

Ecological site R102CY058NE **Loamy Upland**

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General information

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

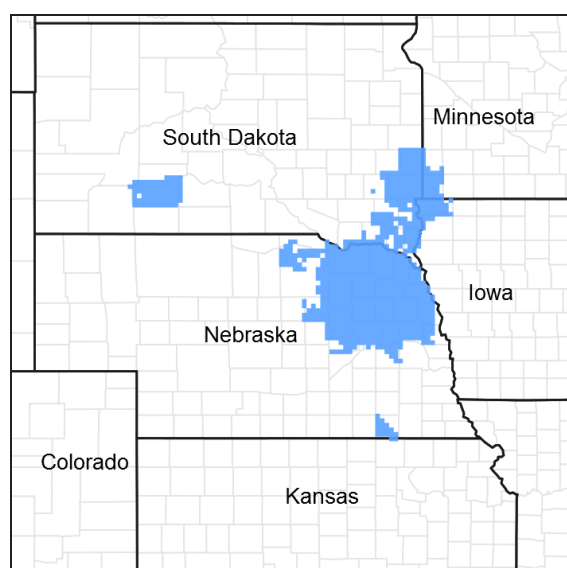


Figure 1. Mapped extent

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

MLRA notes

Major Land Resource Area (MLRA): 102C—Loess Uplands

Most of this area is in the Dissected Till Plains part of the Central Lowland Province of the Interior Plains. This MLRA has broad, undulating to rolling ridgetops and hilly to steep valley sides. The valleys are generally narrow, but broad flood plains and terraces are along the major rivers and the large tributaries. Elevation ranges from 335 to 610 meters (1,100 to 2,000 feet) increasing from southeast to northwest. Peorian age loess covers most of the area with depths ranging from 2 to 20 meters (6 to 70 feet). Glacial till underlies the loess in most areas. Bedrock can be found at or near the surface predominantly along the Missouri River valley found on the eastern side of the MLRA, but some bedrock can also be found in the northern part of 102C in Minnesota and South Dakota. The soils are predominantly Mollisols but Entisols are prominent in the floodplains of the area. Nearly all the area is farmed with 70% of the area being used as cropland for corn and soybeans. Feed grains and hay crops are also grown. The major resource concerns are wind erosion, water erosion, maintenance of organic matter and soil tilth, and soil moisture management. (USDA/NRCS 2006)

Classification relationships

"Silty" range sites for NE NRCS Vegetation Zones 3 & 4

NE Natural Heritage Program/NE Game & Parks Commission: "Upland Tallgrass Prairie"

Similar to R102BY010SD "Loamy"

General information for MLRA 102C:

Fenneman (1916) Physiographic Regions

Division - Interior Plains

East:

Province - Central Lowland

Section - Till Plains

West:

Province - Great Plains

Section - High Plains

USFS (2007) Ecoregions

Domain - Humid Temperate

Division - Prairie

Province - Prairie Parkland (Temperate)

Section - North-Central Glaciated Plains (251B)

EPA Ecoregions (Omernik 1997)

I - Great Plains (9)

II - Temperate Prairies (9.2)

III - Western Corn Belt Plains (9.2.3) IV - Loess Prairies (47a)

IV - Northeastern Nebraska Loess Hills (47k)

IV - Transitional Sandy Plain (47l)

Ecological site concept

This site occurs on higher, stable landscape positions and produces run-off, but gentler slopes generally allow for improved capture and storage of precipitation which produces well-developed soils with carbonates leached at least 25 centimeters (10 inches) below the soil surface.

Associated sites

R102CY050NE	Loamy Lowland Found in run-on positions, typically situated on upland drainages, foot slopes, and terraces.
R102CY059NE	Limy Upland Found in a similar run-off position but generally with steeper slopes.

Similar sites

R102CY059NE	Limy Upland Often intermixed, but steeper slopes reduce infiltration and soil development such that carbonates are not leached to the same degree and plant production is lower.
R102CY050NE	Loamy Lowland Species composition is very similar but with higher production due to additional run-on moisture.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) <i>Andropogon gerardii</i> (2) <i>Schizachyrium scoparium</i>

Physiographic features

This site predominantly occurs on nearly level to moderately steep hills, foot slopes, till plains, and interfluves (0-20% slopes). The slope generates runoff, has a water table greater than 203 centimeters (80 inches) deep, and does not flood or pond.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Interfluve (3) Till plain
Runoff class	Negligible to high
Elevation	351–549 m
Slope	0–20%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. Peak precipitation occurs from the middle of spring to early in autumn. Winter precipitation occurs as snow (USDA/NRCS 2006).

The average annual temperature gradient trends higher from north (7°C / 45°F) to south (11°C/51°F).

The average annual precipitation gradient trends higher from northwest (64 centimeters / 25 inches) to southeast (79 centimeters / 31 inches).

The annual snowfall ranges from about 60 centimeters (24 inches) in the southern part of the area to 85 centimeters (34 inches) in the northern part.

The following data summary includes weather stations representing the full geographic extent of the MLRA, and is based on 70% probabilities (NOAA/UNL) meaning that actual observed climate conditions may fall outside these ranges 30% of the time. Furthermore, climatic events can manifest many different ways. For example, abnormally dry periods could occur as 3 consecutive drought years out of 10, 3 individual years separated by “normal” years, or some combination. Tree-ring records indicate that portions of the Great Plains have also historically experienced droughts lasting several decades, so plant community response will largely depend on the manner in which climatic variability is realized in interaction with past and current land management.

