USDA Natural Resources Conservation Service

Ecological site R056BY090MN
Sands

Last updated: 9/04/2024
Accessed: 09/27/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 056B–Glacial Lake Agassiz, Tallgrass Aspen Parklands

MLRA 56B is part of the glacial Lake Agassiz basin, which formed as the lake receded. Most of the area is glaciolacustrine sediments overlying till. This MLRA is entirely in Minnesota and makes up about 4,664 square miles (12,079 square kilometers). It is bordered by beaches and a lake plain on the west (MLRA 56A), by a till plain on the south (MLRA 102A), and by a lake plain and till plain on the east (MLRA 88). (United States Department of Agriculture, Agriculture Handbook 296)

Classification relationships

Level IV Ecoregions of the Conterminous United States: 48a Glacial Lake Agassiz Basin; 48b Beach Ridges and Sand Deltas; and 48d Lake Agassiz Plains.

MLRA 56B (United States Department of Agriculture, Agriculture Handbook 296, 2022).

Ecological site concept

The Sands ecological site is located on uplands beaches and beach ridges. The soils are very deep. Surface textures typically are loamy fine sand, or loamy sand. Soil on this site is well drained to moderately well drained. Slopes range from 0 to 30 percent.

Associated sites

R056BY087MN	**Limy Subirrigated** This site is lower on the landscape. The soils are highly calcareous in the upper part of the subsoil (within a depth of 16 inches) and have redoximorphic features at a depth of 18 to 30 inches. All textures are included in the site.
R056BY091MN	**Sandy** This site occurs on similar landscape positions. It has fine sandy loam or sandy loam textures (forms a ribbon <1 inch long) to a depth >10 inches.
R056BY095MN	**Subirrigated** This site occurs in swales and blow-outs. It is non-calcareous to a depth >16 inches and has redoximorphic features at a depth of 18 to 30 inches.
R056BY096MN	**Subirrigated Sands** This site occurs lower on the landscape. It has redoximorphic features at a depth of 30 to 40 inches. The subsoil does not form a ribbon.
R056BY104MN	**Choppy Sands** This site occurs on dunes with slopes >15 percent. The surface and subsoil layers do not form a ribbon.

Similar sites

R056BY104MN	**Choppy Sands** This site occurs on dunes with slopes >15 percent. The surface and subsoil layers do not form a ribbon.
R056BY096MN	**Subirrigated Sands** This site occurs lower on the landscape. It has redoximorphic features at a depth of 30 to 40 inches. The subsoil does not form a ribbon.
R056BY091MN	**Sandy** This site occurs on similar landscape positions. It has fine sandy loam or sandy loam textures (forms a ribbon <1 inch long) to a depth >10 inches.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Calamovilfa longifolia*

Physiographic features

This site occurs on uplands on beach ridge and beach landforms.

Table 2. Representative physiographic features

Landforms	(1) Beach (2) Beach ridge
Runoff class	Negligible to medium
Flooding frequency	None
Ponding frequency	None
Elevation	750–1,480 ft
Slope	0–30%
Ponding depth	0 in
Water table depth	30–80 in
Aspect	Aspect is not a significant factor

Climatic features

About 70 percent of the rainfall comes from high-intensity, convective thunderstorms during the growing season. Winter precipitation accounts for about 15 percent of the annual precipitation.

Table 3. Representative climatic features

Frost-free period (characteristic range)	103-108 days
Freeze-free period (characteristic range)	133-136 days
Precipitation total (characteristic range)	22-23 in
Frost-free period (actual range)	102-110 days
Freeze-free period (actual range)	132-137 days
Precipitation total (actual range)	22-24 in
Frost-free period (average)	106 days
Freeze-free period (average)	135 days
Precipitation total (average)	23 in

