conspicuous species; they have been determined by study of historical documents, relict areas, scientific studies, and ecological aspects of plant species and plant communities. Transitional pathways and thresholds have been determined through similar methods.

State 1: Reference State represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. Dynamics of the state were largely determined by variations in climate and weather (e.g., drought), as well as that of fire (e.g., timing, frequency) and grazing by native herbivores (e.g., frequency, intensity, selectivity). Due to those variations, the Reference State is thought to have shifted temporally and spatially between four plant community phases.

Currently, the primary disturbances are due to the widespread introduction of exotic species, concentrated livestock grazing, lack of fire, and perhaps long-term non-use and no fire. Because of these changes (particularly the widespread occurrence of exotic species), as well as other environmental changes, the Reference State is considered to no longer exist. Thus, the presence of exotic species on the site precludes it from being

placed in the Reference State. It must then be placed in one of the other states, commonly State 2: Native/Invaded State (T1A).

State 2: Native/Invaded State. Colonization of the site by exotic species resulted in a transition from State 1: Reference State to State 2: Native/Invaded State (T1A). This transition was probably inevitable; it often resulted from colonization by exotic cool-season grasses (such as Kentucky bluegrass, smooth brome, and/or crested wheatgrass) which have been particularly and consistently invasive under extended periods of non-use and no fire. Other exotics, such as Canada thistle and leafy spurge, are also known to invade the site.

Four community phases have been identified for this state; they are similar to the community phases in the Reference State but have now been invaded by exotic cool-season grasses. These exotic cool-season grasses can be expected to increase. As that increase occurs, plants more desirable to wildlife and livestock may decline. A decline in forb diversity can also be expected. Under non-use or minimal use management, mulch increases and may become a physical barrier to plant growth. This also changes the micro-climate near the soil surface and may alter infiltration, nutrient cycling, and biological activity near the soil surface. As a result, these factors coupled with shading cause desirable native plants to have increasing difficulty remaining viable and recruitment declines.

To slow or limit the invasion of these exotic grasses or other exotic plants, it is imperative that managerial options (e.g., prescribed grazing, prescribed burning) be carefully constructed and evaluated with respect to that objective. If management does not include measures to control or reduce these exotic plants, the transition to State 3: Invaded State should be expected (T2A). The threshold to this transition is reached when both the exotic cool-season grasses exceed 30% of the plant community and native grasses represent less than 40% of the community. This state may also transition to State 4: Invaded Conifer State during extended periods of long-term lack of fire (T2B). Managers need to understand when the plant community is at or near these parameters; all data available needs to be evaluated to determine needed management actions.

State 3: Invaded State. The threshold for this state is reached when both the exotic cool-season grasses (often Kentucky bluegrass, smooth brome, and/or crested wheatgrass) exceed 30% of the plant community and native grasses represent less than 40% of the community. Managers need to understand when the plant community is at or near these parameters; all data available needs to be evaluated to determine needed management actions. One community phase has been identified for this state.

The exotic cool-season grasses can be quite invasive and often form monotypic stands. As they increase, both forage quantity and quality of the annual production becomes increasingly restricted to late spring and early summer, even though annual production may increase. Forb diversity often declines. Under non-use or minimal use management, mulch can increase and become a physical barrier to plant growth which alters nutrient

cycling, infiltration, and soil biological activity. As such, desirable native plants become increasingly displaced.

Once the state is well established, prescribed burning and prescribed grazing techniques have been largely ineffective in suppressing or eliminating the exotic cool-season grasses, even though some short-term reductions may appear successful. However, assuming there is an adequate component of native grasses to respond to treatments, a restoration pathway to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing and prescribed burning with possible range seeding (R3A). This state may also transition to State 4: Invaded Conifer State resulting from long-term lack of fire (T3A).

State 4: Invaded Conifer State. This state historically existed as small patches of fire-tolerant trees and shrubs when precipitation, fire frequency, and other factors enabled woody species to colonize or encroach on the site. This often resulted in a mosaic of small, scattered patches of woody vegetation interspersed within the grass dominated vegetation.

A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread. This is particularly important to the fire-intolerant juniper species' ability to expand, exploit and dominate grasslands. Where a conifer seed source is available, conifer encroachment processes begin to dominate as fire intervals increase or fire is eliminated from the site. As depicted in the following diagram, conifer seeds disperse into an intact grassland State 1.0 or 2.0, beginning the process of conifer encroachment. Extended fire intervals allow conifers to establish allowing for a transition to State 4: Invaded Conifer State.

One community phase has been identified and often results from extended periods of no fire (T2B, T3A). Brush management or a stand-replacing wildfire may lead to State 2: Native/Invaded State (R4A) or State 3: Invaded State (R4B) depending on the abundance of exotic grasses. A range planting may be necessary to complete the restoration to State 2: Native/Invaded State.

State 5: Go-Back State
This state often results following cropland abandonment, recreational activity (e.g., off-road vehicle use), or concentrated livestock activity for a prolonged period. This weedy assemblage may include noxious weeds that need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or crested wheatgrass) will likely predominate.

Initially, due to extensive bare ground and a preponderance of shallow-rooted annual plants, the potential for soil erosion is high. Plant species richness may be high, but overall diversity (i.e., equitability) is typically low, with the site dominated by a relatively small assemblage of species. Due to the lack of native perennials and other factors, restoring the site with the associated ecological processes is difficult. However, a successful range

planting may result in something approaching State 2: Native/Invaded State (R5A). Following seeding, prescribed grazing, prescribed burning, haying, and the use of herbicides will generally be necessary to achieve the desired result and control weeds, some of which may be noxious weeds. A failed range planting and/or secondary succession will lead to State 3: Invaded State (R5B).

The following state and transition model diagram illustrates the common states, community phases, community pathways, and transition and restoration pathways that can occur on the site. These are the most common plant community phases and states based on current knowledge and experience; changes may be made as more data are collected. Pathway narratives describing the site's ecological dynamics reference various management practices (e.g., prescribed grazing, prescribed fire, brush management, herbaceous weed treatment) which, if properly designed and implemented, will positively influence plant community competitive interactions. The design of these management practices will be site specific and should be developed by knowledgeable individuals; based upon management goals and a resource inventory; and supported by an ongoing monitoring protocol.

When the management goal is to maintain an existing plant community phase or restore to another phase within the same state, modification of existing management to ensure native species have the competitive advantage may be required. To restore a previous state, the application of two or more management practices in an ongoing manner will be required. Whether using prescribed grazing, prescribed burning, or a combination of both with or without additional practices (e.g., brush management), the timing and method of application needs to favor the native species over the exotic species. Adjustments to account for variations in annual growing conditions and implementing an ongoing monitoring protocol to track changes and adjust management inputs to ensure desired outcome will be necessary.

The plant community phase composition table(s) has been developed from the best available knowledge including research, historical records, clipping studies, and inventory records. As more data are collected, plant community species composition and production information may be revised.

## State and transition model

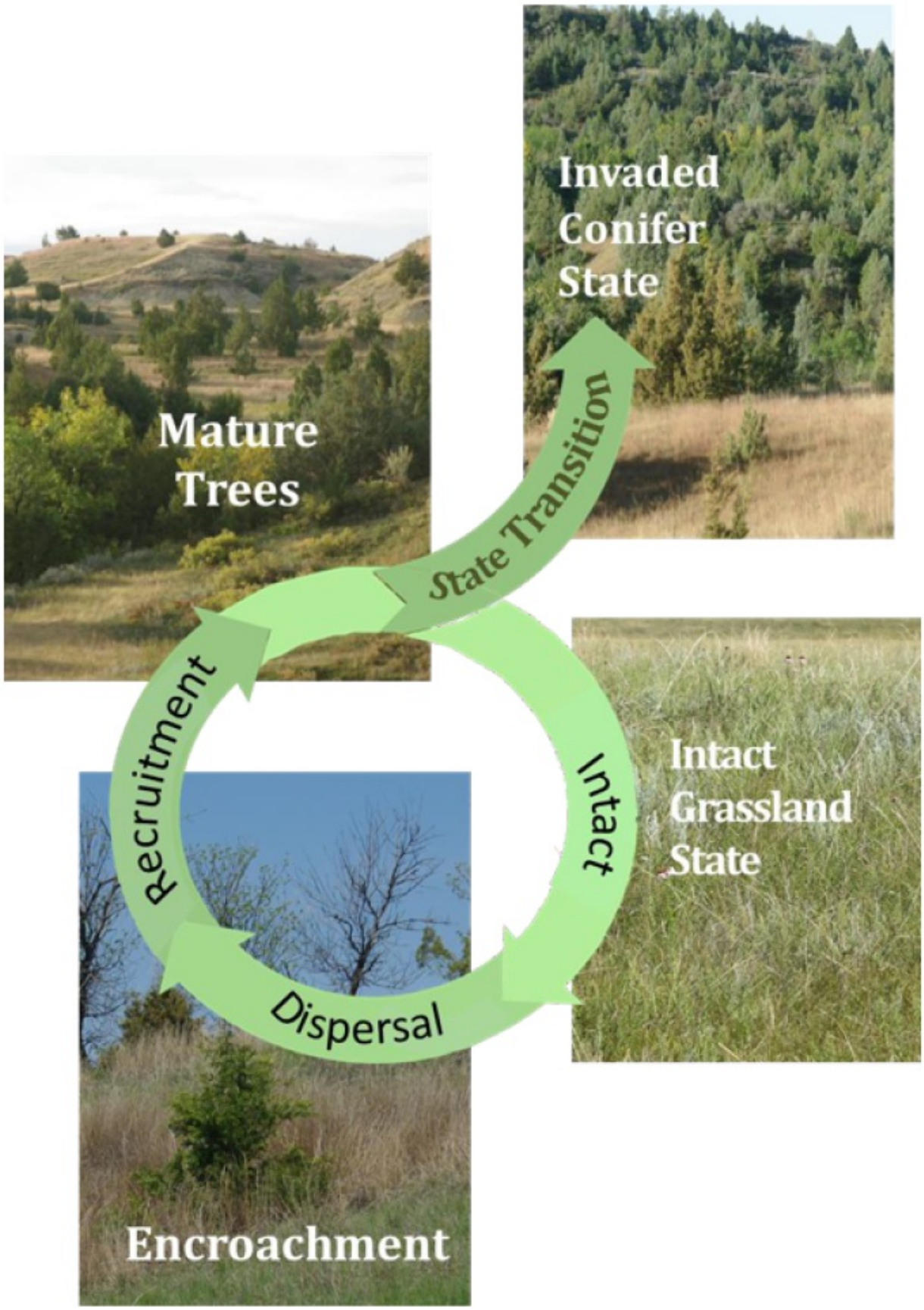


**Figure 7. Stages of Woody Encroachment - Adapted from: Reducing Woody Encroachment in Grasslands – A Guide for Understanding Risk and Vulnerability; Oklahoma Cooperative Extension Service**