Table 3. Representative climatic features

Frost-free period (characteristic range)	125-129 days
Freeze-free period (characteristic range)	144-149 days
Precipitation total (characteristic range)	686-737 mm
Frost-free period (actual range)	124-132 days
Freeze-free period (actual range)	143-158 days
Precipitation total (actual range)	686-762 mm
Frost-free period (average)	127 days
Freeze-free period (average)	148 days
Precipitation total (average)	711 mm

Climate stations used

- (1) GENOA 2 W [USC00253185], Genoa, NE
- (2) EWING [USC00252805], Ewing, NE
- (3) WEST POINT [USC00259200], West Point, NE
- (4) ROCK RAPIDS [USC00137147], Rock Rapids, IA
- (5) FLANDREAU [USC00392984], Flandreau, SD
- (6) SIOUX FALLS [USW00014944], Sioux Falls, SD

Influencing water features

No riparian or wetland features are associated with this site.

Soil features

These are predominantly very deep (moderately deep where residuum is present), well to somewhat excessively drained soils. The surface texture is predominantly silty clay loam, silt loam, or loam from 0 to 19 centimeters (0 to 8 inches) and the Subsurface Texture Group is Loamy from 19 to 203 centimeters (8 to 80 inches).

Rills and gullies are not inherent to this site. Water flow patterns, if present, should be irregular and disconnected, and pedestalling none to slight; although, both of these indicators may become more apparent as slope approaches the upper limit for the site. Soil aggregate stability should be high.

Major soils assigned to this site include Belfore, Dempster, Ihlen, Moody, and Nora

Table 4. Representative soil features

Parent material	(1) Loess (2) Till
Surface texture	(1) Silty clay loam (2) Silt loam (3) Loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to slow
Soil depth	51–203 cm
Surface fragment cover ≤3"	0–5%
Surface fragment cover >3"	0–2%
Available water capacity (0-101.6cm)	12.45–22.86 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–2 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	5.6–9
Subsurface fragment volume ≤3" (Depth not specified)	0–33%
Subsurface fragment volume >3" (Depth not specified)	0–3%

Ecological dynamics

While water is inherently limiting on most rangelands, relative to more arid regions energy capture (sunlight) is also a critical limiting resource, thereby making this site ideal for tallgrass communities. However, the favorable growing conditions and topography that historically made this the largest contributor to the “true prairie” habitat type in this MLRA have also made it one of the most extensively cropped in present time.

This site developed with fire as an integral part of the ecological processes and grassland maintenance. It is presumed that the historic fires generally occurred every 3–4 years, were randomly distributed, and ignited by lightning at various times throughout the summer when thunderstorms were likely to occur. Furthermore, it is also believed that pre-European inhabitants often used fire as a management tool for attracting herds of large migratory herbivores (bison, elk, and/or deer) as well as for warfare. However, the impact of fire over the past 100 years has been diminished due to human prevention and suppression of wildfire and the pervasive lack of cultural acceptance of prescribed fire as a surrogate (Helzer 2010).

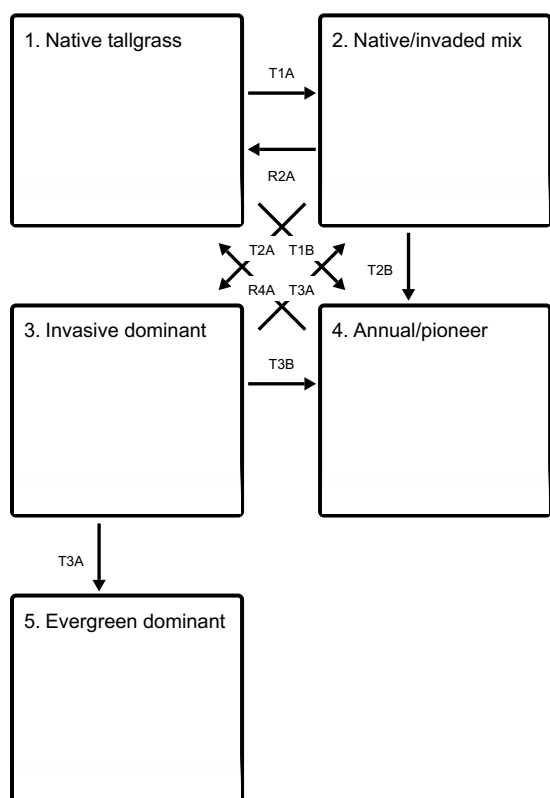
The degree of herbivory (feeding on herbaceous plants) has a significant impact on the dynamics of the site. Historically, periodic grazing by herds of large migratory herbivores was a primary influence; however, herbivory by species such as insects, rodents, and root feeding organisms also impacted the vegetation historically and continue to this day (Helzer 2010). Human control of large herbivore impacts through grazing of domestic livestock and/or manipulation of wildlife populations has been a major contemporary influence on the ecological dynamics of the site (USDA/SCS 1977) and this management coupled with climate largely dictates the plant communities observed.

The reference state characterizes the historic natural condition, and has been determined by the study of rangeland relic areas, areas protected from excessive disturbance, and/or areas under compatible grazing regimes. Trends in plant community dynamics ranging from heavily grazed to unused areas, seasonal use pastures, and historical accounts have also been considered.

