USDA Natural Resources Conservation Service

Ecological site R055BY059ND
Loamy Overflow

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: 42a – Missouri Coteau; 42b – Collapsed Glacial Outwash; 42c – Missouri Coteau Slope; 42d – Northern Missouri Coteau; 42f – Southern Missouri Coteau Slope; 42g – Ponca Plains; and 42h – Southern River Breaks.

Associated sites

R055BY056ND	**Clayey**
R055BY058ND	**Limy Subirrigated**
R055BY064ND	**Loamy**
R055BY065ND	**Subirrigated**
R055BY071ND	**Wet Meadow**

Similar sites

R055BY065ND	**Subirrigated** (055BY065ND) – Subirrigated (Sb) [Some what poorly drained soils with no evidence of lime or salts. Water table found at a depth of1.5 to 4’ from the soil surface at some point during the growing season. Found upslope from Wet Meadow sites and downslope of Loamy Overflow sites; can be in micro low or high positions within the listed associated sites. Indicator species are big bluestem intermixed with switchgrass and American licorice with shrubs like western snowberry. The site has more switchgrass, prairie cordgrass, less green needlegrass; higher production]

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Nassella viridula*

Physiographic features

This site occurs on areas that receive additional water from overflow of intermittent streams or runoff from adjacent slopes.

Table 2. Representative physiographic features

Landforms	(1) Till plain (2) Swale (3) Flood plain
Flooding duration	Brief (2 to 7 days)
Flooding frequency	None to frequent
Ponding frequency	None
Elevation	488–610 m
Slope	0–3%
Water table depth	91–203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 55B is considered to have a continental climate – cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are characteristic. The climate is the result of this MLRA’s location in the geographic center of North America. There are few natural barriers on the northern Great Plains. The air masses move unobstructed across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 16 to 21 inches per year. The normal average annual temperature is about 41.5° F. January is the coldest month with average temperatures ranging from about 2° F (Maddock, ND) to about 11° F (Mellette, SD). July is the warmest month with temperatures averaging from about 67° F (Maddock, ND) to about 73° F (Redfield 2 NE, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 64° F. This large annual range attests to the continental nature of this MLRA's climate. Winds average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 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 native cool-season plants begins in late March and continues to early to mid July. Native warm-season plants begin growth in mid May and continue to the end of August. Green up of cool-season plants can occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (average)	140 days
Freeze-free period (average)	161 days
Precipitation total (average)	533 mm

Influencing water features

Soil features

These are deep and very deep, moderately well and well drained, moderately coarse to moderately fine textured soils. Saturated hydraulic conductivity is moderate to slow and available water capacity is moderate to high. Salinity is none to very slight and sodicity is none. This site is in swale positions that regularly receive additional run-on from surrounding uplands or flooding. These soils occur on swales, terraces and footslopes on lake plains, residual uplands, till plains, and occasionally flooded low terraces and flood plains. Slope ranges from 0 to 6 percent. This site should show slight to no evidence of rills, wind scoured areas or pedestalled plants. Water flow paths are broken, irregular in appearance or discontinuous. The soil surface is stable and intact.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases where vegetative cover is not adequate. 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 sites: FOTG – http://www.nrcs.usda.gov/technical/efotg/; Web Soil Survey – http://websoilsurvey.nrcs.gov/app/

Table 4. Representative soil features

Surface texture	(1) Loam (2) Silt loam (3) Silty clay
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Slow to moderately rapid
Soil depth	203 cm
Surface fragment cover <=3"	0–10%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	15.24–30.48 cm
Calcium carbonate equivalent (0-101.6cm)	0–20%
Electrical conductivity (0-101.6cm)	0–4 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)	0–30%
Subsurface fragment volume >3" (Depth not specified)	0–5%