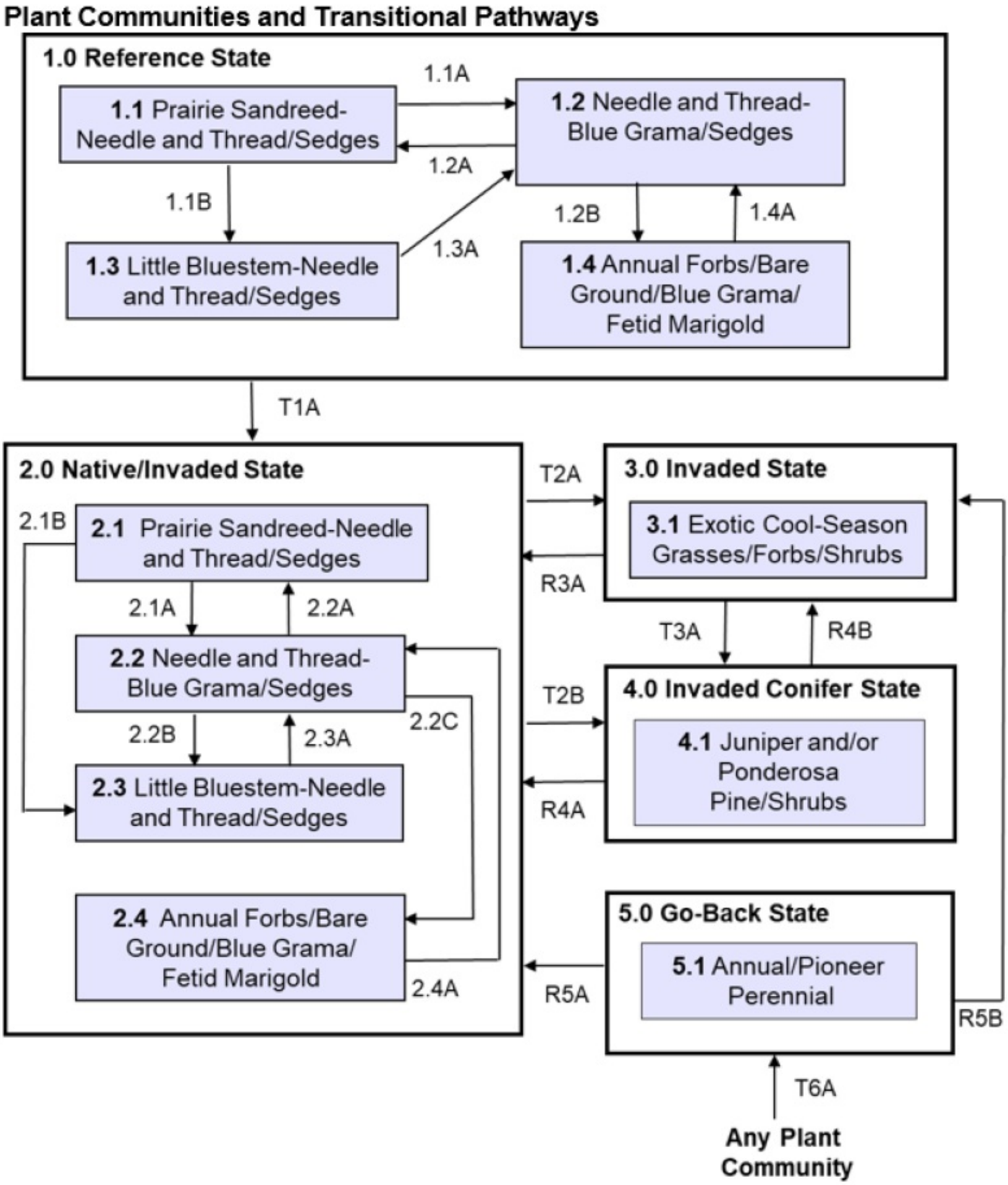


**Figure 8. Shallow Sandy State and Transition Model**

| Diagram Legend - MLRA 58C Shallow Sandy | |
|---|---|
| T1A | Introduction of exotic cool-season grasses |
| T2A | Extended periods of non-use or very light grazing, no fire |
| T3A | Long-term lack of fire |
| T2B | Long-term lack of fire |
| T6A | Cessation of annual cropping |
| R3A | Long-term prescribed grazing and prescribed burning with possible range planting |
| R4A | Brush management or stand-replacing wildfire |
| R4B | Brush management or stand-replacing wildfire |
| R5A | Successful range planting with prescribed grazing and prescribed burning |
| R5B | Failed range planting and/or secondary succession |
| CP 1.1 - 1.2 (1.1A) | Long-term drought with/without heavy, long-term grazing |
| CP 1.1 - 1.3 (1.1B) | Soil movement as a result of rotational sliding or deposition |
| CP 1.2 - 1.1 (1.2A) | Return to average precipitation and reduced grazing |
| CP 1.2 - 1.4 (1.2B) | Long-term occupation by prairie dogs |
| CP 1.3 - 1.2 (1.3A) | Long-term drought |
| CP 1.4 - 1.2 (1.4A) | Prairie dog abandonment, return to average precipitation |
| CP 2.1 - 2.2 (2.1A) | Heavy, season-long grazing with or without drought |
| CP 2.1 - 2.3 (2.1B) | Soil movement as a result of rotational sliding or deposition |
| CP 2.2 - 2.1 (2.2A) | Prescribed grazing and prescribed burning, return to average precipitation |
| CP 2.2 - 2.3 (2.2B) | Soil movement as a result of rotational sliding or deposition |
| CP 2.2 - 2.4 (2.2C) | Long-term occupation by prairie dogs |
| CP 2.3 - 2.2 (2.3A) | Long-term drought |
| CP 2.4 - 2.2 (2.4A) | Prairie dog abandonment/removal |

**Figure 9. State and Transition Model Legend**

## State 1
## Reference State

This state represents the natural range of variability that dominated the dynamics of this ecological site prior to European influence. The primary disturbance mechanisms for this site in the reference condition included frequent fire and grazing by large herding ungulates. Timing of fires and grazing, coupled with weather events, dictated the dynamics that occurred within the natural range of variability. These factors likely caused the community to shift both spatially and temporally between four community phases.

**Characteristics and indicators.** Because of changes in disturbances and other environmental factors (particularly the widespread occurrence of exotic species), the Reference State is considered to no longer exist.

**Resilience management.** If intact, the reference state should probably be managed with current disturbance regimes which has permitted the site to remain in reference condition as well as maintaining the quality and integrity of associated ecological sites. Maintenance of the reference condition is contingent upon a monitoring protocol to guide management.

## Community 1.1
## Prairie Sandreed-Needle and Thread/ Sedges (Calamovilfa longifolia-

## Hesperostipa comata/ Carex spp.)

This community phase was historically the most dominant both temporally and spatially. Warm-season grasses dominated this plant community. The major grasses included prairie sandreed, little bluestem, needlegrasses, plains muhly, blue grama, and upland sedges. Other grasses included sideoats grama, prairie junegrass, Fendler threeawn, and sand dropseed. Common forb and shrub species included blazing star, blacksamson echinacea, prairie clover, cutleaf ironplant, prairie sagewort, and rose. Annual production likely varied from about 650-1650 pounds per acre with grasses and grass-like species, forbs and shrubs contributing about 85%, 10% and 5%, respectively. Both warm-season grasses and cool- season grasses were well represented in the community; as a result, production was distributed throughout the growing season. This community represents the plant community phase upon which interpretations are primarily based and is described in the “Plant Community Composition and Group Annual Production” portion of this ecological site description.

**Table 5. Annual production by plant type**

| Plant Type | Low (Lb/Acre) | Representative Value (Lb/Acre) | High (Lb/Acre) |
|---|---|---|---|
| Grass/Grasslike | 575 | 1018 | 1455 |
| Forb | 55 | 86 | 120 |
| Shrub/Vine | 20 | 40 | 60 |
| Microbiotic Crusts | 0 | 6 | 15 |
| **Total** | **650** | **1150** | **1650** |

## Community 1.2
## Needle and Thread-Blue Grama/ Sedges (Hesperostipa comata-Bouteloua gracilis/ Carex spp.)

This community phase resulted from long-term drought with or without long-term heavy grazing. Needlegrasses, little bluestem and sedges were the dominant species. Other grasses and grass-like species included Fendler threeawn, sand dropseed, western wheatgrass, prairie Junegrass, and annual grasses. Forbs such as Cuman ragweed, scurfpea, white sagebrush, and scarlet globemallow may also have been present. This plant community may occur throughout a pasture, on spot-grazed areas, and around water sources where season-long grazing patterns occur. Evidence from the years 1932-1941 indicates long-term drought results in major shifts in species composition. Blue grama, needle and thread, western wheatgrass, prairie Junegrass, and needleleaf sedge are reduced in density and abundance during one or two seasons of severe drought. Of the major species, only threadleaf sedge maintained approximately the same area. Blue grama and western wheatgrass were the most severely affected and required three to four years to fully recover. Little bluestem, prairie sandreed, and plains muhly were seriously reduced during the two drought years and did not fully recover from the drought effects.

Sandberg's bluegrass increased remarkably during the drought years but decreased during post-drought years due to competition from threadleaf sedge, needle and thread, prairie Junegrass, and needleleaf sedge which recovered to pre-drought levels. The height of all species was reduced (Whitman et.al. 1943).

## Community 1.3
## Little Bluestem-Needle and Thread/ Sedges (Schizachyrium scoparium-Hesperostipa comata/ Carex spp.)

This community phase was initiated with soil movement associated with the formation of "steps" that increased calcium carbonate at the soil surface which favors little bluestem. Soil disturbances such as those described may occur after long-term drought when followed by average to above average precipitation and are more common, but not limited to, northern facing slopes. As the steps or slump(s) widen, they unite with other steps or slumps and become deeper as erosion extends up the slope (Whitman et.al. 1943). This community phase was dominated by little bluestem with lesser amounts of needle and thread, western wheatgrass, sedges, and forbs. Once little bluestem becomes dominant, it is difficult for other grasses to displace it because of its dense, tall growth (assuming soil moisture is adequate). Moisture conditions below the step were more favorable than on the general slope because snow tended to accumulate there; runoff was retarded. As the step widened, united with other steps, and became deeper as erosion extended up the slope, the area of little bluestem enlarged until it occupied most of the hillside. Once established, the cover of little bluestem usually protected the slopes from excessive runoff and erosion. The little bluestem type is of great ecological importance because it stabilizes areas subject to heavy runoff and erosion, holds drifting snow, and hastens soil development due to the numerous roots to 3.5 feet in depth and large volume of herbage. In places, little bluestem appears to be rather short-lived and to be succeeded on more moderate slopes by blue grama, western wheatgrass, needlegrasses, and sedges. These areas tend to become dominated by little bluestem until a severe drought reduces its competitive advantage (Whitman et.al. 1943). See Plant Community Pathway 1.3A.

## Community 1.4
## Annual Forbs/ Bare Ground/ Blue Grama/ Fetid Marigold (Annual Forbs/Bare Ground/ Bouteloua gracilis/ Dyssodia papposa) (Prairie Dog Town)

This community phase formed during periods of long-term occupation by prairie dogs. It was characterized by the abundance of annual forbs (e.g., fetid marigold, woolly plantain) and bare ground. Some perennial native species remained but were greatly reduced in vigor and may not have been readily visible.

## Pathway 1.1A
## Community 1.1 to 1.2

Community Phase Pathway 1.1 to 1.2 occurred during long-term drought with or without

heavy long-term grazing, resulting in a decrease of cool-season bunchgrasses and increases in short-statured warm-season grasses, sedges, and forbs.

### Pathway 1.1B
### Community 1.1 to 1.3

Community Phase Pathway 1.1 to 1.3 was initiated with soil movement associated with the formation of “steps” (minor slumping on slopes of 9 to 25 percent), major slumping on slopes > 25 percent, or soil erosion/deposition events. These events increased amounts of calcium carbonate at the soil surface which favored an increase in little bluestem. Soil disturbances such as those described may occur after long-term drought when followed by average to above average precipitation events and are more common, but not limited to, northern facing slopes. As the steps or slide(s) widen, they unite with other steps or slides and become deeper as erosion extends up the slope (Whitman et.al. 1943).

### Pathway 1.2A
### Community 1.2 to 1.1

Community Phase Pathway 1.2 to 1.1 occurred with the return to average precipitation and reduced grazing, resulting in an increase of cool-season bunchgrasses and corresponding decreases in short-statured warm- season grasses, sedges, and forbs.

### Pathway 1.2B
### Community 1.2 to 1.4

Community Phase Pathway 1.2 to 1.4 occurred with long-term occupation by prairie dogs shifting the community to one largely characterized by the abundance of annual forbs, bare ground, blue grama, and fetid marigold.

### Pathway 1.3A
### Community 1.3 to 1.2

Community Phase Pathway 1.3 to 1.2 resulted from long-term drought, resulting in a marked decrease in little bluestem and a corresponding increase in blue grama.