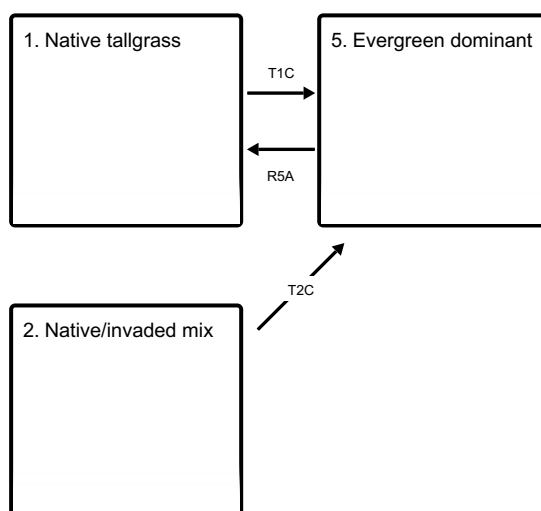
The following is a diagram illustrating predictable and recurring plant communities inherent to this site, and the pathways of change between them (Bestelmeyer 2010). The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Ecosystem states

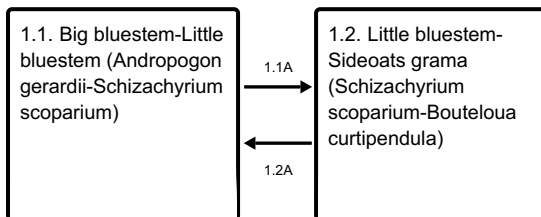


States 1, 5 and 2 (additional transitions)



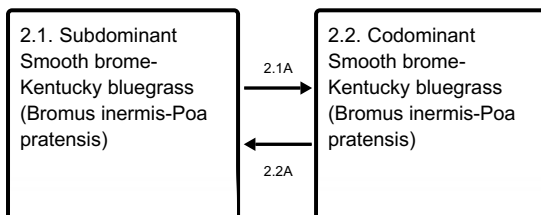
- T1A** - Reduced native grass competitiveness due to excessive defoliation intensity and frequency or drought
- T1B** - Severe disturbance
- T1C** - Cedar encroachment leading to woody plant dominance
- R2A** - Reduced invasive grass competitiveness allows for natives to dominant site
- T2A** - Reduced native competitiveness allows for introduced grass colonization and expansion
- T2B** - Severe disturbance; opportunistic species dominant
- T2C** - Cedar encroachment leading to woody plant dominance
- T3A** - Reduced invasive grass competitiveness allows for natives to increase
- T3B** - Severe disturbance; opportunistic species dominate
- T3A** - Cedar encroachment leading to woody plant dominance
- R4A** - Reduced invasive grass competitiveness allows for natives to dominant site
- R5A** - Restoration of plant community to native grasses

State 1 submodel, plant communities



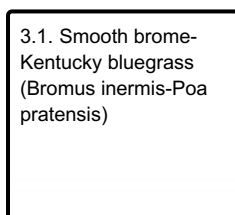
- 1.1A** - Reduced tallgrass vigor due to excessive defoliation intensity and frequency; drought.
- 1.2A** - Improved tallgrass vigor with adequate rest periods; return of normal precipitation.

State 2 submodel, plant communities

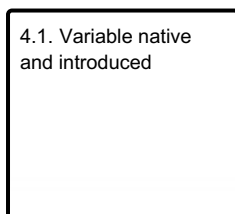


- 2.1A** - Cool-season grasses increase
- 2.2A** - Native warm-season grasses increase in dominance

State 3 submodel, plant communities



State 4 submodel, plant communities



State 5 submodel, plant communities

5.1. Eastern redcedar
(*Juniperus virginiana*)

State 1

Native tallgrass

This state comprises the communities within the range of natural variability under historic conditions and disturbance regimes. Patterns created by wildlife use and fire would have created a mosaic of communities across the landscape; however, tall and/or mid warm-season grasses would remain dominant, with a subdominant contribution from native cool-season grasses, forbs, and shrubs. The cool-season contribution increases with latitude, with species such as needleandthread and green needlegrass becoming more prevalent northward. Fire and bison herbivory were the dominant disturbance regimes that historically maintained the tallgrass dominance with a diverse forb component. Furthermore, bison grazing was closely linked to fire patterns as the animals preferred grazing burned areas offering lush regrowth devoid of decadence and of higher nutritive quality. Thus, historic plant communities were subjected to occasional burning and grazing, with substantial rest/recovery periods as the fuel load rebuilt to eventually start the process again. Fire return intervals of 3-4 years served to suppress woody species, particularly non-sprouting eastern redcedar. The degree to which observed conditions represent this state largely depends on how closely the management has mimicked these past disturbance effects.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1

Big bluestem-Little bluestem (*Andropogon gerardii*-*Schizachyrium scoparium*)



Figure 8. Loamy Upland 1.1

This is the reference plant community and can be found on areas that are managed to allow for adequate recovery periods following defoliation or drought stress. In addition to tallgrass vigor, suppression of woody species either through natural (e.g. fire) or artificial (e.g. chainsaw) methods is necessary to maintain herbaceous dominance. The plant community consists of 75-90% grasses and grass-like, 5-10% forbs and 1-5% shrubs. Dominant grasses include big bluestem, little bluestem, porcupinegrass, and sideoats grama. Other grasses and grass-like are indiagrass, blue grama, prairie junegrass, and sedges. Forb species are diverse and include prairieclovers, scurfpeas, and goldenrods. Common shrubs include leadplant and New Jersey tea (Kaul 2006, Steinauer 2010, USDA/NRCS 2012). This plant community is diverse, stable, and productive with nutrient and water cycles, and energy flow functioning near full potential. Plant litter is properly distributed with negligible movement off-site and natural plant mortality is very low. This community is resistant to many disturbances except continuous season-long heavy grazing, tillage, or non-use. Broadcast herbicide application will dramatically reduce non-target forb diversity

and abundance. Total annual production, during an average year, ranges from 2400 to 4300 pounds per acre air-dry weight and will average 3500 pounds.