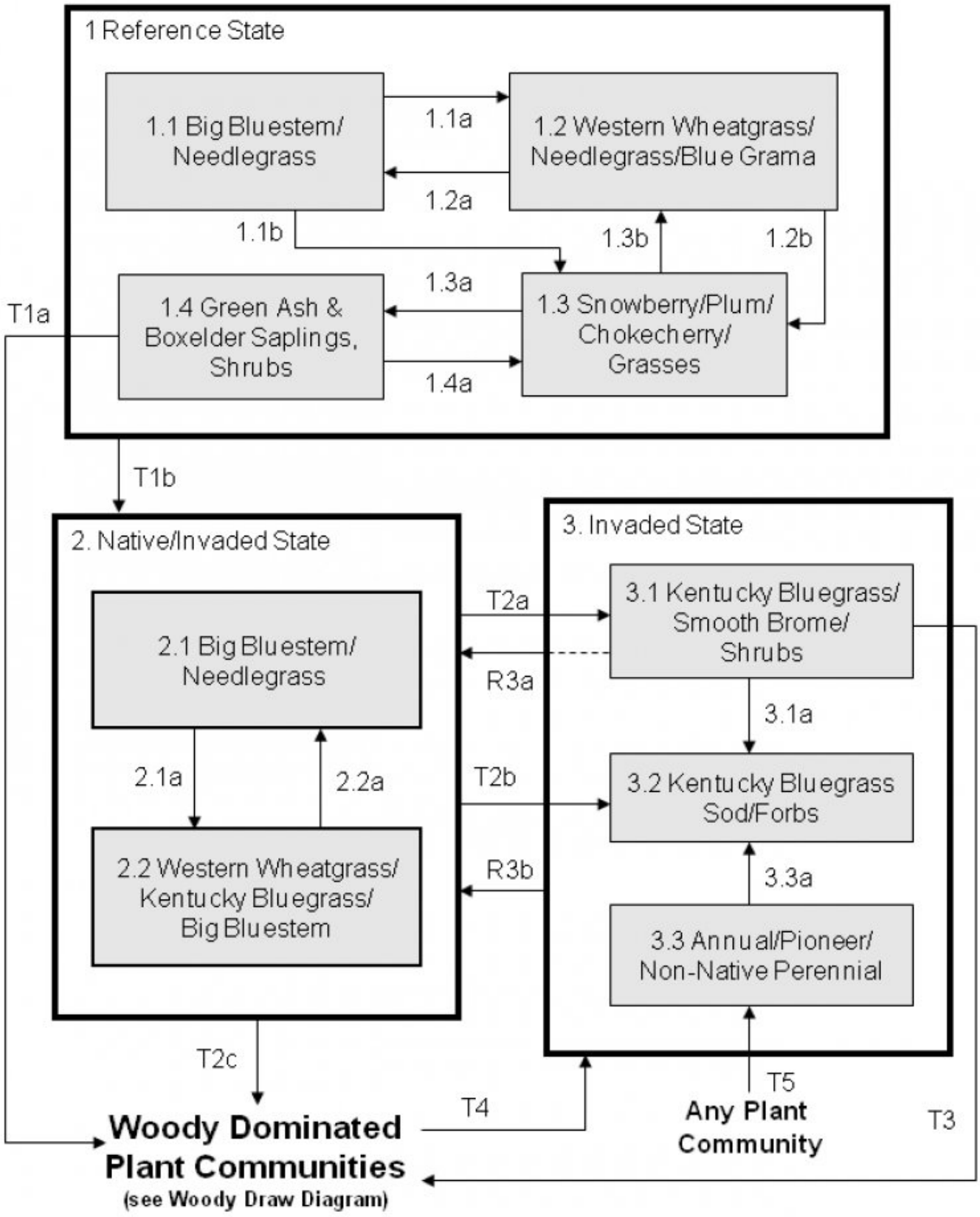
Ecological dynamics

The site developed under Northern Great Plains climatic conditions, and included natural influence of large herding herbivores and sporadic fire. Changes will occur in the plant communities due to weather fluctuations and/or management actions. Interpretations are based on the Big Bluestem/Needlegrass Plant Community Phase (1.1). Under adverse impacts, a slow decline in vegetative vigor and composition will occur. Under favorable conditions the site has the potential to resemble the Big Bluestem/Needlegrass Plant Community Phase. This community phase and 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 sporadic 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 and the use of fencing and reliable water sources have radically changed the disturbance regime of this site. Continuous grazing without adequate recovery periods following each grazing occurrence over several years causes this site to depart from the Reference State. Species such as western wheatgrass and blue grama will initially increase. Big bluestem, green needlegrass, and sideoats grama will decrease in frequency and production. In time, heavy continuous grazing will likely cause a stable dominance of Kentucky bluegrass and blue grama. These species then will have a competitive advantage which prevents other species from establishing or increasing. This plant community is less productive than the Reference State. Runoff increases and infiltration will decrease. Soil erosion will be minimal. 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 Kentucky bluegrass and/or smooth bromegrass. In time, shrubs such as western snowberry and chokecherry will likely increase and become co-dominant with the Kentucky bluegrass and smooth bromegrass.

The following diagram illustrates the common states, community phases, community pathways, transitions and restoration pathways that can occur on the site. These are the most common plant community phases and states based on current knowledge and experience, and changes may be made as more data is collected. Narratives following the diagram contain more detail pertaining to the ecological processes.