### Pathway 1.4A
### Community 1.4 to 1.2

Community Phase Pathway 1.4 to 1.2 occurred with the prairie dog abandonment (e.g., plague) and return to average precipitation. This led to an increase in the less grazing and drought tolerant plants.

## State 2
## Native/Invaded State

This state is very similar to the Reference State, but the invasion of exotic cool-season grasses has altered the natural range of variability for this ecological site. The state is still dominated by native grasses, but exotic cool-season grasses are now present in all community phases. The primary disturbance mechanisms for this state include grazing by domestic livestock, infrequent fires, and possibly prairie dogs. Timing and duration of grazing, coupled with weather events, dictate the dynamics that occur within this state. Cool-season and warm-season native grasses can decline and an increase in exotic grasses will occur. Often this state appears as a mosaic of community phases caused primarily by continuous season- long grazing.

**Characteristics and indicators.** The presence of trace amounts of exotic cool-season grasses indicates a transition from State 1 to State 2. The presence of exotic biennial or perennial leguminous forbs (i.e., sweet clover, black medic) may not, on their own, indicate a transition from State 1 to State 2 but may facilitate that transition.

**Resilience management.** To slow or limit the invasion of these exotic grasses, it is imperative that managerial options (e.g., prescribed grazing, prescribed burning) be carefully constructed and evaluated with respect to that objective. Grazing management should be applied that enhances the competitive advantage of native grass and forb species. This may include: (1) grazing when exotic cool-season grasses are actively growing and native cool- season grasses are dormant; (2) applying proper deferment periods allowing native grasses to recover and maintain or improve vigor; (3) adjusting overall grazing intensity to reduce excessive plant litter (above that needed for rangeland health indicator #14 – see Rangeland Health Reference Worksheet); (4) incorporating early heavy spring utilization which focuses grazing pressure on exotic cool-season grasses and reduces plant litter, provided that livestock are moved when grazing selection shifts from exotic cool-season grasses to native grasses. Prescribed burning should be applied in a manner that maintains or enhances the competitive advantage of native grass and forb species. Prescribed burns should be applied as needed to adequately reduce/remove excessive plant litter and maintain the competitive advantage for native species. Timing of prescribed burns (spring vs. summer vs. fall) should be adjusted to account for differences in annual growing conditions and applied during windows of opportunity to best shift the competitive advantage to the native species.

## Community 2.1
## Prairie Sandreed-Needle and Thread/ Sedges (Calamovilfa longifolia-Hesperostipa comata/ Carex spp.)

This community phase is similar to Community Phase 1.1. It may be maintained with grazing systems that allow for adequate recovery periods following grazing events and, potentially, the combination of grazing and prescribed burning which closely mimics the natural disturbance regime. Decreased fire frequency results in an increase in the shrub component.

## Community 2.2
## Needle and Thread-Blue Grama/ Sedges (Hesperostipa comata-Bouteloua gracilis/ Carex spp,)

**Figure 11. Foreground - Plant Community Phase 2.2: Needle and thread-Blue Grama/Sedges**

This plant community phase is characterized by disturbance tolerant grass and forb species. Needlegrasses decrease in vigor and amount with corresponding increases in blue grama and sedges compared to Community Phase 2.1.

## Community 2.3
## Little Bluestem-Needle and Thread/ Sedges (Schizachyrium scoparium-Hesperostipa comata/ Carex spp.)

This plant community phase is characterized by an increase in little bluestem resulting from soil disturbance such as rotational sliding (aka soil slumping/steps), soil erosion, soil deposition, pipelines, abandoned roads, and livestock trailing. Soil disturbance, coupled with high calcium carbonates, gives the competitive advantage to little bluestem as it tends to act as an invader on disturbed areas. Livestock typically avoid little bluestem; the lack of grazing preference may act as a driver to further favor this plant's abundance once it becomes established. The deep-rooted nature of little bluestem stabilizes soil on slopes and can act as a snow trap allowing the site to collect additional moisture during spring runoff.

## Community 2.4
## Annual Forbs/ Bare Ground/ Blue Grama/ Fetid Marigold (Annual Forbs/ Bare Ground/ Bouteloua gracilis/ Dyssodia papposa) (Prairie Dog Town)

This community phase formed during periods of long-term occupation by prairie dogs. It is characterized by the abundance of annual forbs (e.g., fetid marigold, woolly plantain), bare

ground, and blue grama. Some perennial native species remain but are greatly reduced in vigor and may not be readily visible.

### Pathway 2.1A
### Community 2.1 to 2.2

Community Phase Pathway 2.1 to 2.2 occurs with heavy continuous grazing with or without drought leading to an increase in the more disturbance tolerant plants.

### Pathway 2.1B
### Community 2.1 to 2.3

Community Phase Pathway 2.1 to 2.3 is initiated with soil movement associated with rotational sliding or deposition which forms “steps” (minor slides on slopes of 9 to 25 percent, major slides on slopes >25 percent, or soil erosion/deposition events). These events increase the amount of calcium carbonate at the soil surface which favors little bluestem. These soil disturbances may occur after long-term drought when followed by average to above average precipitation events and are more common, but not limited to, northern facing slopes. As the steps or slide(s) widen, they unite with other steps or slides and become deeper as erosion extends up the slope (Whitman et.al. 1943). This pathway may also result from other ground-disturbing events such as livestock trails, abandoned roads, and pipelines. The plant community is altered by the physical disturbance and movement of calcium carbonates, resulting in an increase in little bluestem.

### Pathway 2.2A
### Community 2.2 to 2.1

Community Phase Pathway 2.2 to 2.1 occurs with the return to average precipitation and implementation of prescribed burning, and prescribed grazing with management which includes adequate recovery periods following each grazing event and stocking levels which match the available resources. If properly implemented, this will shift the competitive advantage from the exotic cool-season species to the native cool-season and warm-season grasses.

### Pathway 2.2B
### Community 2.2 to 2.3

Community Phase Pathway 2.2 to 2.3 is initiated with soil movement associated with rotational sliding or deposition which forms “steps” (minor slides on slopes of 9 to 25 percent, major slides on slopes >25 percent, or soil erosion/deposition events). These events increase the amount of calcium carbonate at the soil surface which favors little bluestem. These soil disturbances may occur after long-term drought when followed by average to above average precipitation events and are more common, but not limited to, northern facing slopes. As the steps or slide(s) widen, they unite with other steps or slides and become deeper as erosion extends up the slope (Whitman et.al. 1943). This pathway

may also result from other ground-disturbing events (e.g., livestock trails, abandoned roads, pipelines). The plant community is altered by the physical disturbance and movement of calcium carbonates, resulting in an increase in little bluestem.

### Pathway 2.2C
### Community 2.2 to 2.4

Community Phase Pathway 2.2 to 2.4 occurs with long-term occupation by prairie dogs shifting the community to one largely characterized by the abundance of annual forbs, bare ground, blue grama, and fetid marigold.

### Pathway 2.3A
### Community 2.3 to 2.2

Community Phase Pathway 2.3 to 2.2 occurs with long-term drought which causes little bluestem to decrease along with corresponding increases in blue grama and other more drought tolerant species.

### Pathway 2.4A
### Community 2.4 to 2.2

Community Phase Pathway 2.4 to 2.2 is initiated with the removal/abandonment of prairie dogs. This leads to decreases in more grazing and drought tolerant plants and corresponding increases in the less grazing and drought tolerant plants.

## State 3
## Invaded State

This state is the result of invasion and dominance by the exotic cool-season grasses (commonly Kentucky bluegrass, smooth brome, and/or crested wheatgrass). The exotic leafy spurge may also invade the site. These exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They also often form monotypic stands. As these exotic cool-season grasses increase, both forage quantity and quality become increasingly restricted to late spring and early summer due to the monotypic nature of the stand, even though annual production may increase. Native forbs generally decrease in production, abundance, diversity, and richness compared to that of State 1: Reference State. Common forbs often include white heath aster, goldenrod, common yarrow, and white sagebrush. Shrubs, such as western snowberry and rose, may show marked increases. Once the state is well established, prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating these species, even though some short-term reductions may appear successful. Annual production of this state may vary widely, in part due to variations in the extent of invasion by exotic cool-season grasses.

**Characteristics and indicators.** This site is characterized by exotic cool-season grasses

constituting greater than 30 percent of the annual production and native grasses constituting less than 40 percent of the annual production.

**Resilience management.** Light or moderately stocked continuous, season-long grazing or a prescribed grazing system which incorporates adequate deferment periods between grazing events and proper stocking rate levels will maintain this State. Application of herbaceous weed treatment, occasional prescribed burning and/or brush management may be needed to manage noxious weeds and increasing shrub (e.g., western snowberry) populations.

### Community 3.1
### Exotic Cool-Season Grasses/Forbs/Shrubs

This plant community phase is characterized by dominance of exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass) with remnant amounts (<5%) of native warm-season grasses (e.g., prairie sandreed, Fendler threeawn, plains muhly), cool-season grasses (e.g., needlegrasses, western wheatgrass, prairie Junegrass), and forbs (e.g., white sagebrush, silverleaf Indian breadroot, and blacksamson echinacea). The opportunity for high intensity spring burns is severely reduced by early green up and increased moisture and humidity at the soil surface. Grazing pressure cannot cause a reduction in exotic grass dominance. Annual production is limited to the exotic species. The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of Kentucky bluegrass or smooth brome are typically short-lived.

## State 4
## Invaded Conifer State

This state is often characterized by dominance of Rocky Mountain juniper and/or ponderosa pine in all layers. Common juniper, creeping juniper, or perhaps eastern red cedar may also be present. Depending upon tree density, an herbaceous understory of grasses and forbs can be minimal to non-existent. The combination of factors including a detritus layer of juniper or pine needles, shading, changes to soil chemistry, interception of rainfall by tree canopies, and shallow rooting morphology of the juniper and/or pine inhibit the herbaceous layer.

**Characteristics and indicators.** The dominance of woody species (by cover and production) distinguishes this state from other herbaceously dominated states.

**Resilience management.** This state is resistant to change in the long-term absence of fire. Restoration efforts would require the use of prescribed fire, mechanical treatment, and prescribed grazing. Considerable time and effort will be required to restore to other States.

### Community 4.1

### Juniper and/or Ponderosa Pine/Shrubs (Juniperus spp., Pinus ponderosa/Shrubs)

This community is characterized by the complete dominance of Rocky Mountain juniper and/or ponderosa pine. Common juniper, creeping juniper, or perhaps eastern red cedar may also be present. The understory of herbaceous vegetation is completely different from the reference plant community state or absent. As junipers increase in size and density, they further reduce the potential for a ground fire by reducing amount of available fine fuel.

## State 5
## Go-Back State

This state is highly variable depending on the level and duration of disturbance related to the T6A transitional pathway. In this MLRA, the most probable origin of this state is plant succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, some of which may be noxious weeds and need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or crested wheatgrass) will likely predominate.

### Community 5.1
### Annual/Pioneer Perennial /Exotics

This community phase is highly variable depending on the level and duration of disturbance related to the T6A transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses, including noxious weeds (e.g., Canada thistle) which may need control. Over time, the exotic cool-season grasses (Kentucky bluegrass, smooth brome, and/or crested wheatgrass) will likely predominate.

## State 6
## Any Plant Community

### Transition T1A
### State 1 to 2

This is the transition from the State 1: Reference State to the State 2: Native/Invaded State due to the introduction and establishment of exotic cool-season grasses (typically Kentucky bluegrass, smooth brome, and/or crested wheatgrass). This transition was probably inevitable and corresponded to a decline in native warm-season and cool-season grasses; it may have been exacerbated by chronic season-long or heavy late season grazing. Complete rest from grazing and suppression of fire could also have hastened the transition. The threshold between states was crossed when Kentucky bluegrass, smooth brome, crested wheatgrass, or other exotic species became established on the site.

**Constraints to recovery.** Current knowledge and technology will not facilitate a successful restoration to Reference State.