Dominant plant species

- big bluestem (*Andropogon gerardii*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2354	3335	3923
Shrub/Vine	168	294	448
Forb	168	295	448
Total	2690	3924	4819

Figure 10. Plant community growth curve (percent production by month). NE1021, 102C Warm-season. Warm-season grass, MLRA 102C.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	7	18	23	26	16	6	2	0	0

Community 1.2

Little bluestem-Sideoats grama (*Schizachyrium scoparium*-*Bouteloua curtipendula*)



Figure 11. Loamy Upland 1.2

This community largely resembles central Great Plains mixed-grass prairies where rainfall is more limiting and overall conditions are relatively drier. Tallgrasses remain an important component, but midgrasses - typically sideoats grama and little bluestem - dominate site structure and function. While still within the range of natural variability, energy capture, nutrient cycling, and hydrology are not functioning at their full potential relative to the reference condition. Reduced photosynthetic biomass does not capture as much light energy, less lignified plant material produces lower quality litter (e.g. less persistent, more easily transported), and reduced soil protection impairs the site's ability to capture and retain moisture.

Dominant plant species

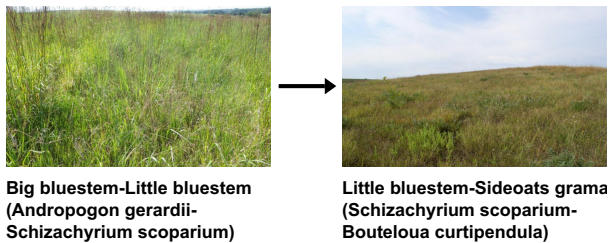
- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass

Figure 12. Plant community growth curve (percent production by month). NE1021, 102C Warm-season. Warm-season grass, MLRA 102C.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	7	18	23	26	16	6	2	0	0

Pathway 1.1A

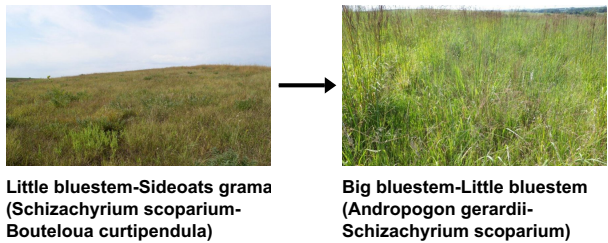
Community 1.1 to 1.2



Events which remove tallgrass growing points and photosynthetic tissues without adequate recovery periods will shift community composition towards shorter statured species, particularly little bluestem and sideoats grama. Likewise, shortgrasses such as hairy and/or blue grama may also proliferate. As cattle grazing pressure increases/persists, rhizomatous grasses may assume a more sodbound growth habit which can further reduce overall diversity and adversely affect both infiltration and litter. Periods of extended drought can have similar impacts on species composition and bring about a shift towards mixed/shortgrass prairie species more tolerant of drier conditions.

Pathway 1.2A

Community 1.2 to 1.1



Management that provides adequate recovery periods and does not annually prevent tallgrass seedset or otherwise impair vigor will facilitate a return to community phase 1.1. In the case of drought, the return to more typical precipitation patterns will promote shift towards tallgrass species.

State 2

Native/invaded mix

This state can manifest three ways: 1) the appearance of introduced cool-season grasses, 2) the expansion of deciduous shrubs and/or trees, or 3) some combination of these. Kentucky bluegrass and smooth brome are the primary cool-season grass invaders in this region, commonly found in roadsides, disturbed areas, and pastures intentionally seeded for cool-season forage. Management practices and/or environmental conditions that are not favorable to native grass vigor may allow introduced grasses to invade the site thereby decreasing native diversity and abundance, particularly of forbs. In the absence of the historic fire regime, woody deciduous species may also expand to become an influential component of the community. The invasive component tends to have very high resilience, is extremely difficult to eradicate, and what might be considered a new "contemporary" range of natural variability is seen as competition between the native grasses and introduced/woody species for space and resources.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Community 2.1

Subdominant Smooth brome-Kentucky bluegrass (Bromus inermis-Poa pratensis)

While native grasses still dominate the site, introduced cool-season species have established a foothold in the system and can be found interspersed throughout the stand. The stand may still have a native tallgrass appearance overall, but bluegrass and/or brome can be easily found. Deciduous shrub/tree species may also have begun to expand into areas where they did not persist historically, but the overall appearance can vary depending on the propagation method of a particular species. Seed propagated species, such as Siberian elm, tend to colonize further from the parent plant and affect larger areas, but in lower densities. In contrast, rhizomatous species such as smooth sumac tend to progress as a higher-density encroachment spreading directly from the parent plants.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Figure 13. Plant community growth curve (percent production by month). NE1022, Warm-season dominant, cool-season subdominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	9	19	23	24	13	7	3	0	0

Community 2.2

Codominant Smooth brome-Kentucky bluegrass (Bromus inermis-Poa pratensis)

This community is comprised of a relatively even mix of native grasses and invasive species overall. This may manifest as a well-distributed interspersion of natives and invaders, as distinct patches wherein competitors dominate locally, or some combination. Forb diversity and abundance is further diminished.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- smooth brome (*Bromus inermis*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Figure 14. Plant community growth curve (percent production by month). NE1023, Warm-season, cool-season codominant.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	10	23	26	16	10	7	4	1	0

Pathway 2.1A

Community 2.1 to 2.2

Management and/or environmental conditions have afforded a persisting competitive advantage to introduced cool-season grasses, and they begin to dominate the ecological dynamics of the site. The robust invasive component is able to quickly and effectively exploit opportunities to outcompete and displace natives. Repeated summer use of an area will place the bulk of stressor impacts on native plants, reducing native vigor and allowing invaders to thrive. Likewise, a climate pattern limiting natural moisture to the spring and fall months coincides with peak cool-season growth and may support a similar process.

Pathway 2.2A

Community 2.2 to 2.1

The native component remains in an abundance that can facilitate a return towards more historic conditions if management is modified to shift stressor impacts to the invasive species, and promote warm-season grass vigor.