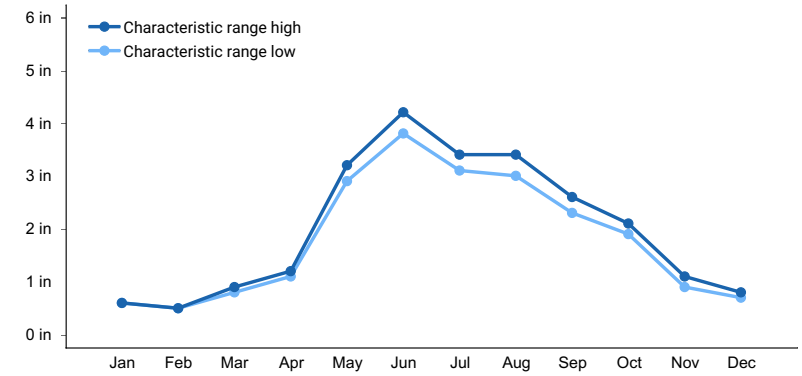


Figure 1. Monthly precipitation range

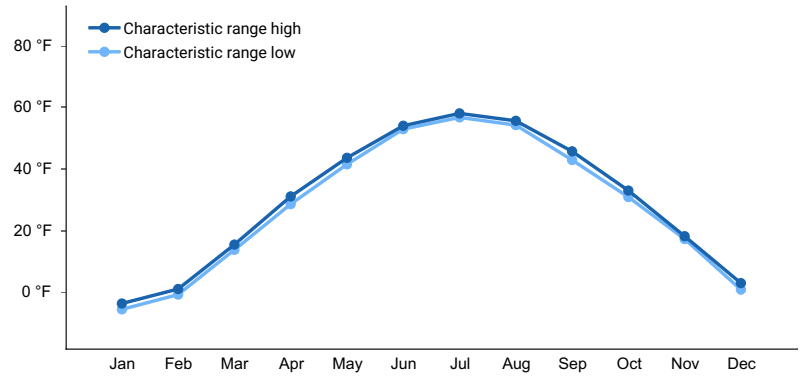


Figure 2. Monthly minimum temperature range

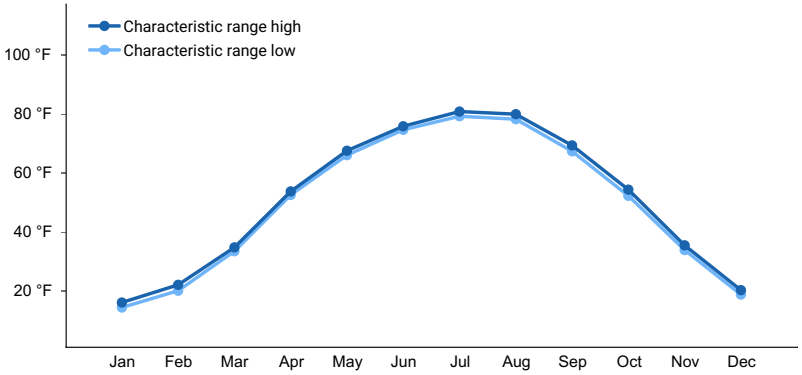


Figure 3. Monthly maximum temperature range

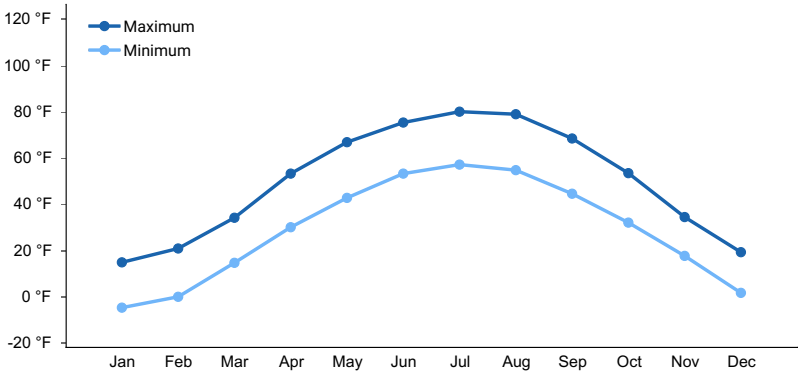


Figure 4. Monthly average minimum and maximum temperature

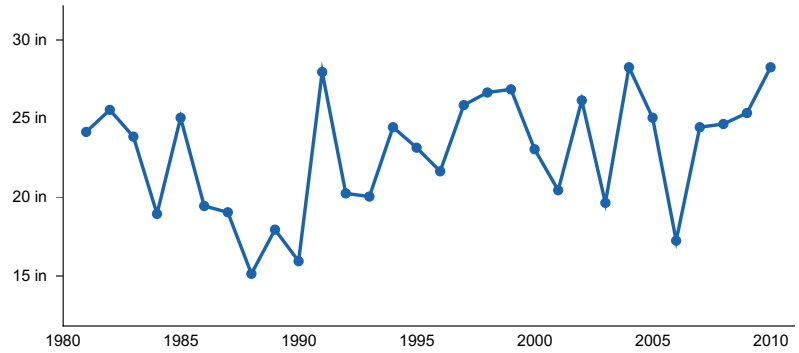


Figure 5. Annual precipitation pattern

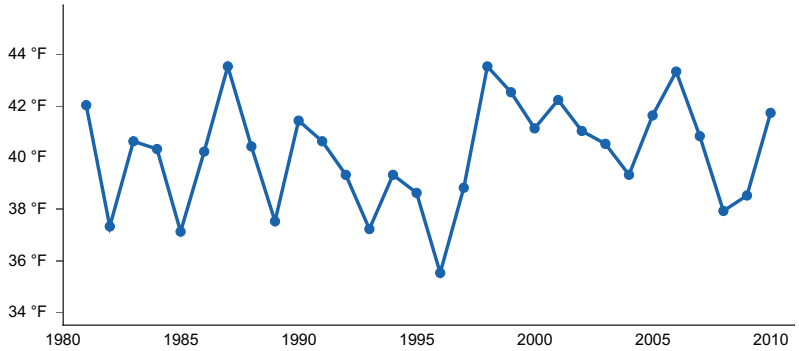


Figure 6. Annual average temperature pattern

Climate stations used

- (1) GOODRIDGE 12 NNW [USW00004994], Grygla, MN
- (2) AGASSIZ REFUGE [USC00210050], Grygla, MN
- (3) RED LAKE FALLS [USC00216787], Red Lake Falls, MN
- (4) CROOKSTON NW EXP STN [USC00211891], Crookston, MN
- (5) HALLOCK [USC00213455], Hallock, MN

Influencing water features

This site does not receive significant additional water, either as runoff from adjacent slopes or from a seasonal high water table. Depth to the water table exceeds 3.5 feet in the spring and commonly exceeds 6 feet in the summer months. Surface infiltration is rapid. Saturated hydraulic conductivity is high in the sandy materials. Water loss is through percolation below the root zone and through evapotranspiration.

Wetland description

Not applicable.

Soil features

Soils associated with Sands ES are in the Mollisol and Entisol orders. These soils were developed under prairie vegetation. The soils are very deep. They are moderately well drained to well drained. The surface layer is most commonly loamy fine sand or loamy sand.

Major soil series correlated to the Sands site are: Hecla, Radium, Sandberg, Maddock, and Serden.

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) Glaciolacustrine deposits (2) Glaciofluvial deposits (3) Eolian sands (4) Beach sand
Surface texture	(1) Loamy fine sand (2) Loamy sand
Family particle size	(1) Sandy
Drainage class	Well drained to moderately well drained
Permeability class	Rapid
Depth to restrictive layer	80 in
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	1.8–3.6 in
Soil reaction (1:1 water) (0-40in)	6.1–7.8
Subsurface fragment volume <=3" (0-40in)	0–16%
Subsurface fragment volume >3" (0-40in)	0–1%

Ecological dynamics

The site developed under Northern Great Plains climatic conditions, and included natural influence of large herding herbivores and frequent fire. Changes will occur in the plant communities due to weather fluctuations and/or management actions. Under adverse impacts, a slow decline in vegetative vigor and composition will occur. Under favorable conditions the site has the potential to resemble the reference state. Interpretations for this site are based on the Prairie Sandreed/Porcupinegrass/Bluestem Plant Community Phase (1.1). The Reference State has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts also have been considered. Community phases, community pathways, states, transitions, thresholds and restoration pathways have been determined through similar studies and experience.