## Transition T2A
## State 2 to 3

This transition from State 2: Native/Invaded State to State 3: Invaded State often occurs during extended periods of no use or very light grazing, and no fire. Complete rest or low intensity (<20% utilization) grazing and elimination of fire are the two major contributors to this transition, especially when exotic cool-season grasses (e.g., Kentucky bluegrass, smooth brome, crested wheatgrass) are present. Preliminary studies indicate this threshold may exist when both exotic cool-season grasses exceed 30 percent of the plant community, and native grasses represent less than 40 percent of the plant community composition.

**Constraints to recovery.** Variations in growing conditions (e.g., cool, wet spring) will influence effects of various management activities on exotic cool-season grass populations.

## Transition T2B
## State 2 to 4

This transition from State 2: Native/Invaded State to State 4: Invaded Conifer State results from long-term lack of fire. This leads to the site becoming dominated by junipers and/or ponderosa pine.

**Constraints to recovery.** The extended fire interval may make recovery doubtful due to the abundance of exotic cool-season grasses and lack of native grasses. Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Ladder fuel and/or fuel loading are required for successfully controlling ponderosa pine (crown vs. ground fire). Continued recruitment of seeds (juniper and pine) from adjacent sites will hamper site restoration. Constraints to recovery include reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. Managing the site for mule deer, big horn sheep, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 2. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

## Restoration pathway R3A
## State 3 to 2

This restoration from State 3: Invaded State to State 2: Native/Invaded State may be

accomplished with the implementation of long-term prescribed grazing and prescribed burning. Depending upon the abundance of exotic cool-season grass, a successful range planting may be necessary to complete the restoration. The success of this restoration pathway depends on the presence of a remnant population of native grasses in Community Phase 3.1. This remnant population may not be readily apparent without close inspection. The application of prescribed burning may be necessary at relatively short intervals in the early phases of this restoration process. Some previous efforts have shown promise with early season prescribed burning; however, summer or fall burning may also be effective under certain circumstances. Prescribed grazing and burning in conjunction with a subsequent successful range planting may be necessary to successfully complete this restoration pathway.

**Context dependence.** Grazing management should be applied in a manner that enhances/maximizes the competitive advantage of native grass and forb species over the exotic species. This may include the use of prescribed grazing to reduce excessive plant litter accumulations above that needed for rangeland health indicator #14 (see Rangeland Health Reference Worksheet). Increasing livestock densities may facilitate the reduction in plant litter provided length and timing of grazing periods are adjusted to favor native species. Grazing prescriptions designed to address exotic grass invasion and favor native species may involve earlier, short, intense grazing periods with proper deferment to improve native species health and vigor. Fall (e.g., September, October) prescribed burning followed by an intensive, early spring graze period with adequate deferment for native grass recovery may shift the competitive advantage to the native species, facilitating the restoration to State 2: Native/Invaded. Prescribed burning should be applied in a manner that enhances the competitive advantage of native grass and forb species over the exotic species. Prescribed burns should be applied at a frequency which mimics the natural disturbance regime, or more frequently as is ecologically (e.g., available fuel load) and economically feasible. Burn prescriptions may need adjustment to: (1) account for change in fine fuel orientation (e.g., “flopped” Kentucky bluegrass); (2) fire intensity and duration by adjusting ignition pattern (e.g., backing fires vs head fires); (3) account for plant phenological stages to maximize stress on exotic species while favoring native species (both cool- and warm-season grasses).

## Transition T3A
## State 3 to 4

This Transition from State 3: Invaded State to State 4: Invaded Conifer State results from long-term lack of fire. This leads to the site becoming dominated by junipers and/or ponderosa pine.

**Constraints to recovery.** Lack of fine fuels in the tree understory limits fire intensity causing incomplete or patchy burns. Ladder fuels and/or fuel loading are required, but are limited, for successfully controlling ponderosa pine (crown vs. ground fire). Cost of mechanical and/or chemical treatment may be prohibitive. Continued recruitment of seeds (juniper and pine) from adjacent sites and sprouting nature of deciduous trees and shrubs

will hamper site restoration. Existing herbaceous vegetation (native grasses and cool-season exotics) may be lacking allowing for invasive species (e.g., Canada thistle, leafy spurge) to dominate after a prescribed fire. Constraints to recovery include reticence to undertake tree removal and the perception that trees may be a desirable vegetation component for wildlife habitat, carbon sequestration, aesthetics, etc. Managing the site for mule deer, big horn sheep, livestock, or grassland nesting birds will need to consider the intensive management required to restore and maintain the site in State 3. The disturbance regime necessary to restore this site to State 2: Native/Invaded State is very labor intensive and costly; therefore, addressing woody removal earlier in the encroachment phase is the most cost-effective treatment for woody control.

## Restoration pathway R4A
## State 4 to 2

This restoration from State 4: Invaded Conifer State to State 2: Native/Invaded State is initiated by brush management (i.e., chemical/mechanical/prescribed burning) or a stand-replacing wildfire which removes or greatly reduces the non-sprouting trees and shrubs. The fire-tolerant (sprouting) shrubs will initially increase but will eventually decrease if the necessary fire frequency is maintained or brush management is applied. As shrubs decrease, the remnant herbaceous component will increase. The amount of native versus exotic herbaceous component remaining will determine whether this pathway leads to the State 2: Native/Invaded State, or State 3: Invaded State. In this case, the amounts of native species present results in a shift to State 2: Native/Invaded State. This may also occur if range planting is implemented successfully to re-establish a native plant community.

**Context dependence.** Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Ladder fuel and/or fuel loading are required for successfully controlling ponderosa pine (crown vs. ground fire). Continued recruitment of seeds (juniper and pine) from adjacent sites will hamper site restoration. Intensive management is required to restore and maintain the site in State 2: Native/Invaded State.

## Restoration pathway R4B
## State 4 to 3

This restoration from State 4: Invaded Conifer State to State 3: Invaded State is initiated by brush management (i.e., chemical/mechanical/prescribed burning) or a stand-replacing wildfire which removes or greatly reduces the non-sprouting trees and shrubs (e.g., juniper species, Ponderosa pine) component. The fire-tolerant (sprouting) shrubs will initially increase but will eventually decrease if the necessary fire frequency is maintained or brush management is applied. As the shrubs decrease, the remnant herbaceous component will increase. The amount of native versus exotic herbaceous component remaining will determine whether this pathway leads to State 2: Native/Invaded State or State 3: Invaded State. In this case, the amounts of exotic species present results in a shift to State 3: Invaded State. This may also occur if range planting is used as an attempt

to re-establish a native plant community but, due to various factors (i.e., drought), the planting fails, and exotic species increase and dominate.

**Context dependence.** Fire intensity along with consumption of available fuels may cause incomplete or patchy burns. Ladder fuel and/or fuel loading are required for successfully controlling ponderosa pine (crown vs. ground fire). Continued recruitment of seeds (juniper and pine) from adjacent sites will hamper site restoration. Intensive management is required to restore and maintain the site in State 3: Invaded State.

## Restoration pathway R5A
## State 5 to 2

This restoration from State 5: Go-Back State to the State 2: Native/Invaded State can be accomplished with a successful range planting. Following seeding, prescribed grazing, prescribed burning, haying, or use of herbicides will generally be necessary to achieve the desired result and control any noxious weeds. It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of State 2: Native/Invaded State. Application of chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, prescribed grazing should include adequate recovery periods following each grazing event and stocking levels which match the available resources; management objectives must include the maintenance of those species, the associated reference state functions, and continued treatment of exotic grasses.

**Context dependence.** A successful range planting will include proper seedbed preparation, weed control (both prior to and after the planting), selection of adapted native species representing functional/structural groups inherent to the State 1, and proper seeding technique. Management (e.g., prescribed grazing, prescribed burning) during and after establishment must be applied in a manner that maintains the competitive advantage for the seeded native species. Adding non-native species can impact the above and below ground biota. Elevated soil nitrogen levels have been shown to benefit smooth brome and Kentucky bluegrass more than some native grasses. As a result, fertilization, exotic legumes in the seeding mix, and other techniques that increase soil nitrogen may promote smooth brome and Kentucky bluegrass invasion. The method or methods of herbaceous weed treatment will be site specific to each situation; but generally, the goal would be to apply the pesticide, mechanical control, or biological control (either singularly or in combination) in a manner that shifts the competitive advantage from the targeted species to the native grasses and forbs. The control method(s) should be as specific to the targeted species as possible to minimize impacts to non-target species.

## Restoration pathway R5B
## State 5 to 3

A failed range planting and/or secondary succession will lead to State 3: Invaded State.

**Context dependence.** Failed range plantings can result from many causes (both singularly and in combination) including drought, poor seedbed preparation, improper seeding methods, seeded species not adapted to the site, insufficient weed control, herbicide carryover, poor seed quality (purity & germination), and/or improper management.

## Transition T6A
## State 6 to 5

This transition from any plant community to State 5: Go-Back State. It is most commonly associated with the cessation of cropping without the benefit of range planting, resulting in a “go-back” situation. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g., development of a plowline, erosion, fertility, herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques.

## Additional community tables

**Table 6. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Lb/Acre) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | **Tall Warm-Season** | | | 230–345 | |
| | prairie sandreed | CALO | *Calamovilfa longifolia* | 173–288 | – |
| | sand bluestem | ANHA | *Andropogon hallii* | 0–12 | – |
| 2 | **Mid Warm-Season** | | | 58–115 | |
| | little bluestem | SCSC | *Schizachyrium scoparium* | 58–173 | – |
| | plains muhly | MUCU3 | *Muhlenbergia cuspidata* | 46–92 | – |
| 3 | **Needlegrasses** | | | 92–138 | |
| | needle and thread | HECOC8 | *Hesperostipa comata ssp. comata* | 58–127 | – |
| | porcupinegrass | HESP11 | *Hesperostipa spartea* | 23–46 | – |
| | green needlegrass | NAVI4 | *Nassella viridula* | 0–12 | – |
| 4 | **Grama** | | | 46–92 | |
| | blue grama | BOGR2 | *Bouteloua gracilis* | 35–81 | – |
| | sideoats grama | BOCU | *Bouteloua curtipendula* | 23–46 | – |
| 5 | **Other Native Grasses** | | | 58–115 | |
| | western | PASM | *Pascopyrum smithii* | 23–46 | – |

| | | | | | |
|---|---|---|---|---|---|
| | wheatgrass | | | | |
| | Grass, perennial | 2GP | *Grass, perennial* | 12–23 | – |
| | prairie Junegrass | KOMA | *Koeleria macrantha* | 12–23 | – |
| | Fendler threeawn | ARPUL | *Aristida purpurea var. longiseta* | 12–23 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 12–23 | – |
| | Scribner's rosette grass | DIOLS | *Dichanthelium oligosanthes var. scribnerianum* | 0–12 | – |
| | plains reedgrass | CAMO | *Calamagrostis montanensis* | 0–12 | – |
| 6 | **Grass-Likes** | | | 58–173 | |
| | threadleaf sedge | CAFI | *Carex filifolia* | 35–115 | – |
| | sun sedge | CAINH2 | *Carex inops ssp. heliophila* | 23–58 | – |
| | Grass-like (not a true grass) | 2GL | *Grass-like (not a true grass)* | 0–35 | – |
| | Pennsylvania sedge | CAPE6 | *Carex pensylvanica* | 0–12 | – |
| **Forb** | | | | | |
| 7 | **Forbs** | | | 58–115 | |
| | prairie clover | DALEA | *Dalea* | 23–35 | – |
| | common yarrow | ACMI2 | *Achillea millefolium* | 12–23 | – |
| | tarragon | ARDR4 | *Artemisia dracunculus* | 12–23 | – |
| | blacksamson echinacea | ECAN2 | *Echinacea angustifolia* | 12–23 | – |
| | stiff sunflower | HEPA19 | *Helianthus pauciflorus* | 12–23 | – |
| | blazing star | LIATR | *Liatris* | 12–23 | – |
| | purple locoweed | OXLA3 | *Oxytropis lambertii* | 12–23 | – |
| | goldenrod | SOLID | *Solidago* | 12–23 | – |
| | onion | ALLIU | *Allium* | 0–12 | – |
| | pussytoes | ANTEN | *Antennaria* | 0–12 | – |
| | white sagebrush | ARLU | *Artemisia ludoviciana* | 0–12 | – |
| | groundplum milkvetch | ASCR2 | *Astragalus crassicarpus* | 0–12 | – |
| | plains milkvetch | ASGI5 | *Astragalus gilviflorus* | 0–12 | – |
| | wavyleaf thistle | CIUN | *Cirsium undulatum* | 0–12 | – |
| | sanddune wallflower | ERCAC | *Erysimum capitatum var. capitatum* | 0–12 | – |
| | blanketflower | GAAR | *Gaillardia aristata* | 0–12 | – |