Environmental conditions and/or disturbance regimes that strongly favor warm-season grasses can also trend the site towards the reference.

State 3
Invasive dominant

Introduced cool-season invasion has progressed to the point that native species comprise a negligible portion of the community and the aggressively rhizomatous invasives preclude native germination and seedling survival. The native component may be completely absent, and the site resembles a seeded pasture. Alternatively, the dominant invasives may be deciduous woody species. Woody competitiveness for sunlight, water, space, and other resources continues to increase as desirable herbaceous species are shaded out, crowded out, or otherwise suppressed.

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Community 3.1
Smooth brome-Kentucky bluegrass (*Bromus inermis*-*Poa pratensis*)



Figure 15. Loamy Upland 3.1

This community is typically composed of smooth brome with bluegrass interspersed among the brome tillers. Warm-season natives, if present, are sparse yet often conspicuous due to pronounced differences in growth habits and metabolic pathways. Community structure and function have been dramatically simplified relative to the reference condition, and very few biotic functional groups are represented in amounts that would influence ecological function. The invasive grass root skein provides good site stability; however, replacement of the deeper roots and complex bunchgrass canopy with the shallower roots and erect tiller canopy of the invaders results in reduced interception and infiltration rates.

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Figure 16. Plant community growth curve (percent production by month).
NE1024, Cool-season. Smooth brome/Kentucky bluegrass.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	4	13	25	28	8	6	9	5	2	0

State 4
Annual/pioneer

Nutrient cycling, hydrologic function, and/or soil stability have been severely altered, and possibly compromised. This is a highly variable state in which the specific plants observed will depend largely on the original community

and the nature of the disturbance. This condition encompasses (but is not necessarily limited to) events such as severe fire impacts, heavy continuous grazing, heavy nutrient inputs, and abandoned cropland.

Dominant plant species

- snow on the mountain (*Euphorbia marginata*), other herbaceous
- ragweed (*Ambrosia*), other herbaceous
- Texas croton (*Croton texensis*), other herbaceous
- nightshade (*Solanum*), other herbaceous
- thistle (*Cirsium*), other herbaceous

Community 4.1

Variable native and introduced



Figure 17. Loamy Upland 4.1

This community is heavily dominated by annual plants that thrive in disturbed areas and often includes snow-on-the-mountain, annual ragweed, Texas croton, nightshades, and/or hoary verbena. It is also particularly vulnerable to noxious weed invasion with the most common species being plumeless, musk, and Canada thistles. Leafy spurge becomes more common northward in the MLRA.

Dominant plant species

- snow on the mountain (*Euphorbia marginata*), other herbaceous
- ragweed (*Ambrosia*), other herbaceous
- Texas croton (*Croton texensis*), other herbaceous
- nightshade (*Solanum*), other herbaceous
- thistle (*Cirsium*), other herbaceous

State 5

Evergreen dominant

Left unchecked, the spatial extent of eastern redcedar encroachment has expanded, and the individual trees have grown substantially. The areas under and near individual cedars experience profoundly altered function through shading, evergreen litter, and suppressed herbaceous understory. The woody overstory now dictates certain disturbance responses, and prescribed fire options become increasingly problematic as any fire will be largely carried by the volatile evergreen canopy instead of the herbaceous understory.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree

Community 5.1

Eastern redcedar (*Juniperus virginiana*)



Figure 18. Loamy Upland 5.1

Cedars have reached stature and abundance that is beyond the range of natural variability, and the remaining herbaceous component is restricted to cedar interspaces. Evergreen canopy and litter serve to dramatically increase interception, capture, and eventual evaporation of precipitation thereby further reducing the resources available for grasses and forbs. Without intervention, woody canopy will progress towards complete closure under which herbaceous species will eventually disappear completely.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree

Transition T1A

State 1 to 2

In the presence of introduced cool-season grasses, environmental conditions and/or management that reduces native vigor and stand resilience, and frees up resources (space, sunlight, nutrients, water) will allow for colonization of Kentucky bluegrass and smooth brome. Likewise, similar processes may also allow for deciduous woody shrubs and trees such as smooth sumac, roughleaf dogwood, and Siberian elm to expand.

Transition T1B

State 1 to 4

There are many possible triggers for this transition that may occur as acute events (e.g. plowing) or cumulative impacts of chronic events (e.g. long-term undermanaged grazing.) The absence of deep-rooted perennial cover exposes the site to topsoil loss, open nutrient cycle, and free space which collectively allow for opportunistic annual species to dominate.

Transition T1C

State 1 to 5

The presence of an invasion source coupled with fire exclusion allows cedar seeds to germinate and establish within the herbaceous stand. This typically begins near fencerows, woody draws, etc, and accelerates outward as propagules increase. Lack of intervening action allows cedar expansion to continue, and tree sizes to increase. Cedar will eventually modify site function in ways that promote further encroachment such as rainfall interception and stemflow, heavy duff litter, and shading of the herbaceous understory.

Restoration pathway R2A

State 2 to 1

Eradication of introduced cool-season grasses from this site will require long-term, targeted management efforts to create an adverse environment during the spring and late fall when bluegrass and brome are most actively growing, with favorable conditions during the summer to promote native warm-season species. Targeted practices such as prescribed burning, flash grazing, and herbicide are often employed at strategic times of the year to set back

undesirable species. The combination of practices should strive to mimic the historic disturbance regimes to which the desirable native species are best adapted.

Transition T2A **State 2 to 3**

If the conditions which initiated and fomented the colonization and expansion of cool-season invasion are not removed or mitigated, stand composition will continue to shift in this direction and begin to resemble a monoculture of bluegrass and/or brome. Due to the dense rhizomatous root mat of brome and bluegrass, native species suffer decreasing opportunities to contribute propagules, and individual plants lost are not replaced by desirable natives.