The natural disturbance regime consisted of frequent fires caused both by natural and Native American ignition sources. These fires occurred during any season of the year, but were concentrated in the spring and late summer or early fall. Lightening fires occurred most frequently in July and August while fires started by Native Americans occurred in April, September and October. Large ungulate grazing was heavy and occurred often, but usually for short durations. Grazing may have been severe when occurring after a fire event. The grazing and fire interaction especially when coupled with drought events, set up the dynamics discussed and displayed in the following state and transition diagram and descriptions.

This ecological site has been grazed by domestic livestock since introduced into the area. The introduction of domestic livestock, elimination of fire, and the use of fencing and reliable water sources have radically changed the disturbance regime of this site. Heavy continuous grazing and/or continuous seasonal (spring) grazing, without adequate recovery periods following each grazing occurrence causes this site to depart from the reference plant community. Blue grama and Kentucky bluegrass if present, will begin to increase. Needleandthread will increase initially and then begin to decrease. Porcupine grass and Bluestems will decrease in frequency and production. In time, heavy continuous grazing will likely cause upland sedges and blue grama and/or Kentucky bluegrass if present to dominate and pioneer perennials and annuals to increase. The resulting plant community is relatively stable and competitive advantage prevents other species from establishing. Extended periods of non-use and/or

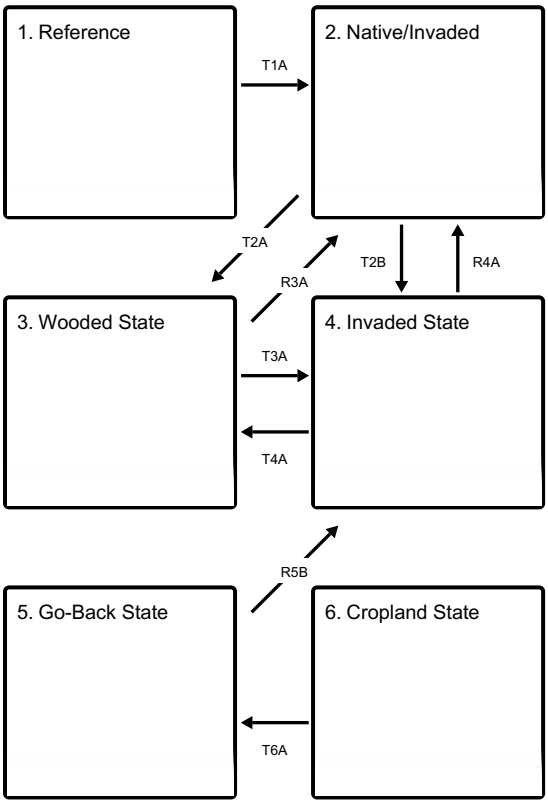
lack of fire will result in a plant community having high litter levels, which favors an increase in shrubs, trees, and a reduction in warm-season grasses with a corresponding increase in Kentucky bluegrass and/or smooth bromegrass. Shrubs such as western snowberry increase in this situation, especially in areas prone to snow accumulation and drift.

Due to a general invasion of exotic species (such as Kentucky bluegrass and smooth bromegrass) across the MLRA within his site, returning to the 1.1 Prairie Sandreed/Porcupine Grass/Bluestem Plant Community Phase may not be possible. Today, the 2.1 Prairie Sandreed/Porcupine Grass/Bluestem Plant Community Phases most resembles the 1.1 Reference Plant Community Phase in appearance and function.

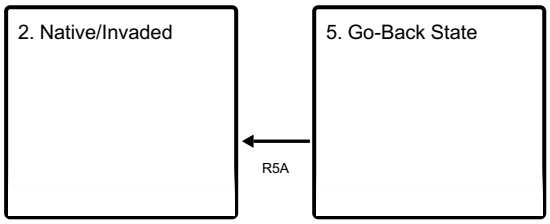
Following the state and transition diagram are narratives for each of the described states and community phases. These may not represent every possibility, but they are the most prevalent and repeatable states/community phases. The plant composition tables shown below have been developed from the best available knowledge at the time of this revision. As more data are collected, some of these community phases and/or states may be revised or removed, and new ones may be added. The main purpose for including the descriptions here is to capture the current knowledge and experience at the time of this revision.

State and transition model

Ecosystem states



States 2 and 5 (additional transitions)



T1A - Introduction of exotic species

T2B - Light grazing, heavy season-long grazing, or no use and no fire

R3A - Brush control and perhaps range planting

T3A - Brush control

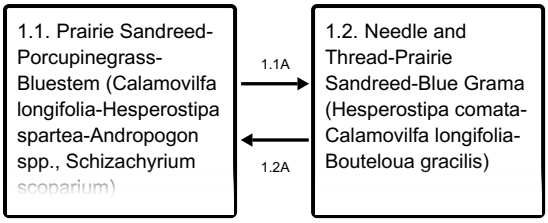
R4A - Prescribed grazing and prescribed burning

T4A - No use, no fire or light grazing

R5A - Successful range planting

R5B - Failed range planting

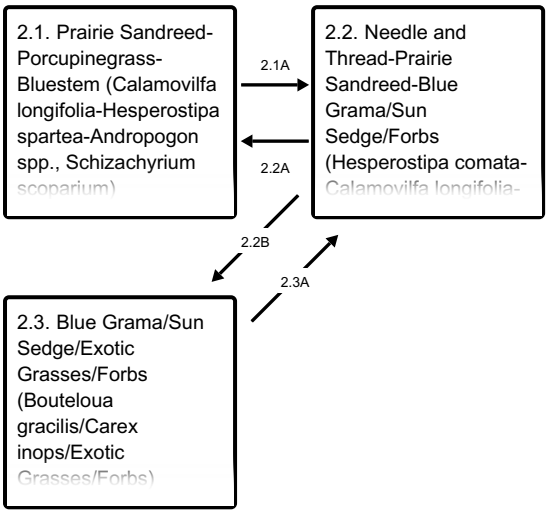
State 1 submodel, plant communities



1.1A - Periods of below average precipitation and increased disturbance

1.2A - Return to average precipitation and disturbance regime

State 2 submodel, plant communities



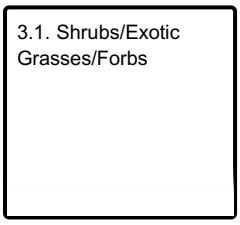
2.1A - Heavy season-long grazing

2.2A - Prescribed grazing, prescribed burning

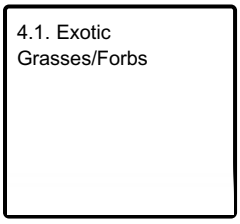
2.2B - Heavy season-long grazing

2.3A - Prescribed grazing and prescribed burning

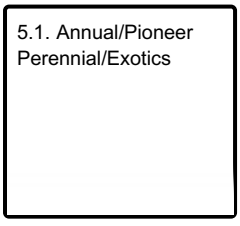
State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities



State 1
Reference

This state represented the natural range of variability that dominated the dynamics of this ecological site. This state was dominated by warm- and cool-season grasses. 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. Mid and tall stature grass species declined and a corresponding increase in short stature warm-season grasses and cool-season grass-like species would have occurred during periods of prolonged drought and/or excessive disturbance . Slight shifts would have occurred in the timing of energy capture, hydrologic function and nutrient cycling between plant community phases within State 1. High basal density, minimal bare ground, and deep root systems resulted in low runoff rates and high infiltration. Overall, the ecological processes were functioning near optimum levels.

Dominant plant species

- prairie sandreed (*Calamovilfa longifolia*), grass
- needle and thread (*Hesperostipa comata*), grass
- bluestem (*Andropogon*), grass
- blue grama (*Bouteloua gracilis*), grass

Community 1.1
Prairie Sandreed-Porcupinegrass-Bluestem (Calamovilfa longifolia-Hesperostipa spartea-Andropogon spp., Schizachyrium scoparium)

This community phase was historically the most dominant both temporally and spatially. The major grasses and sedges included prairie sandreed, porcupinegrass, sand bluestem, and big bluestem. Other associated grasses included needle and thread, little bluestem, sideoats grama, and sand dropseed. Common forbs included Cuman ragweed, field sagewort, white sagebrush, milkweed, field chickweed, Canada horseweed, and purple prairie clover. Leadplant, western sandcherry, prairie sagewort, and prairie rose were common shrubs. Annual production likely varied from about 1800-3200 pounds per acre with grasses and grass-likes, forbs, and shrubs contributing about 85%, 10%, and 5% respectively. Because both warm-season and cool-season grasses were well represented in the community, production would have been 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	1650	2327	2790
Forb	125	195	275
Shrub/Vine	25	78	135
Total	**1800**	**2600**	**3200**

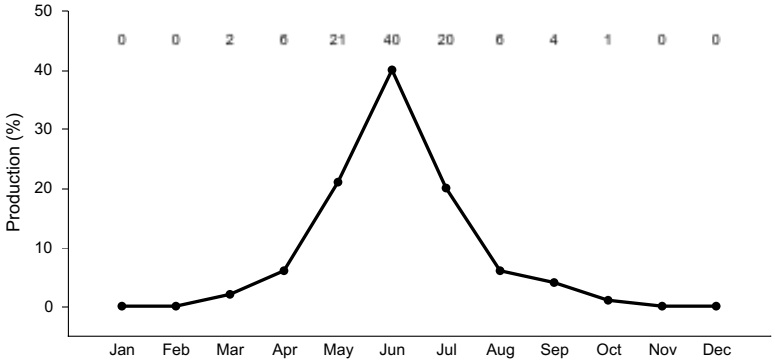


Figure 8. Plant community growth curve (percent production by month). ND5603, Red River Valley of the North, warm-season/cool-season co-dominant.. Cool-season, warm-season co-dominant..

Community 1.2
Needle and Thread-Prairie Sandreed-Blue Grama (Hesperostipa comata-Calamovilfa longifolia-Bouteloua gracilis)

This plant community resulted from periods of below average precipitation with increased disturbance such as heavy, frequent grazing over a period of several years and/or several consecutive years of below average precipitation. This increase in grazing pressure may have resulted from proximity to a water source, changes in fire frequency and/or prolonged drought. Compared to Community Phase 1.1 needle and thread would have displaced porcupinegrass to become the dominant needlegrass while blue grama, sand dropseed, and sedges would have also increased. Prairie sandreed and the bluestems would have decreased. Forb species such as field sagewort, goldenrod, Cuman ragweed, and common yarrow would have increased. Annual production would have been somewhat reduced compared to Community Phase 1.1.

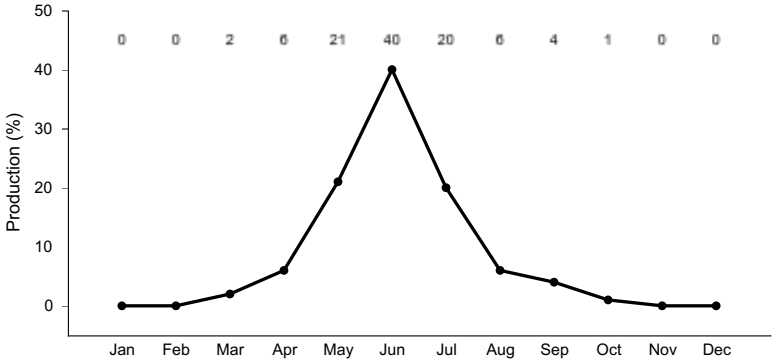


Figure 9. Plant community growth curve (percent production by month). ND5603, Red River Valley of the North, warm-season/cool-season co-dominant.. Cool-season, warm-season co-dominant..

Pathway 1.1A
Community 1.1 to 1.2

Community Phase Pathway 1.1 to 1.2 occurred during periods of below average precipitation with increased disturbance resulting in an increase of needle and thread and blue grama with a corresponding decrease in bluestems and porcupinegrass.

Pathway 1.2A
Community 1.2 to 1.1

Community Phase Pathway 1.2 to 1.1 occurred upon the return to average precipitation and disturbance regime, which allowed for the recovery of the bluestems, porcupinegrass and prairie sandreed.