| | | | | | |
|---|---|---|---|---|---|
| | hairy false goldenaster | HEVIB | *Heterotheca villosa var. ballardii* | 0–12 | – |
| | rush skeletonplant | LYJU | *Lygodesmia juncea* | 0–12 | – |
| | lacy tansyaster | MAPI | *Machaeranthera pinnatifida* | 0–12 | – |
| | beardtongue | PENST | *Penstemon* | 0–12 | – |
| | spiny phlox | PHHO | *Phlox hoodii* | 0–12 | – |
| | cinquefoil | POTEN | *Potentilla* | 0–12 | – |
| | scurfpea | PSORA2 | *Psoralidium* | 0–12 | – |
| | eastern pasqueflower | PUPA5 | *Pulsatilla patens* | 0–12 | – |
| | upright prairie coneflower | RACO3 | *Ratibida columnifera* | 0–12 | – |
| | scarlet globemallow | SPCO | *Sphaeralcea coccinea* | 0–12 | – |
| | spiderwort | TRADE | *Tradescantia* | 0–12 | – |
| | American vetch | VIAM | *Vicia americana* | 0–12 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 0–12 | – |
| **Shrub/Vine** | | | | | |
| 8 | **Shrubs** | | | 23–58 | |
| | winterfat | KRLA2 | *Krascheninnikovia lanata* | 23–35 | – |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 12–23 | – |
| | prairie sagewort | ARFR4 | *Artemisia frigida* | 12–23 | – |
| | rose | ROSA5 | *Rosa* | 12–23 | – |
| | silver sagebrush | ARCA13 | *Artemisia cana* | 0–12 | – |
| | skunkbush sumac | RHTR | *Rhus trilobata* | 0–12 | – |
| | pricklypear | OPUNT | *Opuntia* | 0–12 | – |
| | creeping juniper | JUHO2 | *Juniperus horizontalis* | 0–12 | – |
| | soapweed yucca | YUGL | *Yucca glauca* | 0–12 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 0–12 | – |
| **Microbiotic Crusts** | | | | | |
| 9 | **Cryptogams** | | | 0–12 | |
| | lesser spikemoss | SEDE2 | *Selaginella densa* | 0–12 | – |

## Animal community

Wildlife Interpretations

Landscape:

The MLRA 58C landscape is characterized by moderately dissected rolling plains with areas of local Badlands, buttes, and isolated hills. MLRA 58C is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are common and characteristic of the MLRA. This area supports natural mixed-grass prairie vegetation with prairie rose, leadplant, and patches of western snowberry interspersed throughout the area. Green ash, chokecherry, and buffaloberry occur in draws and narrow valleys, creating woody riparian corridors. Complex/intermingled ecological sites create diverse grass- and shrubland habitats interspersed with varying densities linear, slope, depressional, and in-stream wetlands associated with headwater streams and tributaries to the Missouri River. These habitats provide critical life-cycle components for many wildlife species.

Historic Communities/Conditions within MLRA 58C:

The northern mixed-grass prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary ecological drivers (either singly or often in combination). Many species of grassland birds, small mammals, insects, reptiles, amphibians, and large herds of Audubon bighorn sheep, roaming bison, elk, and pronghorn were historically among the inhabitants adapted to this semi-arid region. Bighorn sheep have been re-introduced. Roaming herbivores, as well as several small mammal and insect species, were the primary consumers linking the grassland resources to large predators (such as the wolf, mountain lion, and grizzly bear) and smaller carnivores (such as the coyote, bobcat, red fox, and raptors). The black-tailed prairie dog was once abundant and provided ecological services by manipulating the plant and soil community providing habitat for the black-footed ferret, burrowing owl, ferruginous hawk, mountain plover, swift fox, small mammals, and amphibians and reptiles. Extirpated species include free-ranging American bison, Canada lynx, common raven, grizzly bear, gray wolf, black-footed ferret, mountain plover, and peregrine falcon (breeding). Extinct from the region is the Rocky Mountain locust.

Present Communities/Conditions within MLRA 58C:

Following European influence, domestic livestock grazing, elimination of fire, energy development, and other anthropogenic factors influenced plant community composition and abundance. Transportation corridors, energy development, and Rocky Mountain juniper and ponderosa pine encroachment are the main factors contributing to habitat fragmentation, reducing habitat quality for area-sensitive species. These influences fragmented the landscape, reduced or eliminated ecological drivers (fire), and introduced exotic plant species including smooth brome, crested wheatgrass, Kentucky bluegrass, and leafy spurge further impacting plant and animal communities. The loss of the bison, reduction of black-tailed prairie dogs, and fire, as primary ecological drivers, greatly influenced the character of the remaining native plant communities and the associated

wildlife moving towards a less diverse and more homogeneous landscape, lacking diverse species composition and stature.

Extensive fragmentation by annual cropping has not occurred within the MLRA. Limited fragmentation from annual cropping or tame hay production has occurred within the Little Missouri River flood plain and the higher, flat plateaus. Fragmentation east and west of MLRA 58C has funneled many species into this area in search of expansive grasslands.

Some wildlife species in this area are: mule deer, white-tailed deer, elk, bighorn sheep, pronghorn, mountain lion, coyote, red fox, bobcat, prairie rattlesnake, American badger, raccoon, North American porcupine, beaver, striped skunk, American mink, white-tailed jackrabbit, black-tailed prairie dog, Eastern and Merriam's wild turkey, golden eagle, ferruginous hawks, sharp-tailed grouse, greater sage-grouse, black-billed magpie, and numerous species of grassland-nesting birds and pollinating insects. The highest diversity of bats in North Dakota also occurs in this MLRA, where eleven species have been documented.

Presence of wildlife species is often determined by ecological site characteristics including grass and forb species, hydrology, aspect, and other associated ecological sites. Home ranges for most species are larger than one ecological site or are dependent on more than one ecological site for annual life requisites. Ecological sites offer different habitat elements as the annual life requisites change. Habitat improvement and creation must be conducted within the mobility limits of a known population for the species.

Insects play an important role providing ecological services for plant community development. Insects that are scavengers or aid in decomposition provide the food chain baseline sustaining the carnivorous insects feeding upon them. Many insects provide the ecological services necessary for pollination, keeping plant communities healthy and productive. Insects provide a protein food source for numerous species including grassland nesting birds and their young.

Species unique to the MLRA:

Mountain Lions: Mountain lions were relatively common in the Badlands but disappeared from the state by the early 20th Century. Sightings resumed in the 1950's and have subsequently increased since that time. The species has recently taken up permanent residency within the region. Mountain lions occur in of the Little Missouri Badlands and woody habitat in MLRA 58C. Rugged terrain and forest provide excellent stalking cover to hunt large mammals and other prey. Mountain lions make use of caves for escape and loafing cover.

Bighorn sheep: Bighorn sheep make use of the rugged terrain, rocky outcrops, and high plateaus of MLRA 58C along the Little Missouri River. North Dakota bighorn sheep populations are almost exclusively within MLRA 58C. Bighorn sheep were once extirpated from North Dakota but were successfully reintroduced in the mid-twentieth century. They

now occur in several distinct populations within MLRA 58C. Rocky Mountain juniper encroachment degrades the limited habitat for bighorn sheep. Managers should consider bighorn sheep association with domestic sheep, since transfer of pneumonia and other diseases is known to occur.

Golden eagle: The badlands within MLRA 58C are key areas for Golden eagle nesting. Adjacent grasslands, shrublands, and black-tailed prairie dog towns are used for hunting.

Bats: MLRA 58C provides life requisites for several bat species, in part due to presence of riparian forest, wooded draws, caves, and rocky outcrops. Hibernacula of six bat species have been found in MRLA 58C; however, additional work is needed to further understand utilization of hibernacula by bats during the winter months in North Dakota.

Short-horned lizard and sagebrush lizard: This MLRA provides preferred habitat for these two species. The short-horned lizard prefers semi-arid, shortgrass prairie in rough terrain, and is uncommon to locally abundant in MLRA 58C. The rare sagebrush lizard prefers sagebrush and rocky areas provided by this MLRA and adjacent MLRA 58D.

Greater sage-grouse and Brewer's sparrow: The extreme southwest extension of MLRA 58C have ecological sites capable of producing sufficient big sage canopy cover to provide greater sage-grouse life requisites. MLRA 58C and 58D are the only MLRAs in North Dakota that support Wyoming big sage brush (big sage) production. Research data indicates greater sage-grouse prefer big sagebrush canopy cover for nesting at ≥8% with an average height of around 16 inches. The species prefers winter cover canopy that averages 15% with an average height of around 8 inches. Soil site potential, management, climate, and other factors all play a role in the amount, if any, of big sagebrush on an ecological site. Changes in big sage canopy cover occur slowly (30-50 years) unless the site is impacted by fire or cultivation. Big sage recovery after a burn can take 30 to 100 years. Greater sage- grouse and Brewer's sparrow habitat and populations are reduced or eliminated when big sagebrush canopy is reduced to less than 8% for greater sage-grouse and 10% cover for Brewer's sparrow. As conifer encroachment increases, greater sage-grouse lekking activity decreases. Once conifer encroachment exceeds 4% canopy cover, no leks remain.

Species of Concern within the MLRA:

Following is a list of species considered "species of conservation priority" in the North Dakota State Wildlife Action Plan (2015); "species of greatest conservation need" in the Montana State Wildlife Action Plan (2015); and species listed as "threatened, endangered, or petitioned" under the Endangered Species Act within MLRA 58C at the time this section was developed:

Invertebrates: Dakota skipper, monarch butterfly, regal fritillary, yellow-banded bumble bee, and western bumble bee.

Birds: American kestrel, Baird's sparrow, bald eagle, black-billed cuckoo, bobolink, Brewer's sparrow, burrowing owl, chestnut-collared longspur, common poorwill, eastern screech-owl ferruginous hawk, golden eagle, grasshopper sparrow, greater sage-grouse, lark bunting, loggerhead shrike, long-billed curlew, marbled godwit, McCown's longspur, mountain plover, northern harrier, northern pintail, peregrine falcon (migration), prairie falcon, red knot (migration), red-headed woodpecker, sharp-tailed grouse, short-eared owl, Sprague's pipit, Swainson's hawk, upland sandpiper, western meadowlark, Wilson's phalarope, whooping crane (migration), and willet.

Mammals: Big brown bat, black-footed ferret, black-tailed prairie dog, dwarf shrew, gray wolf, hispid pocket mouse, little brown bat, long-eared bat, long-legged bat, meadow jumping mouse, Merriam's shrew, northern long-eared bat, porcupine, sagebrush vole, swift fox, Townsend's big- eared bat, and western small-footed bat.

Amphibians and Reptiles: Common snapping turtle, Great Plains toad, greater short-horned lizard, milk snake, northern leopard frog, plains hognose snake, plains spadefoot, sagebrush lizard, smooth softshell, smooth green snake, and spiny softshell.

Fish and Mussels: Blue sucker, burbot, Flathead chub, northern redbelly dace, sickle-fin chub, pearl dace, shortnose gar, sturgeon chub, and sauger.