Transition T2B **State 2 to 4**

There are many possible triggers for this transition that may occur as acute events (e.g. plowing) or cumulative impacts of chronic events (e.g. long-term undermanaged grazing.) The absence of deep-rooted perennial cover exposes the site to topsoil loss, open nutrient cycle, and free space which collectively allow for opportunistic annual species to dominate.

Transition T2C **State 2 to 5**

The presence of an invasion source coupled with fire exclusion allows cedar seeds to germinate and establish within the herbaceous stand. This typically begins near fencerows, woody draws, etc, and accelerates outward as propagules increase. Lack of intervening action allows cedar expansion to continue, and tree sizes to increase. Cedar will eventually modify site function in ways that promote further encroachment such as rainfall interception and stemflow, heavy duff litter, and shading of the herbaceous understory.

Transition T3A **State 3 to 2**

Aggressive intervening actions will be required to simultaneously recolonize native grasses and suppress vigor in undesirable species. Restoration follows the same principles as the R2A pathway, but may also require native range seeding if the latent seedbank is inadequate.

Transition T3B **State 3 to 4**

Nutrient cycling, hydrologic function, and/or soil stability have been severely altered, and possibly compromised. This is a highly variable state in which the specific plants observed will depend largely on the original community and the nature of the disturbance.

Transition T3A **State 3 to 5**

The presence of an invasion source coupled with fire exclusion allows cedar seeds to germinate and establish within the herbaceous stand. This typically begins near fencerows, woody draws, etc, and accelerates outward as propagules increase. Lack of intervening action allows cedar expansion to continue, and tree sizes to increase. Cedar will eventually modify site function in ways that promote further encroachment such as rainfall interception and stemflow, heavy duff litter, and shading of the herbaceous understory.

Restoration pathway R4A **State 4 to 1**

With favorable weather and site stability, it may take just a few years for the site to naturally return to a perennial community. Range seeding can “jump start” the recolonization of desirable species and may re-establish a near reference grass community; although, forb diversity may take longer to recover. Depending on the nature of the

disturbance(s), additional ameliorative efforts may be necessary to mitigate accelerated erosion and weedy competition until the seeded perennial community has stabilized. It is possible for a disturbance and/or subsequent processes (e.g. accelerated erosion) to profoundly, and even permanently, alter fundamental soil properties in such a way that the site may never again exhibit its historic structure or function without extraordinary restoration inputs.

Restoration pathway R5A

State 5 to 1

Tree mortality is required to restore a grassland state, however the herbaceous response will depend on many factors such as method(s) used, mortality rates, and the remnant herbaceous species. Mechanical and chemical methods can remove cedars but will have little if any notable impact on the herbs. Reintroducing the historic fire regime will provide the most profound and beneficial effects, and seasonal timing and burn intensity can have significant influence on the herbaceous outcome. As a general rule, hot spring burns will not only kill trees but also stress shallower-rooted invasive cool-season grasses and promote a shift in favor of the reference community.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	Tall warm-season			1765–2354	
	big bluestem	ANGE	<i>Andropogon gerardii</i>	785–1177	–
	switchgrass	PAVI2	<i>Panicum virgatum</i>	196–392	–
	Indiangrass	SONU2	<i>Sorghastrum nutans</i>	196–392	–
	composite dropseed	SPCO16	<i>Sporobolus compositus</i>	0–196	–
	prairie dropseed	SPHE	<i>Sporobolus heterolepis</i>	0–196	–
2	Mid warm-season			981–1961	
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	588–1177	–
	sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	196–588	–
	purple lovegrass	ERSP	<i>Eragrostis spectabilis</i>	0–196	–
3	Shortgrasses			0–392	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0–392	–
	buffalograss	BODA2	<i>Bouteloua dactyloides</i>	0–196	–
4	Cool-season			336–1177	
	porcupinegrass	HESP11	<i>Hesperostipa spartea</i>	0–588	–
	needle and thread	HECO26	<i>Hesperostipa comata</i>	0–392	–
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	196–392	–
	Scribner's rosette grass	DIOLS	<i>Dichanthelium oligosanthos</i> var. <i>scribnerianum</i>	0–196	–
	fall rosette grass	DIWI5	<i>Dichanthelium wilcoxianum</i>	0–196	–
	Canada wildrye	ELCA4	<i>Elymus canadensis</i>	0–196	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–196	–
	green needlegrass	NAVI4	<i>Nassella viridula</i>	0–196	–
5	Grass-like			196–392	
	heavy sedge	CAGR4	<i>Carex grvida</i>	0–196	–
	sun sedge	CAINH2	<i>Carex inops</i> ssp. <i>heliophila</i>	0–196	–
	Mead's sedge	CAME2	<i>Carex meadii</i>	0–196	–
	sedge	CAREX	<i>Carex</i>	0–196	–