State 2
Native/Invaded

This state is similar to State 1: Reference State but has now been colonized by the exotic cool-season grasses, commonly Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass which are now present in small amounts. Although the state is still dominated by native grasses, an increase in these exotic cool-season grasses can be expected. 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. These exotic cool-season grasses have been particularly and consistently invasive under extended periods of no use and no fire. 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. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 4: Invaded State should be expected. Annual production of this state can be quite variable, in large part due to the amount of exotic cool-season grasses. However, annual production may be similar to that of State 1: Reference State (i.e. 1800-

3200 pounds per acre).

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.

Dominant plant species

- prairie rose (*Rosa arkansana*), shrub
- prairie sagewort (*Artemisia frigida*), shrub
- prairie sandreed (*Calamovilfa longifolia*), grass
- porcupinegrass (*Hesperostipa spartea*), grass
- sand bluestem (*Andropogon hallii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- smooth brome (*Bromus inermis*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- goldenrod (*Solidago*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- sun sedge (*Carex inops ssp. heliophila*), other herbaceous
- field sagewort (*Artemisia campestris*), other herbaceous
- yellow salsify (*Tragopogon dubius*), other herbaceous

Community 2.1
Prairie Sandreed-Porcupinegrass-Bluestem (Calamovilfa longifolia-Hesperostipa spartea-Andropogon spp., Schizachyrium scoparium)

This Community Phase is similar to Community Phase 1.1 but has been colonized by exotic cool-season grasses, often Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass. However, these exotics are present in smaller amounts with the community still dominated by native grasses. Annual production is in the range of 1800-3200 pounds per acre. Grazing systems that allow for adequate recovery periods following grazing events and, potentially, the combination of prescribed grazing and prescribed burning which closely mimics the natural disturbance regime will help maintain this community phase.

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	1650	2237	2790
Forb	125	195	275
Shrub/Vine	21	78	135
Total	**1796**	**2510**	**3200**

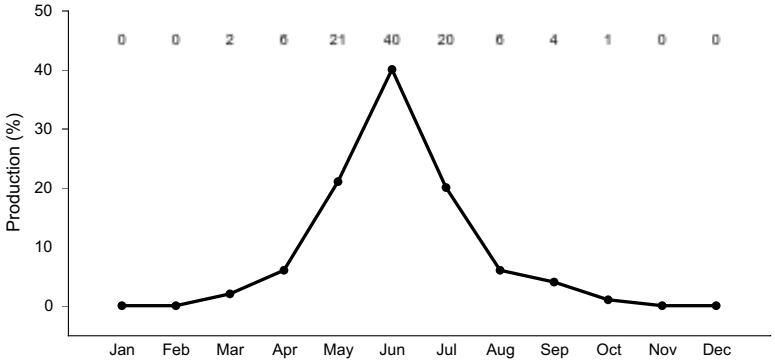


Figure 11. Plant community growth curve (percent production by month). ND5603, Red River Valley of the North, warm-season/cool-season co-dominant.. Cool-season, warm-season co-dominant..

Community 2.2
Needle and Thread-Prairie Sandreed-Blue Grama/Sun Sedge/Forbs (Hesperostipa comata-Calamovilfa longifolia-Bouteloua gracilis/Carex inops/Forbs)

This plant community phase is characterized by a decline in porcupinegrass, sand bluestem, and a corresponding increase in the more grazing tolerant needle and thread, sand dropseed, sedges and Kentucky bluegrass. Forbs such as common yarrow, goldenrod, field sagewort, and white sagebrush will increase while the leguminous forbs may decrease. The shrub component remains similar, however, prairie sagewort may increase.

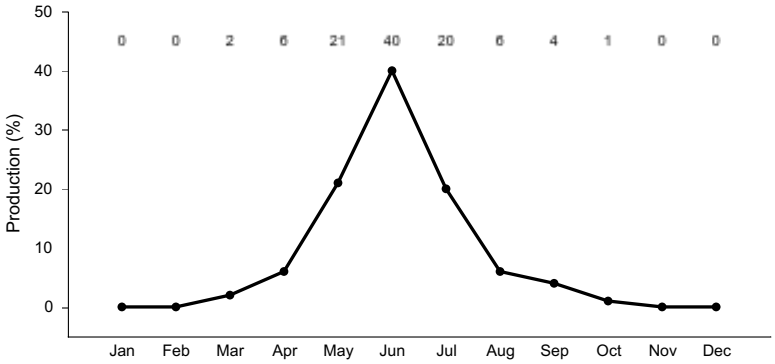


Figure 12. Plant community growth curve (percent production by month). ND5603, Red River Valley of the North, warm-season/cool-season co-dominant.. Cool-season, warm-season co-dominant..

Community 2.3
Blue Grama/Sun Sedge/Exotic Grasses/Forbs (Bouteloua gracilis/Carex inops/Exotic Grasses/Forbs)

This community phase results from heavy season-long grazing over a period of several years. Blue grama becomes the dominant grass with lesser amounts of upland sedges and Kentucky bluegrass. Grazing tolerant forbs also increase. The needlegrasses and tall statured warm-season grasses are likely still present but may not be readily observable. Conspicuous forbs often include goldenrod, field sagewort, yellow salsify, white heath aster, common yarrow, and Cuman ragweed. Prairie sagewort and prairie rose are the principal shrubs. This Community Phase is approaching the threshold leading to a transition to State 4: Invaded State. As a result, it is an “at risk” community. If management does not include measures to control or reduce these exotic cool-season grasses, the transition to State 4: Invaded State should be expected.

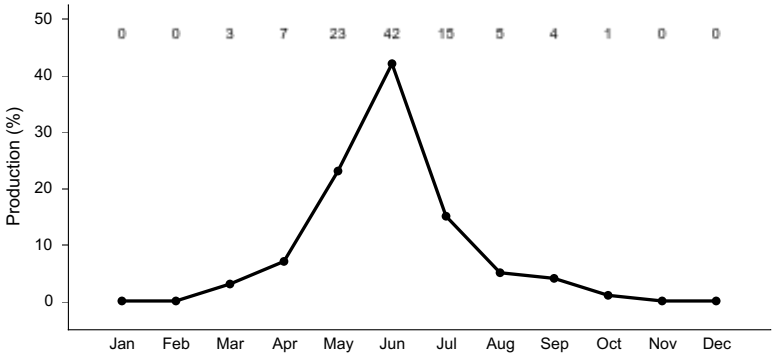


Figure 13. Plant community growth curve (percent production by month). ND5602, Red River Valley of the North, cool-season dominant, warm-season sub-dominant.. Cool-season dominant, warm-season sub-dominant..