Grassland Management for Wildlife in the MLRA

Management activities within the community phase pathways impact wildlife. Community phase, transitional, and restoration pathways are keys to long-term management within each State and between States. Significant inputs must occur to cross the threshold between States (e.g., State 3.0 to 2.0) requiring substantial economic inputs and management (mechanical, reseeding, prescribed fire, woody vegetation removal, grazing intensity, etc.). Timing, intensity, and frequency of these inputs can have dramatic positive or negative effects on local wildlife species. Ranchers and other land managers must always consider the long-term beneficial effects of management on the habitat in comparison to potential short-term negative effects to individuals.

Ecological sites occur as intermingled complexes on the landscape with gradual or sometimes abrupt transitions. Rarely do ecological sites exist in large enough acreage to manage independently. Ecological sites, supporting a dominance of herbaceous vegetation (Loamy/Limy Residual), can be located adjacent to ecological sites that support medium to tall shrubs (Loamy Overflow). Conversely, ecological sites that are dominated by short to mid statured grasses (Claypan) can be adjacent to sites with bare soil only supporting minor amounts of short grasses and forbs (Thin Claypan).

Management of these complex ecological sites can provide a heterogeneous or a homogenous landscape. Grassland bird use declines as the plant community transitions to a homogenous state. Managers need to recognize ecological sites and the complexes they occur in to properly manage the landscape. A management regime for one ecological

site may negatively impact an adjacent site (e.g., alteration of a grazing regime within a Flat Bottom Wooded Draw ecological site to encourage understory growth may encourage exotic, cool-season grasses to increase or dominate an adjacent ecological site).

Life requisites and habitat deficiencies are determined for targeted species. Deficiencies need to be addressed along community phase, transitional, and restoration pathways as presented in specific state and transition models. Ecological sites should be managed and restored within the capabilities of the site to provide sustainable habitat. Managers also need to consider habitat provided by adjacent/intermingled ecological sites for species with home ranges or life requisites that cannot be provided by one ecological site.

With populations of many grassland-nesting birds in decline, it is important to maintain these ecological sites in a 1.0 Reference State or the 2.0 Native/Invaded. Plant communities, optimal for a guild of grassland species, serve as a population source where the birth rate exceeds mortality. Species may use marginal plant communities; however, these sites may function as a population sink where mortality exceeds the birth rate.

Understanding preferred vegetative stature and sensitivity to woody encroachment is necessary to manage for the specific grassland species. Various grass heights may be used for breeding, nesting, foraging, or winter habitat. While most species use varying heights, many have a preferred vegetative stature height. Please reference the provisional ESD on the North Dakota eFOTG (linked below) for a chart that provides preferred vegetative stature heights and sensitivity to woody vegetation encroachment. https://efotg.sc.egov.usda.gov/references/public/ND/58C_Shallow_Sandy_Narrative_FINAL_Ref_FSG.pdf

Shallow Sandy Wildlife Habitat Interpretation:

Shallow Sandy ecological sites are droughty sites identified by the presence of coarse or moderately coarse soil textures (fine sandy loamy or coarser) and a shallow depth (10 to 20 inches) to weathered bedrock or hard sandstone bedrock. Shallow Sandy sites support drought-tolerant species but are still productive compared to Sandy sites due to the increase in tall warm-season grasses like prairie sandreed. Shallow Sandy sites support diverse stands of tall- mid- and short warm- and cool-season grasses. Associated ecological sites include Sands, Sandy, Very Shallow, Limy Sands, Steep-Sided Wooded Draw, and Badland. This complex of ecological sites provides habitat for many edge-sensitive grassland bird species.

Shallow Sandy habitat features and components commonly support grassland-nesting birds (notably sharp-tailed grouse nesting, brood cover, and lekking sites) depending upon its plant community state. Insects rely on associated forbs and grasses for survival, serve as food sources for birds and their young and as forage for small and large herbivores.

Shallow Sandy ecological sites generally do not support big sagebrush. Vigor of cool and warm season grasses outcompete big sagebrush. Fire intensity and frequency on this site

makes it inappropriate to manage Shallow Sandy sites for big sagebrush.
Shallow Sandy ecological sites may be found in five plant community states (1.0 Reference State, 2.0 Native/Invaded State, 3.0 Invaded State, 4.0 Invaded Conifer State, and 5.0 Go-Back State) within a local landscape. Multiple plant community phases exist within States 1.0 and 2.0. Today, these states occur primarily in response to grazing and drought. Secondary influences include anthropogenic disturbances, black-tailed prairie dogs, and fire.

Because there is no known restoration pathway from State 2.0 to State 1.0, it is important to intensively manage using tools in the community phase pathways of State 1.0 and State 2.0 to prevent further plant community degradation along the T1A Transitional Pathways to Native/Invaded State 2.0. Native wildlife generally benefits from the heterogeneous grasslands, in stature and plant composition, found in States 1.0 and 2.0 which include diverse grass and forb species with varying stature and density. As plant communities degrade and transition to States 3.0 and 4.0, short warm- season grasses, exotic grasses, and Rocky Mountain juniper and/or creeping juniper increase while native grasses and forbs are reduced. This transition results in reduced stature or an increase in woody vegetation.

Success along Restoration Pathway R3A from State 3.0 to State 2.0 is very difficult and is dependent upon presence of a remnant native grass population. This concept also applies to wildlife, as the target species must either be present on adjacent State 1.0 or State 2.0 plant communities or on ecological sites within the species' mobility limits. Species with limited mobility, such as Dakota skippers, must exist near the plant community to utilize restored sites. Mobile species, such as grassland-nesting birds, can more easily locate and utilize isolated, restored plant communities.

Plant community phase in the State 3.0 shows increased homogeneity of exotic cool-season grasses with a further reduction in native forbs. Reduced forb diversity limits insect populations, negatively affecting foraging opportunities for grassland-nesting birds. A homogenous grassland landscape does not provide quality escape or winter cover. As a result, many species are not able to meet life requisites within State 3.0. Increased exotic-grass litter can limit access to bare ground by nesting insects.

Shallow Sandy sites can have pockets of (or become dominated by) creeping juniper, Rocky Mountain juniper, and Ponderosa pine. When in high enough density this will impact woody intolerant grassland nesting birds. Ponderosa pine and Rocky Mountain juniper density can create a closed canopy forest.

Management along community phase, transition, or restoration pathways should focus on attainable changes. Short- and long-term monetary costs must be evaluated against short- and long-term ecological services in creating and maintaining habitat of sufficient quality to support a sustainable population density.

1.0 Reference State

Community Phase 1.1 Prairie Sandreed-Needle and Thread/Sedges:
This plant community offers excellent wildlife habitat; every effort should be made to maintain this ecological site within this community phase. This phase retains high functionality through continued maintenance, including prescribed grazing with adequate recovery period as well as prescribed fire. Predominance of grass species in this community favors grazers and mixed-feeders (animals selecting grasses as well as forbs and shrubs). The structural diversity provides habitat for a wide array of migratory and resident birds.

Invertebrates: Insects play a role in maintaining the forb community and provide a forage base for grassland birds, reptiles, and rodents. These services include putting plant material and dung in contact with mineral soil to be used by low trophic level consumers (such as invertebrate shredders, predators, herbivores, dung beetles and fungal-feeders).

Dakota skippers may prefer this site when host plants, such as little bluestem, are present. Regal fritillary habitat is limited due to Nuttall's violet and prairie violets being uncommon. Monarch butterfly may use flowering forbs on this site; however, few milkweed species are found on this site to support breeding. Bumblebees and other native bees utilize forbs and bare ground for nesting amongst bunchgrasses. Prescribed grazing with adequate recovery periods, as well as prescribed fire to maintain the 1.1 Phase, has little effect on nests of ground-dwelling insects.

Birds: This plant community provides quality nesting, foraging, and escape habitats favored by mid- to tall- grass nesting birds. Several species of grassland birds which prefer mid- to tall-grass stature will use this site. In years with reduced precipitation or drought, nesting recruitment may be compromised. This plant community provides suitable areas for sharp-tailed grouse nesting and brood-rearing habitat. Diverse prey populations provide good hunting opportunities for grassland raptors. Silver sagebrush is incidental to the site and will not provide the necessary life requisites for the Brewer’s sparrow.

Mammals: The diversity of grasses and forbs provide high nutrition levels for small and large herbivores including voles, mice, rodents, jackrabbits, pronghorn, and deer (white-tailed and mule). Short- to moderately-statured grasses provide suitable food and thermal, protective, and escape cover for small herbivores. The composition of mid- to tallgrasses may limit use by the hispid pocket mouse.

Amphibians and Reptiles: This ecological site and associated plant communities provide habitat for smooth green snakes. This ecological site can provide habitat for the northern leopard frog and Great Plains toad dependent on distance to wetland or Riparian Complex ecological sites. Plain’s spadefoot utilizes small ephemeral ponds or associated stream for breeding as well as other habitats offered within this Shallow Sandy ecological site. Vegetation may be too tall and dense for short-horned lizard and sagebrush lizard. Shallow Sandy soils are not conducive to sagebrush lizard.

Fish and Mussels: This ecological site is not directly associated with streams, rivers, or water bodies. Associated ecological sites can receive run-on hydrology from Sallow Sandy sites. Management on these interconnected sites will have limited, secondary effects on aquatic species.

Community Phase 1.2 Needle and Thread–Blue Grama/Sedges:
Long-term drought, with or without heavy continuous grazing and/or annual continuous early spring seasonal grazing, increases the percentage of short cool-season and short warm-season grasses and sedges in this plant community. This plant community becomes dominated by shorter grasses, changing the stature of plant community from mid- to tall plant species to mid- to short-grass species.

Invertebrates: Provides similar life requisites as Community Phase 1.1; however, heavy, continuous grazing or early spring seasonal grazing may negatively impact ground-nesting sites for bumblebees, other native bees, and other ground-nesting insects due to reduction of forbs and timing of forb flowering.

Birds: This plant community provides nesting, foraging, and escape habitats favored by short- to mid- grass nesting birds. A shift to shorter herbaceous plant stature along Community Phase Pathway 1.1A begins to benefit McCown's longspur, chestnut-collared longspur, horned lark, and burrowing owl. Species preferring midgrass stature will be generally successful with normal to above normal precipitation and a change in management along the 1.2A Community Phase Pathway. In years with reduced precipitation or heavy grazing, nesting recruitment may be compromised for midgrass nesting species. This plant community provides areas suitable for sharp-tailed grouse leks. Limited cover and diverse prey populations provide good hunting opportunity for grassland raptors.

Mammals: Shorter statured grasses reduce thermal, shelter, and escape cover for larger ungulates. Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

Community Phase 1.3 Little Bluestem-Needle and Thread/Sedges:
Physical soil surface movement associated with the formation of "steps" (minor slumping) through water erosion and deposition in community phase pathway 1.1B cause increased calcium carbonates at the surface giving little bluestem a competitive advantage. This plant community occurs in a mosaic with community phase 1.1 creating a patchwork landscape. Little bluestem dependent species, such as Dakota skipper, can utilize this habitat.

Invertebrates: Provides similar life requisites as Community Phase 1.1; however, the increase in the host plant little bluestem has the potential for increased use by the Dakota

skipper.

Birds: Dominated by bunch grasses with short statured sedges, this plant community provides nesting cover for grassland nesting birds that prefer mid- to short- statured nesting cover.

Mammals: Provides similar life requisites as Community Phase 1.2.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

Community Phase 1.4 Annual Forbs/*Bare Ground*/Blue Grama/Fetid Marigold (Prairie Dog Town):
This plant community phase is characterized by grazing tolerant sedges, annual forbs, and a higher percentage of bare ground due to the increase in annul forbs. Continued heavy grazing, short-term prairie dog occupation, or a combination of these disturbances will cause a shift to increased annual forbs with a reduction in perennial grasses. Perennial forbs stature and abundance are being replaced by short- statured annual forbs. Bare ground increases and litter amounts and infiltration rates decline; soil surface temperatures increase. Scruffy in appearance, this plant community is resilient, retaining sufficient grazing sensitive native species to return to 1.2 community phase via community phase pathway 1.4A.