Forb					
6	Forb			196–392	
	Baldwin's ironweed	VEBA	<i>Vernonia baldwinii</i>	39–196	–
	hoary verbena	VEST	<i>Verbena stricta</i>	0–118	–
	western yarrow	ACMIO	<i>Achillea millefolium</i> var. <i>occidentalis</i>	0–118	–
	Cuman ragweed	AMPS	<i>Ambrosia psilostachya</i>	0–118	–
	candle anemone	ANCY	<i>Anemone cylindrica</i>	0–118	–
	field pussytoes	ANNE	<i>Antennaria neglecta</i>	0–118	–
	white sagebrush	ARLU	<i>Artemisia ludoviciana</i>	0–118	–
	groundplum milkvetch	ASCR2	<i>Astragalus crassicaarpus</i>	0–118	–
	false boneset	BREU	<i>Brickellia eupatorioides</i>	0–118	–
	white prairie clover	DACA7	<i>Dalea candida</i>	0–118	–
	purple prairie clover	DAPU5	<i>Dalea purpurea</i>	0–118	–
	Illinois ticktrefoil	DEIL2	<i>Desmodium illinoense</i>	0–118	–
	blacksamson echinacea	ECAN2	<i>Echinacea angustifolia</i>	0–118	–
	Maximilian sunflower	HEMA2	<i>Helianthus maximiliani</i>	0–118	–
	stiff sunflower	HEPA19	<i>Helianthus pauciflorus</i>	0–118	–
	dotted blazing star	LIPU	<i>Liatris punctata</i>	0–118	–
	rush skeletonplant	LYJU	<i>Lygodesmia juncea</i>	0–118	–
	stiff goldenrod	OLRI	<i>Oligoneuron rigidum</i>	0–118	–
	western marbleseed	ONBEO	<i>Onosmodium bejariense</i> var. <i>occidentale</i>	0–118	–
	purple locoweed	OXLA3	<i>Oxytropis lambertii</i>	0–118	–
	prairie groundsel	PAPL12	<i>Packera plattensis</i>	0–118	–
	silverleaf Indian breadroot	PEAR6	<i>Pedimelum argophyllum</i>	0–118	–
	large beardtongue	PEGR7	<i>Penstemon grandiflorus</i>	0–118	–
	upright prairie coneflower	RACO3	<i>Ratibida columnifera</i>	0–118	–
	prairie blue-eyed grass	SICA9	<i>Sisyrinchium campestre</i>	0–118	–
	compassplant	SILA3	<i>Silphium laciniatum</i>	0–118	–
	Missouri goldenrod	SOMI2	<i>Solidago missouriensis</i>	39–118	–
	white heath aster	SYER	<i>Symphyotrichum ericoides</i>	0–118	–
	aromatic aster	SYOB	<i>Symphyotrichum oblongifolium</i>	0–118	–
	large Indian breadroot	PEES	<i>Pedimelum esculentum</i>	0–118	–
Shrub/Vine					
7				196–392	
	Jersey tea	CEHE	<i>Ceanothus herbaceus</i>	0–196	–
	prairie rose	ROAR3	<i>Rosa arkansana</i>	0–196	–
	western snowberry	SYOC	<i>Symphoricarpos occidentalis</i>	0–196	–
	smooth sumac	RHGL	<i>Rhus glabra</i>	0–118	–
	leadplant	AMCA6	<i>Amorpha canescens</i>	0–118	–

Animal community

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 browsing livestock such as goats or sheep that will more heavily utilize invasive forbs and brush. Carrying capacity and production estimates are conservative estimates that should be used only as guidelines in initial stages of grazing lands planning.

Often, the 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. Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide year-long forage for cattle, sheep, or horses. During the dormant period, the protein levels of the forage may be lower than the minimum needed to meet livestock (primarily cattle and sheep) requirements.

Suggested stocking rates (carrying capacity*) for cattle under continuous season-long grazing under normal growing conditions are listed below:

- 1.1 Big bluestem-Little bluestem; 3500 lbs/acre production and 0.96 AUM/acre
- 1.2 Little bluestem-Sideoats grama; 3000 lbs/acre production and 0.82 AUM/acre
- 2.1 Subdominant smooth brome-KY bluegrass; 2700 lbs/acre production and 0.74 AUM/acre
- 2.2 Codominant smooth brome-KY bluegrass; 2400 lbs/ac and 0.66 AUM/acre with 50% or more introduced cool-season component
- 3.1 Smooth brome-KY bluegrass; 2750 lbs/ac and .75 AUM/ac, unfertilized, non-irrigated naturalized community. Refer to Forage Suitability Groups for cool-season pasture under a higher management level.

*Carrying capacity based on continuous season-long grazing by cattle under average growing conditions, 25% harvest efficiency. Air dry forage requirements based on 3% of animal body weight, or 912 lbs/AU/month.

If grazing distribution problems occur, stocking rates must be reduced to maintain plant health and vigor. Carrying capacity and production estimates are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Utilizing a rotational grazing system that allows for adequate rest and recovery will increase plant vigor and carrying capacity. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended to document plant composition and production. More precise carrying capacity estimates can be calculated based on actual site information along with animal preference data, particularly when livestock other than cattle are involved. With consultation of the land manager, more intensive grazing management may result in improved harvest efficiencies and increased carrying capacity.

Inventory data references

Information presented here has been derived from RANGE-417 archives, Rangeland NRI, and other inventory data. Field observations from range-trained personnel were also used. In addition to the multitude of NRCS field office employees and private landowners that helped with site visits and local knowledge, those involved in developing this site include:

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Russ Hamer, Biologist
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Nebraska Forest Service:
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Approval

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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)	Original Authors: Stu McFarland, Nadine Bishop (08/01/2013). Version V Authors: Nadine Bishop, Emily Helms, Jeff Nichols
Contact for lead author	jeffrey.nichols@usda.gov
Date	12/04/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Rills are not expected on this site.
2. **Presence of water flow patterns:** Typically, none. Water flow patterns may occur on steeper slopes (greater than 20 percent). When they occur, water flow patterns will be barely visible and discontinuous.
3. **Number and height of erosional pedestals or terracettes:** Typically, none. Erosional pedestals or terracettes may be present on steeper slopes (greater than 20 percent), becoming more common as slopes become steeper, but with no exposed roots. Drought or wildfire can contribute to increased incidences pedestalled plants.
4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically 5 percent or less. Bare ground may increase up to 10 percent during and immediately after multi-year drought.