State and transition model



1.1a, 2.1a, T2b, 3.1a – Heavy continuous grazing; **1.2a, 1.3b** – Grazing, precipitation, and fire returned to more normal disturbance levels; **1.2b, 1.3a, T1a, T2a, T2c, T3** – Non-use or light use, and no fire for extended periods; **1.3b, 1.4a** – Fire or heavy browsing; **T1b** – Encroachment of non-native species; **2.2a** – Prescribed grazing with adequate recovery opportunity; **3.3a** – Time with or without grazing; **R3a** – Prescribed burning followed by prescribed grazing; **R3b** – Range seeding followed by prescribed grazing; **T4** – Fire or removal of woody vegetation coupled with encroachment of non-native species; **T5** – Cropped go-back.

State 1
Reference

This state description represents the natural range of variability that dominated the dynamics of this ecological site. Historically, this state ranged from a tall, warm season grass dominated site to one dominated by deciduous saplings and shrubs depending upon disturbance regime. The primary disturbance mechanisms for this site in the reference condition included periodic 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. Dominance during the herbaceous phases of this state shifted between warm-season and cool-season grasses. Although slight shifts in the timing of energy capture, hydrologic function and nutrient cycling between plant community phases with the Reference state may have occurred, overall the ecological process were functioning at near optimum levels. High basal density and deep root systems resulted in low runoff rates and high infiltration rates. Small areas of trees and shrubs may have existed within this state due to irregularity of burn patterns. Small areas which escaped fire may have permitted trees/shrubs to become established. These areas may have served as a seed source for further expansion of the woody dominated plant communities as the fire frequency was altered after settlement. was altered after settlement.

Community 1.1
Big Bluestem/Needlegrass Plant Community Phase

The plant community upon which interpretations are primarily based is the Big Bluestem/Needlegrass Plant Community Phase. This community evolved with grazing by large herbivores and occasional prairie fire. The vegetation was about 80 to 90 percent grasses and grass-like plants, 5 to 10 percent forbs, 5 to 10 percent shrubs, and 0 to 3 percent trees. Major grasses included big bluestem, green needlegrass, Indiangrass, switchgrass, porcupine grass and western wheatgrass. Other grasses that occurred within this community included slender wheatgrass, bearded wheatgrass, Canada wildrye, little bluestem, sideoats grama, and northern reedgrass. Major forbs and shrubs included American licorice, sunflower, goldenrod, and western snowberry. Scattered green ash, American elm and other native tree species may have occurred. This plant community was well adapted to the Northern Great Plains climatic conditions. Individual species varied greatly in production depending on growing conditions (timing and amount of precipitation and temperature). Community dynamics, nutrient cycle, water cycle and energy flow were properly functioning. Due the diversity of warm and cool season species within this plant community phase, energy capture was spread more evenly throughout the growing season compared to other plant community phases within this state. Plant litter was properly distributed, in contact with the soil surface and with very little movement off-site. Natural plant mortality was very low. The diversity in plant species allowed for high drought tolerance. Run-off from adjacent sites and moderate or high available water capacity provided a favorable soil-water-plant relationship.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	2768	3556	4231
Shrub/Vine	185	319	504
Forb	185	319	504
Tree	–	64	140
Total	**3138**	**4258**	**5379**

Figure 5. Plant community growth curve (percent production by month). ND5504, Central Black Glaciated Plains, warm-season dominant, cool-season sub-dominant.. Warm-season dominant, cool-season sub-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	1	5	20	38	25	8	3	0	0	0

Community 1.2

Western Wheatgrass/Needlegrasses/Blue Grama Plant Community

The pathway described in 1.1a reduced the tall warm-season grass component in stature and extent while the grazing tolerant mid statured needlegrass and the short statured blue grama increased. The tall warm-season grasses did not disappear from the plant community but were reduced in vigor. Major grasses included western wheatgrass, green needlegrass, porcupine grass, and blue grama. Big bluestem, switchgrass and Indiangrass were reduced to minor components. Forbs such as western yarrow, goldenrods, and western ragweed would have increased in extent and proportions. Due to the increase in the cool-season grass component of the plant community, energy capture shifted to the early portion of the growing season. Nutrient cycling likely still functioned near optimum levels; however, hydrologic processes would have been somewhat impaired with the increase of the shorter statured, shallower rooted species.