Invertebrates: A switch to annual forbs from perennial forbs may have a significant impact to invertebrates, due to the loss of season-long nectar producing plants for pollinators. Annual forbs' bloom periods are dependent upon climatic conditions, especially precipitation events, and may not provide season-long nectar production. Season-long nectar sources may be found on adjacent plant communities or ecological sites for mobile species. Increased bare ground provides increased nesting sites for bumblebees and other ground nesting insects.

Birds: This short-structured phase, driven by short-term prairie dog occupation, is favored by burrowing owls, chestnut-collared longspur, and McCown's longspur. Prairie dog towns provide abundant prey populations for grassland raptors. The lack of grass and forb structure limits use by many bird species. Long-term prairie dog occupation following transitional phase pathway T1B leads to the 2.0 State with no known return pathway due to the presence of exotic cool-season grasses. Managing this phase along community phase pathway 1.4A can be an economical and successful method to restore habitat for many grassland nesting birds.

Mammals: Suitable food, thermal, shelter, and escape cover (reduction in litter) for most mammals becomes limited. The loss of diversity of grasses and forbs reduces nutrition levels for small and large herbivores including rodents, white-tailed jackrabbits, and deer.

Grazers, such as pronghorn and bison, use prairie dog towns for foraging and loafing. Long-term prairie dog occupation following community phase pathway T1B leads to the 2.0 State with no known return pathway due to the presence of exotic, cool-season grasses. Managing this phase along community phase pathway 1.4A can be an economical and successful method to restore habitat.

Amphibians/Reptiles: Prairie dog towns provide habitat for both amphibians and reptiles. Tiger salamanders, prairie rattlesnakes, plains hog-nosed snake, and other snake species will use the burrow systems of prairie dogs for shelter and denning.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

2.0 Native Invaded State

Community Phase 2.1 Prairie Sandreed-Needle and Thread/Sedges:
This plant community develops through Transition Pathway T1A due to changes in management (chronic season-long or heavy late season grazing or complete rest) and the presence of exotic, cool-season grasses. The threshold between States 1.0 and 2.0 is crossed when Kentucky bluegrass, crested wheatgrass, or other exotic species become established. This plant community phase has a very similar appearance and function to the Reference State of Community 1.1, except it has a minor amount of cool-season exotic grasses and forbs. This phase functions at a high level for native wildlife; therefore, managers should consider the 2.0 Community Phase Pathways to avoid transitioning to State 3.0.

Invertebrates: Provides similar life requisites as Community Phase 1.1.

Birds: Provides similar life requisites as Community Phase 1.1.

Mammals: Provides similar life requisites as Community Phase 1.1.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

Community Phase 2.2 Needle and Thread-Blue Grama/Sedges:
Continuous, heavy season-long grazing or heavy seasonal grazing (with or without drought) along Community Phase Pathway 2.1A, leads to shorter-statured grasses (such as needle and thread, blue grama, and sedges). Dominated by shorter- stature grasses and a loss of nitrogen-fixing or leguminous native forbs, the diversity of this plant community is reduced. Both tap-rooted and fibrous-rooted perennial forbs increase in this phase but remain a minor component. Prescribed grazing (with adequate recovery periods) and return to average precipitation along Community Phase Pathway 2.2A is an

efficient, effective method to regain the cool- season grass and forb diversity components in Community Phase 2.1.

Invertebrates: The loss of native forbs and increase in sod-forming grasses limit foraging and nesting sites for all pollinators. Continuous, heavy season-long grazing or heavy seasonal grazing may reduce ground- nesting site availability. Homogeneity of forb species may limit season-long nectar availability.

Birds: Continuous, heavy season-long grazing or heavy seasonal grazing will reduce nesting sites, forage (invertebrates), and cover. A reduced forb component may limit foraging opportunities. Stature is generally short, serving both mid- and shortgrass-nesting birds. Shortgrass-nesting birds favor this phase. Species preferring midgrass stature will be generally successful with normal to above normal precipitation and a change in management along the 2.2A Community Phase Pathway. In years with reduced precipitation or heavy grazing during the nesting season, nesting recruitment may be compromised for species that prefer midgrass nesting. This plant community provides areas suitable for sharp-tailed grouse lek site development. Limited stature and diverse prey populations provide good hunting opportunity for grassland raptors.

Mammals: Suitable food and thermal, protective, and escape cover (reduction in litter) for most mammals becomes limited. The loss of diversity of grasses and forbs reduces nutrition levels for small and large herbivores including voles, mice, rodents, jack rabbits, pronghorn, and deer.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

Community Phase 2.3 Little Bluestem-Needle and Thread/Sedges:
Physical soil surface movement associated with the formation of “steps” (minor slumping) through water erosion and deposition in community phase pathway 1.1B cause increased calcium carbonates at the surface giving little bluestem a competitive advantage. This plant community occurs in a mosaic with Community Phase 1.1 creating a patchwork landscape. Little bluestem dependent species, such as Dakota skipper, can utilize this habitat.

Insects: Provides similar life requisites as Community Phase 1.3.

Birds: Provides similar life requisites as Community Phase 1.3.

Mammals: Provides similar life requisites as Community Phase 2.2.

Amphibians and Reptiles: Provides similar life requisites as Community Phase 1.1.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

Community Phase 2.4 Annual Forbs/*Bare Ground*/Blue Grama/Fetid Marigold (Prairie Dog Town:
This plant community is a result of ecological services provided by long-term black-tailed prairie dog occupation coupled with the introduction of exotic cool-season grasses and annual forbs along Community Phase Pathway 2.2C. Removal of black-tailed prairie dogs (via Community Phase Pathway 2.4A) can move this community back to Phase 2.2, but this may require significant management and economic inputs. Black- tailed prairie dogs provide primary ecological services to transition to and maintain Plant Community Phase 2.4.

Invertebrates: The loss of native forb diversity limits use by all pollinators. However, invasive forbs will provide limited seasonal use, dependent upon bloom period. Bare ground, burrows, and short plant stature provide nest sites for bumblebees and other ground-nesting insects. Burrowing owls place dung around their burrow entrance to attract dung beetles and other insects as a food source.

Birds: Burrowing owl and McCown's longspur rely on the stature and composition this plant community provides. Presence of black-tailed prairie dogs provided diverse prey populations for grassland raptors, including burrowing owls, prairie falcons, and ferruginous hawks. Burrowing owls nest in abandoned prairie dog burrows.

Mammals: Suitable food, thermal, protective, and escape cover (reduction in litter) for most mammals becomes limited. The loss of grass and forb diversity reduces nutrition levels for small and large herbivores including voles, mice, rodents, white-tailed jackrabbits, cottontail rabbits, and deer. Except for black-tailed prairie dogs, this plant community provides little habitat for mid- or small herbivores. Nonetheless, black-tailed prairie dog towns provide important habitat for many mammal species, including small rodents. Grazers, such as pronghorn and bison, use prairie dog towns for foraging and loafing.

Amphibians and Reptiles: Prairie dog towns provide habitat for both amphibians and reptiles. Tiger salamanders, prairie rattlesnakes, plains hog-nosed snake, and other snake species will use the burrow systems of prairie dogs for shelter and denning.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

3.0 Invaded State

Community Phase 3.1 Exotic Cool-Season Grasses/Forbs/Shrubs:
Community Phase Pathway T2A is characterized by complete rest or low intensity (<20% utilization) grazing and elimination of fire when exotic cool-season grasses are present as in Community Phase 2.0. This plant community phase is characterized by a dominance

(>30%) of exotic cool-season grasses, such as Kentucky bluegrass and crested wheatgrass. Restoration Pathway R3A requires remnant amounts of native grasses (i.e., prairie sandreed, blue grama, needlegrasses, little bluestem) and forbs (e.g., white sagebrush, silverleaf Indian breadroot, and upright prairie coneflower) with frequent prescribed burns and high levels of grazing management targeting the exotic cool-season grasses to improve competitiveness and increase vigor and density. Without intensive management, the remnant native plants will not increase adequately to transition back to State 2.0. Intensified management along the R3A Pathway will have significant short- term negative impacts on wildlife habitat; however, this is necessary to restore long-term native habitat functions. Long-term lack of fire will help this Plant Community Phase transition to 4.1.

Insects: Exotic grasses result from non-use or low intensity (<20% utilization) grazing and limit use by beneficial insects provided in States 1.0 and 2.0. Increased litter and lack of grazing leads to limited contact between plant material and mineral soil resulting in a cooler micro-climate, which is unfavorable to most insects. Lack of bare soil limits ground-nesting sites for native bees and other ground-nesting insects. The lack of nectar-producing plants limits forage opportunities for bumblebees, regal fritillary, monarch butterfly, and other pollinating species.

Birds: The homogeneous community phase, dominated by exotic plant species, provides limited habitat and life requisites for most obligate grassland-nesting birds. Lack of plant diversity and stature, along with increased litter, limits use by many grassland-nesting birds. Litter accumulations reduce use by chestnut- collared and McCown’s longspurs. Burrowing owls may use the site if sufficient burrows of black-tailed prairie dogs or other burrowing mammals exist. Sharp-tailed grouse leks can be found on this exotic cool-season plant-dominated community; however, winter cover must be provided by adjacent ecological sites or plant communities.

Mammals: Black-tailed prairie dog expansion is possible in this plant community phase except where creeping juniper or soapweed yucca are dominant. This community phase provides foraging habitat for pronghorn and deer. Litter accumulation and shrub cover favors thermal, protective, and escape cover for small rodents. However, reduced availability of native grass seed may reduce food availability for species such as the hispid pocket mouse.

Amphibians and Reptiles: Provides similar secondary resources benefits as Community Phase 1.1.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

4.0 Invaded Conifer State

Community Phase 4.1 Juniper and/or Ponderosa Pine/Shrubs:

Transitional Pathway T2B is characterized long-term lack of fire allowing creeping juniper to dominate. Domination by creeping juniper, Rocky Mountain juniper, or ponderosa pine causes a reduction in forbs, as well as warm- and cool-season native and exotic grasses. Prescribed burning along Restoration Pathway R4A or R4B requires remnant amounts of native warm-season grasses (e.g., blue grama), cool-season grasses (e.g., needlegrasses, western wheatgrass, and prairie Junegrass), and forbs (e.g., silverleaf Indian breadroot, and upright prairie coneflower) to move this plant community to 2.0 or 3.0 States. These remnant populations can only be expressed through frequent prescribed burns and high levels of prescribed grazing management targeting the exotic cool-season grasses. Intensified management along the R4A Pathway will have significant short-term negative impacts on wildlife habitat; however, this is necessary to restore long-term native habitat functions.

Invertebrates: Juniper or ponderosa pine dominance limits use by beneficial insects provided in States 1.0 and 2.0. Creeping juniper does not provide a pollen or nectar source and limits establishment of other flowering forbs or shrubs. The lack of nectar-producing plants limits forage opportunities for bumblebees, regal fritillary, monarch butterfly, and other pollinating species.

Birds: Long-term very light grazing and lack of fire (via Transitional PathwaysT2B and T3A) transitions this ecological site from a grassland dominated site to a juniper and/or ponderosa pine dominated ecological site favoring woodland nesting birds. As canopy cover and/or percent woody cover increase, grassland nesting birds tolerant to woody cover increase, as well as woodland edge bird species. Once juniper or ponderosa pine dominate the site, grassland nesting birds become absent and woodland obligate species flourish dependent on patch size. The woodland patch size is determined by the degree of juniper and pine domination of the site as well as on adjoining ecological sites. In most cases the transition to juniper and pine dominance occurs on adjoining ecological sites prone to the same T2B and T3A pathways as this Shallow Sandy ecological site. Juniper berries provide a food source for many bird species including sharptailed grouse.

Mammals: Conifers provide limited loose bark needed for bat roosting. Small herbivores that can use or tolerate woodland edge (such as least chipmunks, American porcupine, and cotton-tail rabbit) will benefit from this plant community phase. Ponderosa pine provide security and thermal cover used by elk and deer for foraging, loafing, and rearing young-of-the-year. Elk utilize Community Phase 4.1 as a source of cover during daylight hours - only emerging early/late in the day to forage in adjacent grasslands, then returning to the relative security provided by this plant community to ruminate and loaf during daylight hours.