Bare ground is exposed mineral soil that is not covered by vegetation (basal and/or foliar canopy), litter, standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

5. **Number of gullies and erosion associated with gullies:** None. Gullies are not expected on this site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind-scoured and/or depositional areas should not be present.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter of small and medium size classes will move after average to high rainfall events. Typically, none. Litter should fall in place. On steeper slopes (greater than 20 percent) fine litter may move short distances (less than 6 inches or 15 cm) of fine especially after high precipitation events. Litter movement from wind is not expected.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Surface Resistance to Erosion: Soil stability ratings will be 5 to 6, typically 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon is typically 8 to 14 inches (20 to 35 cm) thick. Soil colors range from dark grayish brown very dark brown to grayish brown (hue: 10YR, value: 2, 4 or 5, chroma: 2) when dry, and black, very dark grayish brown, or very dark brown when moist (hue: 10YR, value: 2 or 3, chroma: 1 or 2).

The structure of the A-horizon varies with soil series and ranges from weak fine granular to moderate medium subangular blocky parting to moderate fine and medium or weak fine granular; weak fine or weak fine and medium subangular blocky; weak coarse prismatic structure parting to weak coarse subangular blocky and weak fine granular.

See Official Soils Descriptions for additional details; major soil series correlated to the site are Belfore, Dempster, Ihlen, Moody, and Nora.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community composition is approximately 75 to 90 percent perennial grasses and grass-like, 5 to 10 percent forbs, and 5 to 10 percent shrubs which optimizes infiltration on the site. The grass and grass-like component is composed of C4, rhizomatous, tallgrasses; C4, midgrasses; C3, bunchgrasses; C3, rhizomatous grasses; C4, shortgrasses, and grass-like. The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration.

Invasion of introduced cool-season grasses such as Kentucky bluegrass and smooth brome may have an adverse impact infiltration and runoff. Tree encroachment may also negatively impact infiltration and runoff.

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

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

Dominant: Phase 1.1

1. Native, perennial, warm-season, tallgrass, 1575-2100#/ac, 45-60 percent (3 species minimum): big bluestem, Indiangrass, switchgrass, prairie dropseed, composite dropseed.
2. Native, perennial, warm-season, midgrass, 1575-2100#/ac, 45-60 percent (2 species minimum): Little bluestem, sideoats grama.

Phase 1.2

1. Native, perennial, warm-season, midgrass (2 species minimum): Little bluestem, sideoats grama.

Sub-dominant: Phase 1.1

1. Native, perennial, cool-season (C3), bunchgrass, 175-700 #/ac, 5-20 percent (2 species minimum): Canada wildrye, needle and thread, green needlegrass, porcupinegrass, prairie junegrass, fall rosette grass, Scribner's rosette grass.

Phase 1.2

1. Native, perennial, warm-season tallgrass, (2 species minimum): sand bluestem, Indiangrass, switchgrass, prairie sandreed.
2. Native, perennial, cool-season grass (3 species minimum): Canada wildrye, needle and thread, green needlegrass, porcupinegrass, prairie junegrass, fall rosette grass, Scribner's rosette grass.
3. Native, cool-season (C3) rhizomatous grass (1 species minimum): western wheatgrass

Other: Minor - Phase 1.1

1. Native, perennial, cool-season (C3), rhizomatous grass, 175-350 #/ac, 5-10 percent (1 species minimum): western wheatgrass.
2. Grass-likes, 175-350 #/ac, 5-10 percent: heavy sedge, sun sedge, Mead's sedge, other sedges.
3. Native forb, 175-350 #/ac, 5-10 percent: forbs present vary from location to location.
4. Shrubs, 175-350 #/ac, 5-10%: leadplant, Jersey tea, prairie rose, smooth sumac, western snowberry.
5. Native, perennial, warm-season (C4) short grasses, 0-350#/ac, 0-10 percent: blue grama, buffalograss.

Minor - Phase 1.2

1. Native, perennial, warm-season (C4) short grasses: blue grama, buffalograss.
2. Native forb: forbs present vary from location to location.
3. Native shrub: leadplant, Jersey tea, prairie rose, smooth sumac, western snowberry.
4. Grass-likes: heavy sedge, sun sedge, Mead's sedge, other sedges.

Additional: The Big Bluestem – Little Bluestem Reference Community (1.1) includes eight F/S groups which include in order of relative abundance, native, perennial, warm-season (C4), tallgrass; native, perennial, warm-season (C4), midgrass; native, perennial, cool-season (C3), bunchgrass; native, perennial, cool-season (C3), rhizomatous grass; grass-likes = native forbs = shrubs and native, perennial, warm-season (C4), shortgrass.

The Little Bluestem – Sideoats Community (1.2) includes eight F/S groups which include in order of relative abundance, native, perennial, warm-season (C4), midgrass; native, perennial, warm-season (C4), tallgrass; native, perennial, cool-season (C3), bunchgrass; native, perennial, cool-season (C3), rhizomatous grass; native, perennial, warm-season (C4), shortgrass = native forbs = shrubs; and grass-likes.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Bunchgrasses have strong, healthy centers with few (less than 3 percent) dead centers. Shrubs may show some dead branches (less than 5 percent) as plants age

14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 75 to 85 percent and at a depth of 0.50 to 1.0 inch (1.3-2.6 cm). Kentucky bluegrass excessive litter can negatively impact the functionality of this site.
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 3,500 pounds per acre in a year with normal precipitation and temperatures. Low and High production years should yield 2,400 and 4,300 pounds per acre respectively.
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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** No non-native invasive species are present. Annual bromes (cheatgrass and Japanese/field), musk thistle, Canada thistle, plumeless thistle, spotted and diffuse knapweed, sulphur cinquefoil, absinth wormwood, leafy spurge, and eastern redcedar are known invasives that have the potential to become dominant or co-dominant on the site
- .

Note: species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants.

17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to climatic conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
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