USDA Natural Resources Conservation Service

Ecological site R056AY090ND
Sands

Accessed: 05/07/2024

General information

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

Figure 1. Mapped extent

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

Classification relationships

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

Associated sites

R056AY087ND	**Limy Subirrigated**
R056AY091ND	**Sandy**
R056AY095ND	**Subirrigated**
R056AY096ND	**Subirrigated Sands**
R056AY104ND	**Choppy Sands**

Similar sites

R056AY104ND	**Choppy Sands**
R056AY096ND	**Subirrigated Sands**
R056AY091ND	**Sandy**

Table 1. Dominant plant species

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

Physiographic features

This site typically occurs on nearly level to steep uplands.

Table 2. Representative physiographic features

Landforms	(1) Dune (2) Moraine (3) Stream terrace

Flooding frequency	None
Ponding frequency	None
Elevation	198–305 m
Slope	0–45%
Water table depth	152 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 56 is considered to have a continental climate – cold winters and relatively hot summers, low to moderate humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 18 to 23 inches per year. The average annual temperature is about 40°F. January is the coldest month with average temperatures ranging from about 1°F (Pembina, North Dakota (ND)) to about 11°F (Wheaton, Minnesota (MN)). July is the warmest month with temperatures averaging from about 68°F (Pembina, ND) to about 73°F (Wheaton, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 65°F. This large annual range attests to the continental nature of this area's climate. Winds are estimated to average about 13 miles per hour annually, ranging from about 15 miles per hour during the spring to about 11 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of cool season plants begins in early to mid March, slowing or ceasing in late June. Warm season plants begin growth about mid May and continue to early or mid September. Green up of cool season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (average)	143 days
Freeze-free period (average)	162 days
Precipitation total (average)	584 mm

Influencing water features

No significant water features influence this site.

Soil features

These are very deep, well to excessively drained, coarse textured soils. Saturated hydraulic conductivity is rapid to very rapid and available water capacity is moderate to very low. Salinity and sodicity are absent. Soils on this site are highly susceptible to wind erosion. This site is on nearly level to steep outwash plains, terraces, flood plains, lake plains and delta plains. Slope ranges from 0 to 45 percent. This site should show slight to no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are not observable except on steeper slopes where they may be short, broken, irregular in appearance and discontinuous. The soil surface is stable and intact.

These soils are susceptible to water and wind erosion. Loss of the soil surface layer can result in a shift in species composition and/or production.

Major soil series correlated to this ecological site can be found in Section II of the Natural Resources Conservation Service Field Office Technical Guide or the following web site:
http://www.nrcs.usda.gov/technical/efotg/

Table 4. Representative soil features

Surface texture	(1) Loamy fine sand (2) Loamy sand (3) Fine sandy loam
Family particle size	(1) Sandy
Drainage class	Well drained to excessively drained
Permeability class	Rapid to very rapid
Surface fragment cover <=3"	0–1%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	10.16–12.7 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0–5%
Subsurface fragment volume >3" (Depth not specified)	0%

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.