Pathway 2.1A
Community 2.1 to 2.2

Community Phase Pathway 2.1 to 2.2 occurs during periods of heavy season-long grazing which causes a shift from dominance of prairie sandreed and porcupinegrass to more grazing tolerant needle and thread, blue grama, sun sedge, and minor amounts of Kentucky Bluegrass.

Pathway 2.2A
Community 2.2 to 2.1

Community Phase Pathway 2.2 to 2.1 is initiated with the implementation of prescribed grazing and prescribed burning. If properly implemented, this will shift the competitive advantage away from the exotic cool-season species to the mid statured bunchgrasses and tall statured rhizomatous grasses. Properly timed prescribed burning may expedite this shift.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 2.2B
Community 2.2 to 2.3

Community Phase Pathway 2.2 to 2.3 occurs during periods heavy season-long grazing, leading to a marked increase short statured grasses and sedges (i.e. blue grama, sun sedge) with a corresponding decrease prairie sandreed and the needlegrasses.

Pathway 2.3A
Community 2.3 to 2.2

This community phase pathway 2.3 to 2.2 is initiated by implementation of prescribed grazing and prescribed burning. If properly implemented, this will shift the competitive advantage from the exotic cool-season species to the remnant native cool-season bunchgrass species and tall statured warm-season grasses. Kentucky bluegrass will remain in this community at varying amounts depending on the level of management. Caution should be exercised when initiating this restoration pathway to ensure that management actions do not favor Kentucky bluegrass resulting in unexpectedly crossing the threshold to State 4: Invaded State.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 3
Wooded State

This state historically existed as small patches of shrubs (e.g. smooth sumac, western snowberry, chokecherry, and/or wild rose) scattered across the site, particularly where these shrubs could have encroached onto the site vegetatively (e.g. rhizomes, root sprouts) or by seed from nearby woody vegetation.

Dominant plant species

- smooth sumac (*Rhus glabra*), shrub
- chokecherry (*Prunus virginiana*), shrub
- western snowberry (*Symphoricarpos occidentalis*), shrub
- prairie rose (*Rosa arkansana*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- sand dropseed (*Sporobolus cryptandrus*), grass
- goldenrod (*Solidago*), other herbaceous
- field sagewort (*Artemisia campestris*), other herbaceous

Community 3.1
Shrubs/Exotic Grasses/Forbs

This Community Phase is results from no use and no fire, or light grazing particularly during times of above average precipitation. Common woody species often include smooth sumac, western snowberry, chokecherry, and wild rose. A marked increase in non-use management and active fire suppression since European influence has enabled this state to expand and become more widespread. Exotic cool-season grasses such as Kentucky bluegrass generally increase along with woody species.

State 4
Invaded State

This state is the result of invasion and dominance by exotic cool-season grasses, commonly Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass. The exotic leafy spurge and Canada thistle are also known to invade the site. The exotic cool-season grasses can be quite invasive on the site and are particularly well adapted to heavy grazing. They 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, however, show marked increases. Once the state is well established, prescribed burning and grazing techniques have been largely ineffective in suppressing or eliminating these three 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. However, annual production may be in the range of 2800-3800 pounds per acre with the exotic cool-season grasses contributing the bulk of the production.

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.

Dominant plant species

- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- leafy spurge (*Euphorbia esula*), other herbaceous

- Canada thistle (*Cirsium arvense*), other herbaceous
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous
- white sagebrush (*Artemisia ludoviciana*), other herbaceous

Community 4.1
Exotic Grasses/Forbs

This community phase is typically dominated by exotic grasses, often Kentucky bluegrass, but perhaps smooth brome, crested wheatgrass, and/or quackgrass. Exotic forbs such as leafy spurge or Canada thistle may also be present. Grazing tolerant native forbs such as white sagebrush, Cuman ragweed, and common yarrow are often noticeably present. Left untreated, leafy spurge will continue to increase, reducing the remnant native grasses and eventually reducing the Kentucky bluegrass. The longer this community phase exists, the more resilient it becomes. Natural or management disturbances that reduce the cover of Kentucky bluegrass are short-lived.

State 5
Go-Back State

Dominant plant species

- bristlegrass (*Setaria*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- smooth brome (*Bromus inermis*), grass
- leafy spurge (*Euphorbia esula*), other herbaceous
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous
- horseweed (*Conyza*), other herbaceous
- golden tickseed (*Coreopsis tinctoria*), other herbaceous

Community 5.1
Annual/Pioneer Perennial/Exotics

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 needing control. Over time, however, the exotic cool-season grasses Kentucky bluegrass, smooth brome, crested wheatgrass, and/or quackgrass will likely predominate.

State 6
Cropland State

Cropland State results from planting and production of annual crops. This plant community is most commonly associated with cropped fields. Soil conditions can be quite variable on the site, in part due to variations in the management/cropping history (e.g. development of tillage induced compaction, erosion, fertility, herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques..

Dominant plant species

- corn (*Zea*), other herbaceous
- soybean (*Glycine*), other herbaceous

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, crested wheatgrass, and/or quackgrass. This transition was probably inevitable and corresponded to a decline in native warm-season and cool-season grasses. This transition 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 bromegrass, crested wheatgrass, quackgrass, or

other exotic species became established on the site.

Constraints to recovery. (i.e. variables or processes that preclude recovery of the former state). Current knowledge and technology will not facilitate a successful restoration to Reference State.

Transition T2A
State 2 to 3

This transition from the State 2: Native/Invaded to State 3: Wooded State generally occurs during periods of no use and no fire, light grazing, and extended periods of above average precipitation, particularly when an abundant shrub component is present. It has also become more frequent following European settlement when the historic fire regime was markedly reduced.