Figure 6. Plant community growth curve (percent production by month). ND5503, Central Black Glaciated Plains, cool-season/warm-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 1.3
Snowberry/Plum/Chokecherry/Grasses

Although this community phase appeared shrub dominated, grasses still constituted the majority of the production for this community phase. The vegetation was about 50 to 80 percent grasses and grass-like plants, 5 to 10 percent forbs, 15 to 30 percent shrubs, and 2 to 10 percent trees. Major grasses included western wheatgrass, green needlegrass, slender/bearded wheatgrass and Canada wildrye. Big bluestem, switchgrass and Indiangrass were minor components. Prominent forbs would have included meadow anemone, goldenrods, and American licorice. Shrub species would have included snowberry, plum, chokecherry, hawthorn, leadplant, and rose. The increase of shading and litter fall has a cooling effect on the soil surface, and provides for favorable micro-sites for establishment of various tree species. Without a disturbance that reduces woody vegetation, these changes have a tendency to result in an increase of shrubs and trees on the site. Within this plant community phase, scattered mature trees such as American elm, boxelder and green ash would have been present but a majority of tree species would have been maintained at the seedling and sapling stage.

Community 1.4
Green Ash & Boxelder Saplings, Shrubs

This plant community phase is dominated by woody plant species. Visually, saplings of green ash, boxelder and cottonwood would have been prominent but shrub species would have been the most productive component of this plant community phase. Herbaceous species would have constituted a sub-dominant component in the early stages of this phase, declining as tree canopy increased. The vegetation was about 50 to 75 percent grasses and grass-like plants, 5 to 10 percent forbs, 15 to 30 percent shrubs, and 2 to 10 percent trees. This plant community phase was nearing a threshold which would have lead to dominance by trees and a significant reduction in the herbaceous component of the site.

Pathway 1.1a
Community 1.1 to 1.2

This pathway occurred as a result of relatively heavy, continuous grazing typically in successive years. This typically occurred in areas adjacent to water sources. Successive years of below normal precipitation may also have contributed to this shift.

Pathway 1.2a
Community 1.2 to 1.1

A return to normal fire, grazing and weather regimes resulted in a plant community shift to the 1.1 Big Bluestem/Needlegrass Plant Community Phase.

Pathway 1.2b
Community 1.2 to 1.3

Avoidance of fire due to micro site and weather, and slight to no use on the woody vegetation.

Pathway 1.3b
Community 1.3 to 1.2

A combination of intense disturbance events (fire, drought, grazing) occurring over multiple years reduced shrub vigor allowing a shift toward an herbaceous dominated plant community.

Pathway 1.3a
Community 1.3 to 1.4

This shift resulted when areas of indeterminate size escaped multiple fire events due to cooler/wetter microclimates, above normal precipitation and/or the mosaic of natural fire patterns.

Pathway 1.4a
Community 1.4 to 1.3

A single, intense fire event causing high tree sapling mortality resulted in a shift to a shrub dominated plant community.

State 2
Native/Invaded

This state is very 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 is still dominated by mid and tall native warm- and cool-season grasses, 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. Timing and intensity of grazing events coupled with weather dictate the dynamics that occur within this state. The cool-season native grasses can decline and an increase in introduced sod grasses will occur. Many times, this state appears as a mosaic of community phases caused primarily by continuous season-long grazing.

Community 2.1
Big Bluestem/Needlegrass

This plant community phase closely resembles plant community phase 1.1 with the addition of minor amounts of non-native species. The vegetation is about 75 to 90 percent grasses and grass-like plants, 5 to 10 percent forbs, 5 to 10 percent shrubs, and 0 to 3 percent trees. Major grasses include big bluestem, needlegrasses, Indiangrass, switchgrass and western wheatgrass. Other grasses within this community include porcupine grass, Canada wildrye, and bearded wheatgrass. Major forbs and shrubs include American licorice, sunflower, goldenrod, and western snowberry. Scattered green ash, American elm and other native tree species may occur on the site. Ecological processes are functioning at levels near what would be expected for the Reference State although nutrient cycling may be somewhat altered due to changes in disturbance regimes (lack of fire, frequency and intensity of grazing events) and energy capture may be shifted slightly to more late spring, early summer.