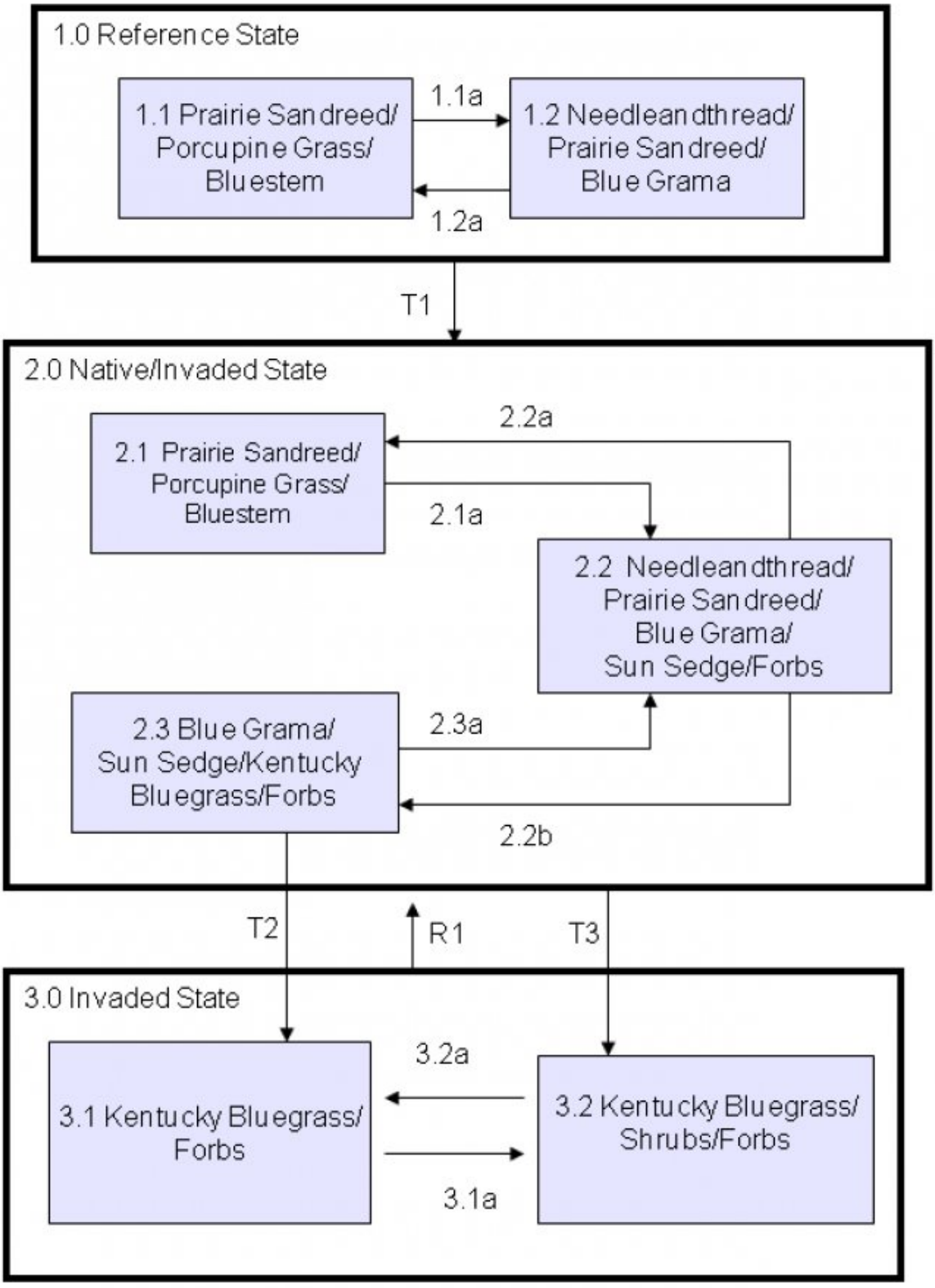
This ecological site has been grazed by domestic livestock since introduced into the area. The introduction of domestic livestock, elimination of fire, and the use of fencing and reliable water sources have radically changed the disturbance regime of this site. Heavy continuous grazing and/or continuous 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



1.1a – Below normal precipitation with grazing following short term fire intervals; 1.2a – Return to normal precipitation and disturbance regime; T1 – Altered disturbance regime and introduction of non-native species; 2.1a – Continuous season-long grazing, 2.2a – Prescribed grazing, prescribed fire; 2.2b Heavy continuous season-long grazing, 2.3a – Prescribed grazing, T2 – Heavy, continuous season-long grazing, T3 – Extended rest, no disturbance; 3.1a – Complete rest from grazing, no fire; 3.2a – Prescribed fire or heavy, continuous grazing, R1 – Prescribed fire with prescribed grazing and maybe range seeding, T4 – Crop go-back.

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.