Context dependence. No use and no fire or light grazing, long-term above average precipitation

Transition T2B
State 2 to 4

This transition from the State 2: Native/Invaded State to State 4: Invaded State generally occurs with light grazing, heavy season-long grazing, or periods of non-use especially when the shrub component is sparse. Exotic cool-season grasses such as Kentucky bluegrass and/or smooth brome often become the dominant graminoids. Studies indicate that a threshold may exist in this transition when Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition. Similar thresholds may exist for other exotic cool-season grasses.

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. The opportunity for high intensity spring burns (which can serve to reduce the introduced cool-season species) is severely reduced by early green-up and the lack of fuel.

Restoration pathway R3A
State 3 to 2

This restoration pathway from State 3: Wooded State to State 2: Native/Invaded State can be accomplished with brush control. However, depending upon level of remnant native grasses and forbs, a range planting may also be necessary to re-establish the herbaceous plant community, thus completing the restoration. A combination of brush control methods may be necessary (e.g. chemical, mechanical, prescribed burning). However, initially, low fuel loads may preclude the application of prescribed burns. As a result, herbicides and/or mechanical brush control may be necessary to initiate the restoration effort. Subsequently, several prescribed burns may be needed at relatively short intervals, in part because many of the shrubs sprout profusely following one burn. If a range planting is necessary, 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 planting methods using adapted varieties of the dominant native grasses are possible and can be successful.

Context dependence. 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 fuel type (herbaceous vs. shrub vs. tree), fine fuel amount and orientation ; (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 woody and exotic species while favoring native species (both cool- and warm-season grasses). The method of brush management will be site specific, 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. 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. Some evidence suggests the addition of exotic legumes to the seeding mixture may favor exotic cool-season grass expansion/invasion.

Transition T3A
State 3 to 4

This transition from State 3: Wooded State to State 4: Invaded State can be accomplished with brush control. Initial use of herbicides and/or mechanical brush control to reduce smooth sumac and other shrubs may be necessary to increase fine fuel loads to enable the application of prescribed burning to further control sprouting shrubs species.

Restoration pathway R4A
State 4 to 2

This restoration pathway from State 4: Invaded State to State 2: Native/Invaded State may be accomplished with the implementation of long-term prescribed grazing and prescribed burning, assuming there is an adequate component of native grasses to respond to the treatments. Both prescribed grazing and prescribed burning are likely necessary to successfully initiate this restoration pathway, the success of which depends upon the presence of a remnant population of native grasses in Community Phase 4.1. That remnant population, however, may not be readily apparent without close inspection. The application of several prescribed burns may be needed at relatively short intervals in the early phases of this restoration process, in part because many of the shrubs (e.g. western snowberry) sprout profusely following one burn. Early season prescribed burns have been successful; however, fall burning may also be an effective technique. The prescribed grazing should include 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 grasses to the native cool-season grasses.

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). 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.

Transition T4A
State 4 to 3

This transition from State 4: Invaded State to State 3: Wooded State occurs during periods of no use and no fire, or light grazing. It frequently occurs when the site is in close proximity to wooded areas where the shrubs may encroach vegetatively upon the site and/or serve as a seed source for these species to colonize the site. It has also become more frequent following European settlement when the historic fire regime was markedly reduced.

Restoration pathway R5A
State 5 to 2

This Restoration Pathway from State 5: Go-Back State to the State 2: Native/Invaded State can be accomplished with a successful range planting. Following planting, 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 planting 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 4

A failed range planting and/or secondary succession will lead to State 4: 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), improper management.

Transition T6A
State 6 to 5

This is the 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 tillage induced compaction, erosion, fertility, herbicide/pesticide carryover). Thus, soil conditions should be assessed when considering restoration techniques.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			780–1170	
	sand bluestem	ANHA	*Andropogon hallii*	260–520	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	130–390	–
	big bluestem	ANGE	*Andropogon gerardii*	130–260	–
2	**Mid Cool-Season Bunchgrasses**			390–650	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	130–390	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	26–78	–
	Canada wildrye	ELCA4	*Elymus canadensis*	26–52	–
3	**Mid Warm-Season Grasses**			130–390	
	sideoats grama	BOCU	*Bouteloua curtipendula*	130–260	–

	sideoats grama	BOCU	*Bouteloua curtipendula*	130–260	–
	little bluestem	SCSC	*Schizachyrium scoparium*	130–260	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	26–130	–
4	**Short Warm-Season Grasses**			26–130	
	blue grama	BOGR2	*Bouteloua gracilis*	26–130	–
5	**Other Native Grasses**			26–130	
	Grass, perennial	2GP	*Grass, perennial*	0–130	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	26–130	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–78	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–78	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–78	–
6	**Grass-likes**			130–260	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–130	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	26–130	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	26–78	–
	sedge	CAREX	*Carex*	0–78	–
	Schweinitz's flatsedge	CYSC3	*Cyperus schweinitzii*	0–26	–
Forb					
7	**Forbs**			130–260	
	Forb, native	2FN	*Forb, native*	26–130	–
	western wallflower	ERAS2	*Erysimum asperum*	26–52	–
	hairy false goldenaster	HEVIV	*Heterotheca villosa var. villosa*	26–52	–
	hoary puccoon	LICA12	*Lithospermum canescens*	26–52	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	26–52	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	26–52	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	26–52	–
	field sagewort	ARCA12	*Artemisia campestris*	26–52	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	26–52	–
	milkweed	ASCLE	*Asclepias*	26–52	–
	field chickweed	CEAR4	*Cerastium arvense*	26–52	–
	Canadian horseweed	COCAC3	*Conyza canadensis var. canadensis*	26–52	–
	purple prairie clover	DAPU5	*Dalea purpurea*	26–52	–
	silky prairie clover	DAVI	*Dalea villosa*	26–52	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	26–52	–
	large beardtongue	PEGR7	*Penstemon grandiflorus*	26–52	–
	lilac penstemon	PEGRG3	*Penstemon gracilis var. gracilis*	26–52	–
	prairie groundcherry	PHHI8	*Physalis hispida*	26–52	–
	white heath aster	SYER	*Symphyotrichum ericoides*	26–52	–
	prairie spiderwort	TROCO	*Tradescantia occidentalis var. occidentalis*	26–52	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	26–52	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	26–52	–