Amphibians/Reptiles: Community Phase 4.1 will not support most of the amphibians and reptiles expected to be present in State 1.0, 2.0 and 3.0.

Fish and Mussels: Provides similar secondary resources benefits as Community Phase 1.1.

5.0 Go-Back State

Community Phase 5.1 Annual/Pioneer Perennial: These plant communities are the result of severe soil disturbance (such as cropping, recreational activity, or concentrated livestock activity for a prolonged period). Following cessation of disturbances, the resulting plant community is dominated by early pioneer annual and perennial plant species. Plant species composition and production are highly variable. Weedy plants can provide pollinator habitat along with spring and summer cover for many mammals and birds, and their young. Dense weed cover can keep soils moist, increasing the presence of insects. Tall stature provided by some weeds, such as marsh elder and ragweed, offer thermal cover and seeds throughout winter.

Successful restoration of native species along Restoration Pathway R5A results in a native grass and forb community in State 2.0, Native/Invaded. Failed restoration to native species through Restoration Pathway R5B results in Invaded State 3.0. Wildlife species response will be dependent upon plant community composition, vegetative stature, patch size, and management activities (such as prescribed grazing, burning, interseeding, haying, or noxious weed control).

Grazing Interpretations

This site is well adapted to managed grazing by domestic livestock. The predominance of herbaceous plants across all plant community phases best lends these sites to grazing by cattle, but other domestic grazers with differing diet preferences may also be a consideration depending upon management objectives. Often, the current plant community does not match any particular plant community (as described in the ecological site description). Because of this, a resource inventory is necessary to document plant composition and production. Proper interpretation of this inventory data will permit the establishment of a safe, initial stocking rate for the type and class of animals and level of grazing management. More accurate stocking rate estimates should eventually be calculated using actual stocking rate information and monitoring data.

NRCS defines prescribed grazing as “managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives”. As used in this site description, the term ‘prescribed grazing’ is intended to include multiple grazing management systems (e.g., rotational grazing, twice-over grazing, conservation grazing, targeted grazing, etc.) provided that, whatever management system is implemented, it meets the intent of prescribed grazing definition.

The basic grazing prescription addresses balancing forage demand (quality and quantity) with available forage, varying grazing and deferment periods from year-to-year, matching recovery/deferment periods to growing conditions when pastures are grazed more than once in a growing season, implementation of a contingency (e.g., drought) plan, and a monitoring plan. When the management goal is to facilitate change from one plant

community phase or state to another, then the prescription needs to be designed to shift the competitive advantage to favor the native grass and forb species.

Grazing levels are noted within the plant community narratives and pathways in reference to grazing management on adjacent sites. “Degree of utilization” is defined as the proportion of the current years forage production that is consumed and/or destroyed by grazing animals (may refer to a single plant species or a portion or all the vegetation). “Grazing utilization” is classified as slight, moderate, full, close, and severe (see the following table for description of each grazing use category). The following utilization levels are also described in the Ranchers Guide to Grassland Management IV. Utilization levels are determined by using the landscape appearance method as outlined in the Interagency Technical Reference “Utilization Studies and Residual Measurements” 1734-3.

Utilization Level:
Slight (Light) 0-20% Appears practically undisturbed when viewed obliquely. Only choice areas and forage utilized.

Moderate 20-40% Almost all of accessible range shows grazing. Little or no use of poor forage. Little evidence of trailing to grazing.

Full 40-60% All fully accessible areas are grazed. The major sites have key forage species properly utilized (about half taken, half left). Points of concentration with overuse limited to 5 to 10 percent of accessible area.

Close (Heavy) 60-80% All accessible range plainly shows use and major sections closely cropped. Livestock forced to use less desirable forage, considering seasonal preference.

Severe > 80% Key forage species completely used. Low-value forages are dominant.

## Hydrological functions

Available water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group D. Infiltration is typically moderately rapid to rapid; runoff potential for this site varies from low to high depending on surface texture, slope percent, and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An example of an exception would be where shortgrasses form a strong sod and dominate the site. Dominance by blue grama, Kentucky bluegrass, and/or smooth bromegrass will result in reduced infiltration and increased runoff. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

## Recreational uses

The largest acreage of public land available for recreation in the MLRA is owned and

managed by the United States Forest Service (USFS) within the Little Missouri National Grasslands in North Dakota (525,211 acres). These areas are available for hunting, fishing, hiking, camping, horse and bike riding, nature viewing, etc. In addition, the Bureau of Land Management (BLM) manages 30,895 acres in North Dakota and Montana with the same recreational opportunities as the USFS lands. North Dakota and Montana Department of Trust Lands (80,220 acres) provide hunting, bird watching, hiking, and other outdoor recreation opportunities. North Dakota Wildlife Management Areas (3,447 acres) of land managed by the states for wildlife habitat in MLRA 58C.

MLRA 58C is home to the North and South Units of Theodore Roosevelt National Park. The Park encompasses approximately 70,000 acres and welcomes approximately 900,000 visitors annually. 29,920 acres of the park is designated Wilderness Area. The south unit of the park has a 48-mile scenic drive while the north unit has a 28-mile scenic drive. The Badland and associated ecological sites provide the main scenery attraction.

Bird watching: Public and private grasslands within MLRA 58C provide essential habitat for prairie-dependent bird species (such as Sprague's pipits, western meadowlark, and Baird's sparrow) along with some of the larger, showy members of the upland prairie including marbled godwits, upland sandpipers, and willets. The abundance of publicly owned lands (such as Theodore Roosevelt National Park, USFS, North Dakota Department of Trust Lands, BLM, etc.) provide excellent birding opportunities. MLRA 58C is in the Central Flyway.

Hunting/Fishing: MLRA 58C is a fall destination for upland game bird hunters, especially sharp-tailed grouse. This MLRA also provides excellent white-tailed deer, mule deer, pronghorn, elk, coyote, and mountain lion hunting opportunities along with the only bighorn sheep hunting units in the North Dakota. The North Dakota Game and Fish Department manages three man-made fishing lakes within the MLRA. Available species include rainbow and brown trout, bluegill, and largemouth and smallmouth bass.

Camping: Many camping opportunities exist in the MLRA. Modern and primitive camping is available at the Theodore Roosevelt National Park, Sully’s Creek State Park, Little Missouri State Park, Buffalo Gap Campground, BLM land, and the Dakota Prairie National Grasslands. The Sully’s Creek and Little Missouri State Parks are designated horse parks.

Hiking/Biking: Over 150 miles of the May-Daah-Hey Trail provide some of the best single-track trails in the world for biking, hiking, or horseback riding. The International Mountain Biking Association (IMBA) has designated the hiking, biking, and horseback riding trail as EPIC - meaning it’s one of the top mountain biking trails in the United States. The trail has nine fenced campgrounds, each accessible by gravel surfaced roads; they include camping spurs, potable water, hitching rails, picnic tables, fire rings, and accessible toilets. They are spaced about every 20 miles along the trail. The North and South Units of the Theodore Roosevelt National Park provide 38.9 and 49.6 miles, respectively, of hiking trails for walkers, bikers, or horseback riders. The Little Missouri State Park has 45 miles of trails that run through the North Dakota Badlands.

Canoeing: Traversing 274 miles through MLRA 58C, the Little Missouri River provides early spring canoeing and kayaking. The Little Missouri River is the only designated State Scenic River in the MLRA. The river passes through Sully Creek State Park, the Little Missouri National Grassland, and Theodore Roosevelt National Park.

## Wood products

No appreciable wood products are present on the site.

## Other products

Seed harvest of native plant species can provide additional income on this site.

## Other information

Associated with this site are similar soils which are less than 10 inches deep to weathered or hard sandstone which affects or restricts root growth. Currently, these soils are included in the Very Shallow site. Some investigation of the plant communities on these soils is recommended.

This ESD is the best available knowledge. The site concept and species composition table have been used in the field and tested for more than five years. It is expected that as additional information becomes available revisions may be required.

## Inventory data references

Information presented here has been derived from NRCS and other federal/state agency clipping and inventory data. Also, field knowledge of range-trained personnel was used. All descriptions were peer reviewed and/or field-tested by various private, state and federal agency specialists.

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## Approval

Suzanne Mayne-Kinney, 4/21/2025

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## 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) | USDA-NRCS North Dakota |
| Contact for lead author | NRCS State Rangeland Management Specialist |
| Date | 06/19/2025 |
| Approved by | Suzanne Mayne-Kinney |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:** Due to wide slope range associated with this site, the number and extent of rills will vary from none on sites with slopes less than 15% to common but short, shallow, and discontinuous on sites with slopes greater than 15%.

2. **Presence of water flow patterns:** Due to the wide slope range associated with this site, water flow patterns will vary from barely observable, broken and irregular in appearance on sites with slopes of < 15% to continuous on slopes > 15%.

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3. **Number and height of erosional pedestals or terracettes:** Not evident on sites with slopes < 15%. Erosional pedestals and terracettes will be observable but uncommon on sites with slopes > 15%.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground ranges from 25 to 40%. Bare ground patches should be small (less than 6 inches in diameter) and not connected. Animal activity (burrows and ant mounds) may occasionally result in isolated patches of up to 24 inches in diameter.

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5. **Number of gullies and erosion associated with gullies:** Gullies not expected on this site.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** No wind-scoured or depositional areas expected on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** No litter movement expected on sites with less than 15% slope. Short (less than 24 inches) movement of fine, small class litter may be observable on slopes of greater than 15%.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class anticipated to average 5 or greater.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Primary surface structure is fine granular. A-horizon is 2 to 6 inches thick with dark grayish brown (2.5Y 4/2 moist) or light brownish gray (2.5Y 6/2 dry) colors.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Mid- and short-statured bunch grasses and tall-statured rhizomatous grasses are dominant and well distributed across the state. Grass-likes and a diverse forb population are subdominant.

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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):** No compaction layers occur naturally on this site except for the naturally occurring rooting restriction occurring at 10 to 20 inches below the soil surface.

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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: Phase 1.1
    Mid & short C4 bunch grasses (6); Tall C4 rhizomatous grasses (1)

    Sub-dominant: Phase 1.1
    Mid & short C3 bunch grasses (3); Grass-likes (2); Forbs (7)

    Other: Minor - Phase 1.1
    Mid & short C3 rhizomatous grasses; Shrubs; Mid & short C4 rhizomatous grasses

    Trace - Phase 1.1
    Evergreen forb

    Additional: Due to differences in phenology, root morphology, soil biology relationships, and nutrient cycling Kentucky bluegrass, smooth brome, and crested wheatgrass are included in a new Functional/structural group, mid- and short-statured early cool-season grasses (MSeC3), not expected for this site.

    To see a full version 5 rangeland health worksheet with functional/structural group tables, please use the following hyperlink:
    https://efotg.sc.egov.usda.gov/references/public/ND/58C_Shallow_Sandy_Narrative_F

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Some (less than 10%) dead or dying plants or

plant parts may be observed on this site. Decadence of warm-season bunchgrasses may be commonly observed following multi- year drought.

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14. **Average percent litter cover (%) and depth ( in):** Plant litter cover is 15 to 25% with a depth of 0.1 to 0.25 inches. Litter is in contact with soil surface.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** Annual air-dry production is 1150 lbs./ac (reference value) with normal precipitation and temperatures. Low and high production years should yield 650 lbs./ac to 1650 lbs./ac respectively.

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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:** State and local noxious species, Kentucky bluegrass, smooth bromegrass, crested wheatgrass, creeping juniper, common juniper, and Rocky Mountain juniper.

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17. **Perennial plant reproductive capability:** Noninvasive species in all functional/structural groups are vigorous and capable of reproducing annually under normal weather conditions. Bunchgrasses should exhibit good vigor with basal diameters of 3 to 6 inches and numerous seed producing tillers.

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