Community 1.1
Prairie Sandreed/Porcupinegrass/Bluestem

This community phase was the most dominant both temporally and spatially. The prevailing climate and weather patterns favored the development of this community phase. Mid statured cool-season bunchgrass such as needleandthread and porcupine grass would have been co-dominants with tall warm-season grasses such as prairie sandreed, big bluestem, and sand bluestem. Other grass and grass-likes species included sand dropseed, sideoats grama, prairie Junegrass, Canada wildrye, blue grama, and sedge. A variety of leguminous and non-leguminous perennial forbs including American vetch, dotted gayfeather, goldenrod, purple prairie clover, large beardtongue, western wallflower and scurfpea were present. Shrubs included fringed sagewort, leadplant and western snowberry. In this community phase, grasses and grass-likes would have constituted about 85 to 95 percent, forbs 5 to 15 percent and shrub 1 to 5 percent of the annual production. This 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. Community dynamics, nutrient cycling, water cycle and energy flow were functioning at near optimum levels. A good component of bunchgrasses, minimal bare ground, litter in contact with the soil surface and deep rooted plants would have resulted in high infiltration rates and minimal runoff. Due to the balance between warm- and cool-season grasses, energy capture would have been spread across the entire growing season. Natural plant mortality was low. The diversity in plant species allowed for high drought tolerance. Bare ground would have been less than 5 percent, with litter cover averaging 70 percent and in contact with soil surface. Energy capture would have occurred from late spring through late summer. Soil stability would have averaged 5 or higher. Infiltration rates would have averaged 5 inches per hour or more due to high percent of bunchgrasses and deep rooted, tall statured, warm season grasses present in the plant community.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1849	2535	2959
Forb	140	291	476
Shrub/Vine	28	87	151
Total	**2017**	**2913**	**3586**

Figure 5. 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..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	6	21	40	20	6	4	1	0	0

Community 1.2
Needleandthread/Prairie Sandreed/Blue Grama

This plant community shift results from heavy, frequent grazing over a period of several years and/or several consecutive years of below normal precipitation. This increase in grazing pressure may have resulted from proximity to a water source, changes in fire frequency and/or prolonged drought. Grasses and grass-like species would have still dominated this phase but the overall productivity of these species would have been reduced and the number and amount of forbs would have increased. Needleandthread would have displaced porcupine grass to become the dominant needlegrass while blue grama, sand dropseed and sedges would have also increased. Prairie sandreed and the bluestems would have decreased but still be present. Forb species such as green sagewort, goldenrod, western ragweed, and western yarrow would have increased. The shift to the shallower rooted, short statured blue grama and sedges coupled with an increase in bare ground results in lower infiltration rates and higher soil surface temperatures as compared to plant community phase 1.1. This reduction in infiltration would have resulted in a short term increase in the number and size of water flow patterns on steeper slopes. While the timing of energy capture would have remained similar to that of plant community phase 1.1, total energy capture may have been slightly reduced due to a decrease in overall leaf area.

Figure 6. 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..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	6	21	40	20	6	4	1	0	0

Pathway 1.1a
Community 1.1 to 1.2

Repeated heavy grazing, either due to proximity to water or following short term fire intervals followed by intense grazing, will convert the dominance to short stature grasses such as blue grama and upland sedges. This shift may have been facilitated by periods of below normal precipitation.

Pathway 1.2a
Community 1.2 to 1.1

A return to normal precipitation patterns, grazing and fire regime allows for recovery of porcupine grass as well as the prairie sandreed and bluestem species.

State 2
Native/Invaded

This state is similar to the reference state. The invasion of introduced cool-season sodgrasses has altered the natural range of variability for this ecological site. This state still has a strong component of warm and cool season native grass species, but invasive introduced cool-season sodgrasses are now present in all community phases of this state. The primary disturbance mechanisms for this state include grazing by domestic livestock and infrequent fires.

Community 2.1
Prairie Sandreed/Porcupinegrass/Bluestem

This community phase most closely resembles plant community phase 1.1 in appearance and ecological function (e.g., hydrologic, biotic and soil/site stability). This community phase is 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. This plant community phase is characterized by co-dominance of mid statured cool-season bunchgrass such as needleandthread and porcupine grass and tall warm-season grasses such as prairie sandreed, big bluestem, and sand bluestem. Other grass and grass-likes species would include sand dropseed, sideoats grama, prairie Junegrass, Canada wildrye, blue grama, and sedge. Non-native cool- season grasses such as Kentucky bluegrass and smooth bromegrass and/or non-native forbs such as leafy spurge would be present in very small amounts. Grasses and grass-likes would constitute about 85 to 95 percent of this phase. A variety of leguminous and non-leguminous perennial forbs including American vetch, dotted gayfeather, goldenrod, purple prairie clover, large beardtongue, western wallflower and scurfpea were present.