	dotted blazing star	LIPU	*Liatris punctata*	26–52	–
	gray goldenrod	SONE	*Solidago nemoralis*	0–26	–
	hoary verbena	VEST	*Verbena stricta*	0–26	–
	prairie violet	VIPE2	*Viola pedatifida*	0–26	–
	cinquefoil	POTEN	*Potentilla*	0–26	–
	primrose	PRIMU	*Primula*	0–26	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–26	–
	thymeleaf sandmat	CHSE6	*Chamaesyce serpyllifolia*	0–26	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–26	–
	heartleaf four o'clock	MINY	*Mirabilis nyctaginea*	0–26	–
	flat-top goldentop	EUGR5	*Euthamia graminifolia*	0–26	–
	onion	ALLIU	*Allium*	0–26	–
Shrub/Vine					
8	**Shrubs**			26–130	
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	26–78	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	26–78	–
	leadplant	AMCA6	*Amorpha canescens*	26–78	–
	prairie sagewort	ARFR4	*Artemisia frigida*	26–52	–
	prairie rose	ROAR3	*Rosa arkansana*	26–52	–
	white meadowsweet	SPAL2	*Spiraea alba*	0–52	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	26–52	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–26	–

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			780–1170	
	sand bluestem	ANHA	*Andropogon hallii*	260–520	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	130–390	–
	big bluestem	ANGE	*Andropogon gerardii*	130–260	–
2	**Mid Cool-Season Bunchgrasses**			390–650	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	130–390	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	26–78	–
	Canada wildrye	ELCA4	*Elymus canadensis*	26–52	–
3	**Mid Warm-Season Grasses**			130–390	
	sideoats grama	BOCU	*Bouteloua curtipendula*	130–260	–
	little bluestem	SCSC	*Schizachyrium scoparium*	130–260	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	26–130	–
4	**Short Warm-Season Grasses**			26–130	
	blue grama	BOGR2	*Bouteloua gracilis*	26–130	–
5	**Other Native Grasses**			26–130	
	Grass, perennial	2GP	*Grass, perennial*	0–130	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	26–130	–

	western wheatgrass	PASM	*Pascopyrum smithii*	0–78	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–78	–
	Canada wildrye	ELCA4	*Elymus canadensis*	0–78	–
6	**Grass-likes**			130–260	
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	26–130	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–130	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	26–78	–
	sedge	CAREX	*Carex*	0–78	–
	leafless swallow-wort	CYSC5	*Cynanchum scoparium*	0–26	–
7	**Exotic Cool-Season Grasses**			26–130	
	Kentucky bluegrass	POPR	*Poa pratensis*	0–130	–
	smooth brome	BRIN2	*Bromus inermis*	0–130	–
Forb					
8	**Forbs**			130–260	
	Forb, native	2FN	*Forb, native*	26–130	–
	western wallflower	ERAS2	*Erysimum asperum*	26–52	–
	hairy false goldenaster	HEVIV	*Heterotheca villosa var. villosa*	26–52	–
	dotted blazing star	LIPU	*Liatris punctata*	26–52	–
	hoary puccoon	LICA12	*Lithospermum canescens*	26–52	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	26–52	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	26–52	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	26–52	–
	field sagewort	ARCA12	*Artemisia campestris*	26–52	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	26–52	–
	milkweed	ASCLE	*Asclepias*	26–52	–
	field chickweed	CEAR4	*Cerastium arvense*	26–52	–
	Canadian horseweed	COCAC3	*Conyza canadensis var. canadensis*	26–52	–
	purple prairie clover	DAPU5	*Dalea purpurea*	26–52	–
	silky prairie clover	DAVI	*Dalea villosa*	26–52	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	26–52	–
	large beardtongue	PEGR7	*Penstemon grandiflorus*	26–52	–
	lilac penstemon	PEGRG3	*Penstemon gracilis var. gracilis*	26–52	–
	white heath aster	SYER	*Symphyotrichum ericoides*	26–52	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	26–52	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	26–52	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	26–52	–
	groundcherry	PHYSA	*Physalis*	26–52	–
	gray goldenrod	SONE	*Solidago nemoralis*	0–26	–
	hoary verbena	VEST	*Verbena stricta*	0–26	–
	prairie violet	VIPE2	*Viola pedatifida*	0–26	–
	cinquefoil	POTEN	*Potentilla*	0–26	–
	primrose	PRIMU	*Primula*	0–26	

	primrose	PRIMU	*Primula*	0–26	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–26	–
	thymeleaf sandmat	CHSE6	*Chamaesyce serpyllifolia*	0–26	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–26	–
	heartleaf four o'clock	MINY	*Mirabilis nyctaginea*	0–26	–
	flat-top goldentop	EUGR5	*Euthamia graminifolia*	0–26	–
	onion	ALLIU	*Allium*	0–26	–
9	**Exotic Forbs**			26–130	
	leafy spurge	EUES	*Euphorbia esula*	0–130	–
	Canada thistle	CIAR4	*Cirsium arvense*	0–130	–
Shrub/Vine					
10	**Shrubs**			26–130	
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	26–78	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	26–78	–
	leadplant	AMCA6	*Amorpha canescens*	26–78	–
	prairie sagewort	ARFR4	*Artemisia frigida*	26–52	–
	rose	ROSA5	*Rosa*	26–52	–
	white meadowsweet	SPAL2	*Spiraea alba*	0–52	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	26–52	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–26	–

Inventory data references

This is a provisional ecological site, and as such no field plots were inventoried for this project. MLRA 56 was split into 2 MLRAs 56A and 56B with Agricultural Handbook 296 (2022). All information was taken from original MLRA 56 ecological site descriptions in which MLRA 56B was part of. Future field verification is needed to refine the plant communities and ecological dynamics described in this ecological site description.

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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)	
Contact for lead author	
Date	09/27/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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

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

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

---

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

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

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

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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

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

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**