Figure 7. Plant community growth curve (percent production by month). ND5504, Central Black Glaciated Plains, warm-season dominant, cool-season sub-dominant.. Warm-season dominant, cool-season sub-dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	1	5	20	38	25	8	3	0	0	0

Community 2.2
Western Wheatgrass/Kentucky Bluegrass/Big Bluestem

This plant community phase is characterized by a shift to mid cool-season rhizomatous grasses with minor amounts

of tall warm-season and mid cool-season bunchgrasses. The vegetation is about 75 to 90 percent grasses and grass-like plants, 5 to 10 percent forbs, 5 to 10 percent shrubs, and 0 to 3 percent trees. Dominant grasses would include western wheatgrass and Kentucky bluegrass with minor amounts of needlegrasses, big bluestem and switchgrass. Major forbs would include western ragweed, goldenrods and western yarrow. Chokecherry and snowberry would be the dominate shrubs. Scattered green ash and American elm trees may be present. Energy capture by this plant community phase has shifted from late spring and summer to early spring through early summer.

Figure 8. Plant community growth curve (percent production by month). ND5502, Central Black Glaciated Plains, 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 will shift the competitive advantage from the tall warm-season and mid cool-season bunchgrasses to the more grazing tolerant mid and short statured cool-season rhizomatous grasses.

Pathway 2.2a
Community 2.2 to 2.1

The implementation of prescribed grazing including adequate recovery periods between grazing events and season of use change will initiate this pathway by shifting the competitive advantage away from the mid and short cool-season rhizomatous grasses to the tall warm-season and cool-season bunchgrasses.

State 3
Invaded

This state is the result of invasion and dominance by Kentucky bluegrass, smooth bromegrass and/or pioneer annual/perennial species depending upon the intensity and frequency of disturbance regime. 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 non-native sodgrasses rebound and again dominate the system.

Community 3.1
Kentucky Bluegrass/Smooth Bromegrass/Shrubs

This plant community phase is characterized by a co-dominance of Kentucky bluegrass and smooth bromegrass. Lack of further disturbance usually results in dominance by smooth bromegrass. Some remnant native grasses such as green needlegrass and big bluestem may still be present. Grasses constitute about 70 to 90 percent of the production with forbs contributing 5 to 10 percent, shrubs 5 to 15 percent and trees 0 to 3 percent. Dominant forbs include cudweed sagewort, goldenrod, and American licorice. Shrubs would include snowberry, plum, chokecherry and prairie rose. The opportunity for high intensity spring burns is reduced by early green up and increased moisture and humidity at the soil surface. Grazing pressure cannot induce a reduction in sodgrass dominance. Production is limited to the sod forming species. Infiltration continues to decrease and runoff increases. Energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominate species and lack of litter to soil surface contact.

Figure 9. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	8	24	45	10	3	5	2	0	0

Community 3.2
Kentucky Bluegrass Sod/Forbs

This plant community phase is characterized by a dense Kentucky bluegrass sod. Kentucky bluegrass is the dominant grass species with minor amounts of other grasses such as western wheatgrass and ticklegrass as well as grass-likes still represented. Forb species would include curly-cup gumweed, western yarrow and stiff goldenrod. Shrubs are very limited but may include snowberry. The opportunity for spring burns is severely limited due to lack of fine fuel and early green up. Production is reduced due to lack of plant vigor. Infiltration is greatly reduced due to the dense sod while energy capture is shifted to early spring through early summer.

Figure 10. Plant community growth curve (percent production by month). ND5501, Central Black Glaciated Plains, cool-season dominant. Cool-season dominant..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	8	24	45	10	3	5	2	0	0

Community 3.3
Annual/Pioneer/Non-Native Perennial

The Annual/Pioneer/Non-Native Perennial community phase is highly variable depending on the level and duration of disturbance related to the T5 transitional pathway. In this MLRA, the most probable origin of this phase is secondary succession following cropland abandonment. This plant community will initially include a variety of annual forbs and grasses. Overtime, the introduced cool-season perennial grasses will begin to establish on this site. Community Pathway 3.3a – With grazing and time, the grazing tolerant Kentucky bluegrass will continue to increase leading to community phase 3.2. In the absence of grazing, this pathway will lead to a community phase resembling 3.1 with the primary difference being the lack of western snowberry and remnant native grass species.

Pathway 3.1a
Community 3.1 to 3.2

Heavy continuous season-long grazing will result in a shift to the Kentucky Bluegrass/Forb plant community phase by favoring the very grazing tolerant Kentucky bluegrass and unpalatable forbs. Smooth bromegrass will be reduced to a minor component while the shrubs will be reduced in vigor.

Pathway 3.3a
Community 3.3 to 3.2

With grazing and time, the grazing tolerant Kentucky bluegrass will continue to increase leading to community phase 3.2. In the absence of grazing, this pathway will lead to a community phase resembling 3.1 with the primary difference being the lack of western snowberry and remnant native grass species.