Shrubs included fringed sagewort, leadplant and western snowberry. In this community phase, grasses and grass-likes would have constituted about 85 to 95 percent, forbs 5 to 15 percent and shrub 1 to 5 percent of the annual production. The ecological processes are functioning at levels very close to those of plant community phase 1.1. Slight departure may be noted within the functional/structural group indicator due to the presence of a functional/structural group(s) not expected for the site. The basic difference between this community phase and 1.1 of the Reference State is the presence of minor amounts of introduced cool-season grasses and forbs. This is likely a naturally nitrogen deficient plant community, but perhaps less so than the Reference State. A change in the nutrient cycle on this ecological site, possibly due to the introduction of non-native leguminous species such as sweet clover, may be a causative factor leading to the eventual dominance of cool-season introduced grasses in the Invaded State.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1849	2535	2959
Forb	140	291	476
Shrub/Vine	28	87	151
Total	**2017**	**2913**	**3586**

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..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	6	21	40	20	6	4	1	0	0

Community 2.2
Needleandthread/Prairie Sandreed/Blue Grama/Sun Sedge/Forbs

This plant community phase is characterized by a decline in porcupine grass, sand bluestem, and a corresponding increase in the more grazing tolerant needleandthread, sand dropseed, sedges and Kentucky bluegrass. Forbs such as western yarrow, goldenrod, green sagewort, and cudweed sagewort will increase while the leguminous forbs may decrease. The shrub component remains fairly constant, however fringed sagewort may increase. Although grasses and grass-likes still comprise 60 to 80 percent of the production, the forb component would increase to 15 to 30 percent of the production with shrubs contributing from 5 to 10 percent. The ecological processes are functioning at levels very close to those of plant community phase 2.1 but some departures begin to occur. Energy capture is shifted to earlier in the growing season due to the decline in the warm-season component of the plant community. Nutrient cycling may be reduced due to the decline in the number and amount of native legumes in the community. Infiltration rates may be slightly reduced due to the reduction in the bunchgrass component as well as the reduction in deep rooted, tall statured warm-season grasses. Departure will be noted within the functional/structural indicator due to the presence of a functional/structural group(s) not expected for the site.

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..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	6	21	40	20	6	4	1	0	0

Community 2.3
Blue Grama/SunSedge/Kentucky Bluegrass/Forbs

This plant community shift results from heavy continuous or heavy continuous 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. These grazing tolerant short grasses such as blue grama and Kentucky bluegrass, along with the grass-likes, out-compete the taller statured grass species. Common forbs would

include goldenrod, green sagewort, western salsify, heath aster, western yarrow, and western ragweed. Fringed sagewort, and prairie rose are the principal shrubs. Grasses and grass-likes would be co-dominants in this phase with shrubs still comprising 5 to 10 percent of the community. Although greatly reduced in amount and extent, the needlegrasses and tall statured warm season grasses would still be present in limited amounts but may not be readily observable. The shift in the plant community composition results in changes to how the ecological processes function on this site. Due to the increase in short statured grasses and grass-likes, infiltration for this phase is reduced when compared to plant community phases 1.1 and 2.1. Since the ratio of warm-season to cool-season plants within this community phase is similar to 2.1, the timing of energy capture is not altered but overall energy capture would be less due to the reduction in total leaf surface area available to capture solar energy. This plant community phase represents an “at risk” plant community. Due to the amount of Kentucky bluegrass present and the reduced competitive abilities of the associated native species, the possibility exists for this community to cross a threshold and transition to State 3, Invaded State. Therefore, caution needs to exercised when developing and implementing restoration strategies for this plant community phase.

Figure 10. 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..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	7	23	42	15	5	4	1	0	0

Pathway 2.1a
Community 2.1 to 2.2

Heavy continuous grazing or heavy late seasonal grazing will shift this plant community from a dominance of porcupinegrass and prairie sandreed to a dominance of grazing tolerant needleandthread, blue grama, sun sedge and minor amounts of Kentucky Bluegrass.

Pathway 2.2a
Community 2.2 to 2.1

This community pathway is initiated by implementation of prescribed grazing 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 away from the introduced cool-season species and back to the mid statured bunchgrasses and tall statured rhizomatous grasses. The addition of properly timed prescribed burning may expedite this shift.

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 2.2b
Community 2.2 to 2.3

Heavy continuous grazing or heavy continuous season-long grazing allows the grazing tolerant short stature grasses and sedges to become more competitive and dominant.

Pathway 2.3a
Community 2.3 to 2.2

This community pathway is initiated by implementation of prescribed grazing management, which includes adequate recovery periods following each grazing event with stocking levels which match the available resources and properly timed prescribed burning. If properly implemented, this will shift the competitive advantage from the introduced 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 dependant 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 3, Invaded State

Conservation practices

Prescribed Burning
Prescribed Grazing

State 3
Invaded

This state is the result of invasion and dominance of Kentucky bluegrass and/or smooth bromegrass. This state is characterized by these two species and an increasing thatch layer that effectively blocks introduction of other plants into the system. Once the state is well established, even drastic events such as high intensity fires driven by high fuel loads of litter and thatch will not result in more than a very short term reduction of these two species. These events may reduce the dominance of the sodgrasses, but due to the large amount of rhizomes in the soil there is no opportunity for the native species to establish and dominate before the sodgrasses rebound and again dominate the system. This state also includes the Annual, Pioneer Perennial community phase which is highly variable depending on the disturbance which causes this transition (T4). Over time, the Annual, Pioneer Perennial community phase will likely become dominated by introduced cool-season grasses, and shift to the Kentucky Bluegrass/Shrubs/Forbs community phase (3.2).

Community 3.1
Kentucky Bluegrass/Forbs

This community phase is dominated by Kentucky bluegrass with lesser amounts of sedge, and Blue Grama. Grazing tolerant forbs such as cudweed sagewort, western ragweed and western yarrow are also present. Leafy spurge left untreated will continue to increase in this plant community 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 very short lived due to the abundance of rhizomes of Kentucky bluegrass in the soil and the lack of propagules of other species present. Production is limited to the sod forming species. Energy capture into this system is limited to one early growing species. Runoff increases and is the highest of any plant community phase on this ecological site. Nutrient cycling is severely limited to the rooting depth of the Kentucky bluegrass and lack of leguminous forbs.

Community 3.2
Kentucky Bluegrass/Shrubs/Forbs

This community phase is dominated by the cool-season sodgrasses including Kentucky bluegrass and sometimes smooth brome. Western snowberry can increase and become a major component in this community phase. Remnants of native warm- and cool-season grasses are still present, but greatly reduced. Infiltration may be reduced and runoff is increased when compared to the Reference State. Nutrient cycling is limited by the rooting depth of these species, the lack of leguminous forbs, and the alteration of the soil biotic community. Energy capture into the system is restricted to a short window provided by the early season species and heavy litter layer which reduces the amount of sunlight reaching the grass plant crowns. This further favors the shade tolerant introduced species and shrubs.

Pathway 3.1a
Community 3.1 to 3.2

Complete rest from grazing and elimination of fire initiates this pathway. Plant litter accumulation favors the more shade tolerant introduced grass species and western snowberry.

Pathway 3.2a
Community 3.2 to 3.1

Prescribed burning or heavy continuous grazing will reduce the shrub component.

Conservation practices

Prescribed Burning

Transition T1
State 1 to 2

Transition from Reference State (State 1) to Native/Invaded State (State 2) This is the transition from the native grass dominated reference state to a state that has been invaded by introduced cool-season grass and/or species. When propagules of Kentucky bluegrass are present, this transition occurs as natural conditions and/or management actions favor a decline in the composition of warm and cool season bunch grasses and an increase in cool-season sodgrasses. This transition is compounded by a change in the historic grazing and fire regime where native herbivores would follow periodic fires with grazing. This historic grazing/fire sequence has largely been replaced by season-long or heavy late season grazing. Complete rest from grazing and suppression of fire can also lead to this transition. The threshold between states is crossed when Kentucky bluegrass, smooth brome, and other introduced species become established on the site. These species typically are part of functional/structural groups that were not present in the Reference State.

Transition T2
State 2 to 3

Transition from Native/Invaded State (State 2) Community Phase 2.3 Blue Grama/SunSedge/Kentucky Bluegrass/Forbs to Invaded State (State 3) Community Phase 3.1 Kentucky Bluegrass/Forbs Heavy continuous season-long grazing is the primary driver of this transition. The very grazing tolerant species have the competitive advantage during this transition. 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. The nutrient cycle is impaired due to a shift from perennial native legumes to introduced biennial legumes and the lack of available carbon for soil biota due to accumulation in the surface layer root mat. These two factors result in reduced soil biological activity. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in sodgrass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition.