State 4
Wooded

Historically, this state existed as small patches of trees and shrubs scattered across the site. Repeated intense disturbances (e.g., fire, fire coupled with grazing) would have reverted these smaller patches of trees to the herbaceous dominated Reference State (State 1) in pre-European times, while it will likely revert to the Invaded State (State 4) today. For simplification purposes, the pre-European transition returning from the wooded state to the reference state is not shown on the state and transition diagrams. Likewise the pre-European and modern day conditions of the Wooded State are combined within this state description. Community phases 4.1 and 4.2 would have occurred in pre-European times without the presence of non-native species; whereas, community phase 4.3 will only be present in modern times, and all three community phases will likely have some amounts of non-native species in the present day. Otherwise, the community pathways between 4.1 and 4.2 would generally apply in both pre-European and under modern day circumstances. In pre-European times, periodic low intensity fires typically would have maintained these small, wooded patches in a tree dominated state. Alterations to the historic fire and grazing disturbance regimes have resulted in these scattered tree/shrub patches forming almost continuous woody dominated plant communities across the site. This state is characterized by an overstory of tall trees, an understory

of shrubs and, depending upon the amount of canopy cover, an herbaceous understory of sedges and/or Kentucky bluegrass.

Community 4.1
Green Ash/American Elm

This plant community phase is characterized by a dominance of green ash with lesser amounts of American elm, bur oak, boxelder, cottonwood, and occasionally other tree species. Shrubs may include chokecherry, plum, snowberry, and gooseberry. An herbaceous understory of sedges, wildrye, slender and/or bearded wheatgrass and the more shade-tolerant forbs such as false Solomon's-seal, stickseed, Northern bedstraw, wood lily, and others may also be present depending upon the amount of canopy cover. The stage would be considered an early mature seral stage. Canopy has not closed and is relatively diffuse allowing for a moderate level of herbaceous and shrub production. As the trees mature and canopy cover increases herbaceous production declines and shrubs/vines associated with mature woodlands may begin to occupy the understory.

Community 4.2
American Elm/Green Ash

This plant community phase is a result of a lack of disturbance for extended periods of time. Initially, tree regeneration is still taking place, but has been greatly reduced. Over time, the tree canopy becomes closed or nearly so. The herbaceous understory is greatly reduced, and can at times seem almost non-existent. This would be considered an over-mature seral stage. In pre-European times or in areas not affected by disease, American elm would have become more dominant in the overstory. Shade tolerant trees and shrubs would make up the secondary stand or the understory of this community. Species such as ironwood increase substantially in the shaded levels of the secondary stand of this community.

Community 4.3
Green Ash/Shrubs/Kentucky Bluegrass/Smooth Bromegrass

This plant community phase is characterized by a "park like appearance" with scattered mature green ash and bur oak. Little regeneration occurs. Snowberry and scattered chokecherry are the primary shrubs. Invasive cool season sod forming grasses become the dominant herbaceous cover. The establishment of tree seedlings is further limited by the competitive nature of these grasses.

Pathway 4.1a
Community 4.1 to 4.2

Lack of disturbance can lead to a reduced regeneration of tree species, and allows for closure of the tree canopy. In pre-European times, the occurrence of this pathway would have been limited to areas randomly escaping fire, or if patches became large enough to prevent fire from carrying through the entire patch.

Pathway 4.2a
Community 4.2 to 4.1

Periodic low intensity fire removes some of the understory and smaller trees, and stimulates tree regeneration which leads plant community 4.2 back to the Green Ash/American Elk Plant Community Phase (4.1).

Pathway 4.2b
Community 4.2 to 4.3

Lack of disturbance can lead to a reduced regeneration of tree species. Encroachment of non-native species also has detrimental impacts on the ecological processes, and results in dramatic changes in the understory.

Transition T1b
State 1 to 2

This is the transition from the native herbaceous or herbaceous/shrub dominated reference state to the herbaceous

dominated native/invaded state. This transition occurs when propagules of non-native species such as Kentucky bluegrass and/or smooth bromegrass are present and become established on the site. This occurs as natural and/or management actions (altered grazing and/or fire regime) favor a decline in the composition of the warm-season native species and an increase in cool-season sodgrasses. Chronic season-long or heavy late season grazing facilitates this transition. Complete rest from grazing and no fire events can also lead to this transition. The threshold between states is crossed when the non-natives become established on the site.

Transition T5
State 1 to 3

This transition occurs with cessation of cropping practices being applied to any plant community phase on this ecological site.

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State 1 to 3

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Transition T5
State 1 to 3

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Transition T5
State 1 to 3

This transition occurs with cessation of cropping practices being applied to any plant community phase on this ecological site.