Transition T3
State 2 to 3

Transition from Native/Invaded State (State 2)to Invaded State (State 3) Community Phase 3.2 Kentucky Bluegrass/Shrubs/Forbs Complete rest from grazing and elimination of fire are the two major contributors to this transition, especially when smooth brome is present. The opportunity for high intensity spring burns is severely reduced by early green up, and increased moisture and humidity at the soil surface. Plant litter accumulation tends to favor the more shade tolerant introduced grass species and western snowberry. The nutrient cycle is also impaired, and the result is typically a higher level of nitrogen which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns thereby shifting competitive advantage to shade tolerant introduced grass species. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in sodgrass dominance. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30% of the plant community and native grasses represent less than 40% of the plant community composition.

Restoration pathway R1
State 3 to 2

This restoration pathway may be initiated with the combination of prescribed burning followed by high levels of prescribed grazing management. The success of this restoration pathway depends on the presence of a remnant population of native grasses in State 3. This remnant population may not be readily apparent without close inspection. The application of prescribed burning may be needed at relatively short intervals in the early phases of this restoration process. Some previous efforts have shown promise with early season prescribed burning;

however, fall burning may also be effective under certain circumstances. Both prescribed grazing and prescribed burning are necessary to successfully initiate this restoration pathway. It may be possible using selected plant materials and agronomic practices to approach something very near the functioning of the Native/Invaded State (State 2). Application of herbicides and the use of mechanical treatments and seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native grasses, management objectives must include the maintenance of those species, the associated reference state functions and continued treatment of the introduced sodgrasses, and noxious weeds.

Conservation practices

Prescribed Burning
Prescribed Grazing

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			874–1311	
	sand bluestem	ANHA	*Andropogon hallii*	291–583	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	146–437	–
	big bluestem	ANGE	*Andropogon gerardii*	146–291	–
2	**Mid Cool-Season Bunchgrasses**			437–729	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	146–437	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	29–87	–
	Canada wildrye	ELCA4	*Elymus canadensis*	29–58	–
3	**Mid Warm-Season Grasses**			146–437	
	sideoats grama	BOCU	*Bouteloua curtipendula*	146–291	–
	little bluestem	SCSC	*Schizachyrium scoparium*	146–291	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	29–146	–
4	**Short Warm-Season Grasses**			29–146	
	blue grama	BOGR2	*Bouteloua gracilis*	29–146	–
5	**Other Native Grasses**			29–146	
	Grass, perennial	2GP	*Grass, perennial*	0–146	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	29–146	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–87	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–87	–
6	**Grass-likes**			146–291	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–146	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	29–146	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	29–87	–
	sedge	CAREX	*Carex*	0–87	–
	Schweinitz's flatsedge	CYSC3	*Cyperus schweinitzii*	0–29	–
Forb					
7	**Forbs**			146–437	
	Forb, native	2FN	*Forb, native*	29–146	

	Forb, native	2FN	*Forb, native*	29–146	–
	western wallflower	ERAS2	*Erysimum asperum*	29–58	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	29–58	–
	blazing star	LIATR	*Liatris*	29–58	–
	hoary puccoon	LICA12	*Lithospermum canescens*	29–58	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	29–58	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	29–58	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	29–58	–
	field sagewort	ARCA12	*Artemisia campestris*	29–58	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	29–58	–
	milkweed	ASCLE	*Asclepias*	29–58	–
	field chickweed	CEAR4	*Cerastium arvense*	29–58	–
	Canadian horseweed	COCAC3	*Conyza canadensis var. canadensis*	29–58	–
	purple prairie clover	DAPU5	*Dalea purpurea*	29–58	–
	silky prairie clover	DAVI	*Dalea villosa*	29–58	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	29–58	–
	large beardtongue	PEGR7	*Penstemon grandiflorus*	29–58	–
	lilac penstemon	PEGRG3	*Penstemon gracilis var. gracilis*	29–58	–
	prairie groundcherry	PHHI8	*Physalis hispida*	29–58	–
	white heath aster	SYER	*Symphyotrichum ericoides*	29–58	–
	longbract spiderwort	TRBR	*Tradescantia bracteata*	29–58	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	29–58	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	29–58	–
	gray goldenrod	SONE	*Solidago nemoralis*	0–29	–
	hoary verbena	VEST	*Verbena stricta*	0–29	–
	prairie violet	VIPE2	*Viola pedatifida*	0–29	–
	cinquefoil	POTEN	*Potentilla*	0–29	–
	primrose	PRIMU	*Primula*	0–29	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–29	–
	thymeleaf sandmat	CHSE6	*Chamaesyce serpyllifolia*	0–29	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–29	–
	heartleaf four o'clock	MINY	*Mirabilis nyctaginea*	0–29	–
	flat-top goldentop	EUGR5	*Euthamia graminifolia*	0–29	–
	onion	ALLIU	*Allium*	0–29	–
Shrub/Vine					
8	**Shrubs**			29–146	
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	29–87	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	29–87	–
	leadplant	AMCA6	*Amorpha canescens*	29–87	–
	prairie sagewort	ARFR4	*Artemisia frigida*	29–58	–
	rose	ROSA5	*Rosa*	29–58	–
	white meadowsweet	SPAL2	*Spiraea alba*	0–58	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	29–58	–

	western poison ivy	TORY	*Toxicodendron rydbergii*	0–29	–

Table 8. Community 2.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall Warm-Season Grasses**			874–1311	
	sand bluestem	ANHA	*Andropogon hallii*	291–583	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	146–437	–
	big bluestem	ANGE	*Andropogon gerardii*	146–291	–
2	**Mid Cool-Season Bunchgrasses**			437–729	
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	146–437	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	29–87	–
	Canada wildrye	ELCA4	*Elymus canadensis*	29–58	–
3	**Mid Warm-Season Grasses**			146–437	
	sideoats grama	BOCU	*Bouteloua curtipendula*	146–291	–
	little bluestem	SCSC	*Schizachyrium scoparium*	146–291	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	29–146	–
4	**Short Warm-Season Grasses**			29–146	
	blue grama	BOGR2	*Bouteloua gracilis*	29–146	–
5	**Other Native Grasses**			29–146	
	Grass, perennial	2GP	*Grass, perennial*	0–146	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	29–146	–
	western wheatgrass	PASM	*Pascopyrum smithii*	0–87	–
	Scribner's rosette grass	DIOLS	*Dichanthelium oligosanthes var. scribnerianum*	0–87	–
6	**Introduced Grasses**			29–87	
	smooth brome	BRIN2	*Bromus inermis*	0–87	–
	Kentucky bluegrass	POPR	*Poa pratensis*	29–87	–
7	**Grass-likes**			146–291	
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–146	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	29–146	–
	Pennsylvania sedge	CAPE6	*Carex pensylvanica*	29–87	–
	sedge	CAREX	*Carex*	0–87	–
	Schweinitz's flatsedge	CYSC3	*Cyperus schweinitzii*	0–29	–
Forb					
8	**Forbs**			146–437	
	Forb, native	2FN	*Forb, native*	29–146	–
	western wallflower	ERAS2	*Erysimum asperum*	29–58	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	29–58	–
	blazing star	LIATR	*Liatris*	29–58	–
	hoary puccoon	LICA12	*Lithospermum canescens*	29–58	–
	narrowleaf stoneseed	LIIN2	*Lithospermum incisum*	29–58	–
	rush skeletonplant	LYJU	*Lygodesmia juncea*	29–58	–