Transition T1a
State 1 to 4

This is the transition from the native herbaceous or herbaceous/shrub dominated Reference State to a state that was dominated by mature trees and shrubs. Change in fire frequency allowed woody plant species to grow large enough to escape the next fire event. As trees increased in size, canopy cover increased which altered micro-climate and reduced fine fuel amounts resulting in reduced fire intensity and frequency. This would have been the primary pathway under the historic disturbance regime and would have resulted in a mosaic pattern of small wooded patches interspersed within herbaceous plant community phases.

Transition T5
State 2 to 3

This transition occurs with cessation of cropping practices being applied to any plant community phase on this ecological site.

Transition T5
State 2 to 3

This transition occurs with cessation of cropping practices being applied to any plant community phase on this ecological site.

Transition T2a
State 2 to 3

This represents the transition from the more native dominated Native/Invaded State to a plant community phase

dominated by non-native cool-season rhizomatous grasses. Complete rest from grazing and elimination of fire are the two major contributors to this transition, especially when smooth bromegrass is present. 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 T2b
State 2 to 3

This represents the transition from the more native dominated Native/Invaded State to a plant community phase dominated by a dense Kentucky bluegrass sod and grazing tolerant forbs. Heavy continuous season-long grazing is the major contributor to this transition. 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 T2c
State 2 to 4

This represents the transition from the Native/Invaded State (State 2) to the Wooded State (State 4) under the current disturbance regime. Lack of fire and grazing shifts the competitive advantage to the trees and shrubs. Rather than patches of trees and shrubs interspersed within herbaceous dominated plant communities as referenced in the T1a transitional pathway, this transition results in an expansion of the patches into an almost continuous woody dominated site.

Restoration pathway R3a
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 community phase 3.1. 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. Early season burning seems to be the most effective method to achieve the desired results; however, some work has shown that fall burning may also be effective. Both prescribed grazing and prescribed burning are necessary to successfully initiate this restoration pathway.

Restoration pathway R3b
State 3 to 2

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 chemical herbicides and the use of mechanical seeding methods using adapted varieties of the dominant native grasses are possible and can be successful. After establishment of the native plant species, management objectives must include the maintenance of those species, the associated reference state functions and continued treatment of the introduced sodgrasses.

Transition T3
State 3 to 4

This pathway represents the transition from the Kentucky Bluegrass/Smooth Bromegrass/Shrub plant community phase to the Wooded State (State 4). This transition results from the complete removal of fire and grazing related disturbances. This shifts the competitive advantage to the shrubs and trees. As the woody canopy increases, only shade tolerant herbaceous species remain in the understory.

Transition T4
State 4 to 3

This transitional pathway involves a dramatic decrease in the amount and extent of the woody component of the plant community through either catastrophic fire and/or mechanical removal of the trees and shrubs. Potentially, this pathway could also be initiated or compounded with the introduction of various tree and/or shrub diseases or pests.

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 Grasses**			852–1704	
	big bluestem	ANGE	*Andropogon gerardii*	852–1704	–
	switchgrass	PAVI2	*Panicum virgatum*	85–426	–
	Indiangrass	SONU2	*Sorghastrum nutans*	85–426	–
2	**Needlegrass**			213–639	
	green needlegrass	NAVI4	*Nassella viridula*	128–639	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	43–426	–
	Canada wildrye	ELCA4	*Elymus canadensis*	43–213	–
3	**Mid Cool-season Grasses**			85–426	
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	85–426	–
	slender wheatgrass	ELTRS	*Elymus trachycaulus ssp. subsecundus*	85–426	–
	western wheatgrass	PASM	*Pascopyrum smithii*	85–426	–
	northern reedgrass	CASTI3	*Calamagrostis stricta ssp. inexpansa*	0–213	–
4	**Warm-season Grasses**			0–213	
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–213	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–213	–
	prairie dropseed	SPHE	*Sporobolus heterolepis*	0–213	–
5	**Other Native Grasses**			43–128	
	Graminoid (grass or grass-like)	2GRAM	*Graminoid (grass or grass-like)*	0–128	–
	blue grama	BOGR2	*Bouteloua gracilis*	43–128	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–43	–
6	**Grass-likes**			43–170	
	sedge	CAREX	*Carex*	43–170	–
	Grass-like (not a true grass)	2GL	*Grass-like (not a true grass)*	0–85	–
Forb					
7	**Forbs**			213–426	
	Forb, native	2FN	*Forb, native*	43–213	–
	American licorice	GLLE3	*Glycyrrhiza lepidota*	43–128	–
	Maximilian sunflower	HEMA2	*Helianthus maximiliani*	43–128	–
	stiff sunflower	HEPA19	*Helianthus pauciflorus*	43–85	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	43–85	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	43–85	–
	Canadian anemone	ANCA8	*Anemone canadensis*	0–85	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	43–85	–
	wavyleaf thistle	CIUN	*Cirsium undulatum*	43–85	–