	Cuman ragweed	AMPS	*Ambrosia psilostachya*	29–58	–
	field sagewort	ARCA12	*Artemisia campestris*	29–58	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	29–58	–
	milkweed	ASCLE	*Asclepias*	29–58	–
	field chickweed	CEAR4	*Cerastium arvense*	29–58	–
	Canadian horseweed	COCAC3	*Conyza canadensis var. canadensis*	29–58	–
	purple prairie clover	DAPU5	*Dalea purpurea*	29–58	–
	silky prairie clover	DAVI	*Dalea villosa*	29–58	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	29–58	–
	large beardtongue	PEGR7	*Penstemon grandiflorus*	29–58	–
	lilac penstemon	PEGRG3	*Penstemon gracilis var. gracilis*	29–58	–
	prairie groundcherry	PHHI8	*Physalis hispida*	29–58	–
	white heath aster	SYER	*Symphyotrichum ericoides*	29–58	–
	longbract spiderwort	TRBR	*Tradescantia bracteata*	29–58	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	29–58	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	29–58	–
	gray goldenrod	SONE	*Solidago nemoralis*	0–29	–
	hoary verbena	VEST	*Verbena stricta*	0–29	–
	prairie violet	VIPE2	*Viola pedatifida*	0–29	–
	cinquefoil	POTEN	*Potentilla*	0–29	–
	primrose	PRIMU	*Primula*	0–29	–
	smooth horsetail	EQLA	*Equisetum laevigatum*	0–29	–
	thymeleaf sandmat	CHSE6	*Chamaesyce serpyllifolia*	0–29	–
	Flodman's thistle	CIFL	*Cirsium flodmanii*	0–29	–
	heartleaf four o'clock	MINY	*Mirabilis nyctaginea*	0–29	–
	flat-top goldentop	EUGR5	*Euthamia graminifolia*	0–29	–
	onion	ALLIU	*Allium*	0–29	–
9	**Introduced Forbs**			146–291	
	Forb, introduced	2FI	*Forb, introduced*	0–29	–
	leafy spurge	EUES	*Euphorbia esula*	0–29	–
Shrub/Vine					
10	**Shrubs**			29–146	
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	29–87	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	29–87	–
	leadplant	AMCA6	*Amorpha canescens*	29–87	–
	prairie sagewort	ARFR4	*Artemisia frigida*	29–58	–
	rose	ROSA5	*Rosa*	29–58	–
	white meadowsweet	SPAL2	*Spiraea alba*	0–58	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	29–58	–
	western poison ivy	TORY	*Toxicodendron rydbergii*	0–29	–

Animal community

Animal Community – 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 entirely 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.

Hydrological functions

-- Under Development --

Recreational uses

-- Under Development --

Wood products

-- Under Development --

Other products

-- Under Development --

Other information

-- Under Development --

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. Those involved in developing this site description include: Stan Boltz, NRCS State Rangeland Management Specialist; Bernadette Braun, USFS Rangeland Management Specialist; Stacey Swenson, USFS Rangeland Management Specialist; Jeff Printz, NRCS State Rangeland Management Specialist; Dr. Kevin Sedivec, Extension Rangeland Management Specialist; Dr. Shawn Dekeyser, North Dakota State University; Rob Self, The Nature Conservancy; Lee Voigt, NRCS Area Rangeland Management Specialist; Dr. Mark Gonzales, USFS Hydrologist; David Dewald, NRCS State Biologist; Keith Anderson, NRCS Soil Scientist, Fred Aziz; NRCS Area Resource Soil Scientist; and Steve Sieler, NRCS Soil Scientist.

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Contributors

Jeff Printz

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)	Lee Voigt, Bernadette Braun, Stacy Swenson, Jeff Printz
Contact for lead author	Jeff.printz@nd.usda.gov 701-530-2080
Date	02/06/2012
Approved by	Jeff Printz
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

2. **Presence of water flow patterns:** Barely observable on steeper slopes. Not visible on lesser slopes.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5% or less.

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

6. **Extent of wind scoured, blowouts and/or depositional areas:** None typically present. Small areas of exposed/ wind-blown sand, usually in conjunction with localized animal disturbances, maybe compounded by drought, should be < few feet in diameter.

7. **Amount of litter movement (describe size and distance expected to travel):** None visible.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability should average 5 to 6.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Use soil series description for depth, color and structure of A horizon/surface layer.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool- and warm-season grasses) with fine and coarse roots positively influences infiltration.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** No compaction layer should be present.

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: Tall, warm-season grasses >

Sub-dominant: Mid, cool-season bunchgrass > mid, warm-season grasses =

Other: Forbs > grass-likes > short, warm-season grasses = shrubs

Additional: Due to differing root structure and distribution, Kentucky bluegrass and smooth bromegrass do not fit into reference plant community F/S groups.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** None.

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14. **Average percent litter cover (%) and depth (in):** 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):** Ranges from 1800 to 3200 lbs/ac air dry depending upon growing conditions with a representative value (RV) of 2600 lbs./acre air dry.

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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 weeds, Kentucky bluegrass, smooth bromegrass.

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17. **Perennial plant reproductive capability:** All species exhibit high vigor relative to climatic conditions. Do not rate based solely on seed production. Perennial grasses should have vigorous rhizomes or tillers.