	cinquefoil	POTEN	*Potentilla*	43–85	–
	scurfpea	PSORA2	*Psoralidium*	43–85	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	43–85	–
	ragwort	SENEC	*Senecio*	43–85	–
	goldenrod	SOLID	*Solidago*	43–85	–
	purple prairie clover	DAPU5	*Dalea purpurea*	43–85	–
	white heath aster	SYER	*Symphyotrichum ericoides*	43–85	–
	American vetch	VIAM	*Vicia americana*	43–85	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–43	–
	golden tickseed	COTI3	*Coreopsis tinctoria*	0–43	–
	wood lily	LIPH	*Lilium philadelphicum*	0–43	–
	soft-hair marbleseed	ONBEB	*Onosmodium bejariense var. bejariense*	0–43	–
Shrub/Vine					
8	**Shrubs**			213–426	
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–213	–
	snowberry	SYMPH	*Symphoricarpos*	43–213	–
	American plum	PRAM	*Prunus americana*	43–128	–
	chokecherry	PRVI	*Prunus virginiana*	0–128	–
	prairie rose	ROAR3	*Rosa arkansana*	43–85	–
	leadplant	AMCA6	*Amorpha canescens*	43–85	–
	hawthorn	CRATA	*Crataegus*	0–43	–
Tree					
9	**Trees**			0–128	
	Tree	2TREE	*Tree*	0–128	–
	boxelder	ACNE2	*Acer negundo*	0–128	–
	common hackberry	CEOC	*Celtis occidentalis*	0–128	–
	green ash	FRPE	*Fraxinus pennsylvanica*	0–128	–
	hophornbeam	OSVI	*Ostrya virginiana*	0–128	–
	cottonwood	POPUL	*Populus*	0–128	–
	willow	SALIX	*Salix*	0–128	–
	basswood	TILIA	*Tilia*	0–128	–
	American elm	ULAM	*Ulmus americana*	0–128	–

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

Water is the principal factor limiting herbage production on this site. The site is dominated by soils in hydrologic group B, with localized areas in hydrologic group C. Infiltration and runoff potential for this site varies from negligible to moderate depending on soil hydrologic group and ground cover. In many cases, areas with greater than 75% ground cover have the greatest potential for high infiltration and lower runoff. An exception would be where shortgrasses form a dense sod and dominate the site. Areas where ground cover is less than 50% have the greatest potential to have reduced infiltration and higher runoff (refer to Section 4, NRCS National Engineering Handbook for runoff quantities and hydrologic curves).

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants which bloom from spring until fall have an esthetic value that appeals to visitors.

Wood products

No appreciable wood products are present on the site.

Other products

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

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 Range Management Specialist; Michael D. Brand, State Land Dept., Director Surface Management; David Dewald, NRCS State Biologist; Jody Forman, NRCS Range Management Specialist; Jeff Printz, NRCS State Range Management Specialist; Kevin Sedivec, Extension Rangeland Management Specialist; Shawn Dekeyser, North Dakota State University; Rob Self, The Nature Conservancy and Lee Voigt, NRCS Range Management Specialist.

Other references

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Contributors

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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)	Jeff Printz, Stan Boltz, Lee Voigt, Jody Forman
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Date	02/10/2012
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:** None.

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.

7. **Amount of litter movement (describe size and distance expected to travel):** Little to no plant litter movement. Litter orientation may be affected by heavy rainfall events but will remain in place.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil aggregate stability ratings should typically be 5 to 6, normally 6. 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):** 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):** None. Soil layers may contain stratification which should not be interpreted as compaction.

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

    Dominant: Tall, warm-season rhizomatous grasses >

    Sub-dominant: Mid, cool-season bunchgrasses >

    Other: Mid and short, cool-season grasses > forbs = shrubs > mid and short, warm-season grasses > grass-likes

    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):** 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):** Representative value = 3800 lbs/ac air dry with a range of 2800 to 4800 lbs/acre air dry depending upon growing conditions.

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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/local noxious weeds, Kentucky bluegrass, smooth bromegrass, Russian olive, Siberian elm.

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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.
