Ecological site R102BY040SD
Loamy Floodplain

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 102B–Till Plains

The Till Plains (102B) is located within the Western Lake Section of the Central Lowland Province of the Interior Plains. It is entirely in South Dakota, encompassing 2,215 square miles (Figure 1). The elevation ranges from 1,140 to 1,880 feet. The MLRA is characterized by glaciated, nearly level to hilly plains populated by stagnation and end moraines, glacial outwash terraces, and floodplains as the major landforms. The dominant parent materials are silty drift, glacial till, glacial outwash, and alluvium. (USDA-NRCS, 2006)

The dominant soil order in this MLRA is Mollisols. The soils in the area dominantly have a mesic temperature regime, a udic ustic moisture regime and mixed or smectitic mineralogy. They generally are very deep, well drained to poorly drained, and clayey or loamy. This area is in the western area of the tall grass prairie and supports big bluestem (Andropogon gerardi), little bluestem (Schizachyrium scoparium), Indiangrass (Sorghastrum nutans), porcupine grass (Hesperostipa spartea), and green needlegrass (*Nassella viridula*) as the dominant native species. Cattails (Typha), prairie cordgrass (Spartina pectinate), bulrush (Cyperaceae) and reed canarygrass (Phalaris arundinacea) are commonly found on the poorly drained soils. (USDA-NRCS, 2006).

Classification relationships

Major Land Resource Area (MLRA): Till Plains (102B) (USDA-NRCS, 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Outer Coteau des Prairies (251Bb); Yankton Hills and Valleys (251Bf); Northwest Iowa Plains (251Bd); (Cleland et al., 2007).

US EPA Level IV Ecoregion: Prairie Coteau (46k); James River Lowland (46n); Loess Prairies (47a); Big Sioux Basin (46m) - (USEPA, 2013)

Ecological site concept

The Loamy Floodplain ecological site occurs in high floodplain areas. Soils are moderately well drained which have water flow into and over or through the site and have occasional to frequent flooding.

Vegetation in the Reference State is dominated by warm-season grasses including big bluestem, Indiangrass, and switchgrass. Trees may be common on this site, including green ash and plains cottonwood. The site may become invaded by non-native grasses including Kentucky bluegrass and smooth bromegrass.

Associated sites

R102BY002SD	**Linear Meadow** These sites occur on lower floodplain area. Soil are poorly to very poorly drained which have a water table within 2 feet of the soil surface that persists longer than the wettest part of the growing season, typically until the month of August. The central concept soil series are Arlo and Clamo, but other series are included.
R102BY003SD	**Subirrigated** These sites occur in drainageways. Soils are somewhat poorly drained which have a water table within 2 to 5 feet of the soil surface that persists longer than the wettest part of the growing season, typically until the month of August. The central concept soil series is Lamo, but other series are included.

Similar sites

R102BY020SD	**Loamy Overflow** The Loamy Overflow site occurs in upland swales. Soils are moderately well drained which have water flow into and over and through the site. The Loamy Overflow site will have less shrubs and trees compared to the Loamy Floodplain site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon gerardii* (2) *Sorghastrum nutans*

Physiographic features

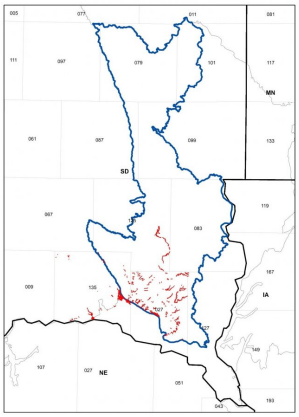

Figure 1. Site Distribution Map for the Loamy Floodplain site in MLRA 102B.

Table 2. Representative physiographic features

Landforms	(1) Plains > Flood plain
Flooding duration	Brief (2 to 7 days)
Flooding frequency	Rare to frequent
Elevation	1,140–1,880 ft
Slope	0–2%
Water table depth	30–80 in

Climatic features

Major Land Resource Area 102B is considered to have a continental climate with cold winters and relatively hot

summers, low to moderate humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of the location of this MLRA near the geographic center of North America. There are few natural barriers on the Northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 24 to 26 inches per year. The average annual temperature is about 46°F. January is the coldest month with average temperatures ranging from about 14°F (Wentworth 2 WNW, South Dakota, to about 18°F (Canton 4 WNW, SD). July is the warmest month with temperatures averaging from about 72°F (Wentworth 2 WNW, SD), to about 73°F (Canton 4 WNW, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57°F. This large annual range attests to the continental nature of the climate of this area. Hourly winds are estimated to average about 11 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 10 mph 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 mph.

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

Table 3. Representative climatic features

Frost-free period (characteristic range)	124-127 days
Freeze-free period (characteristic range)	138-140 days
Precipitation total (characteristic range)	26 in
Frost-free period (actual range)	123-128 days
Freeze-free period (actual range)	137-141 days
Precipitation total (actual range)	26-27 in
Frost-free period (average)	126 days
Freeze-free period (average)	139 days
Precipitation total (average)	26 in

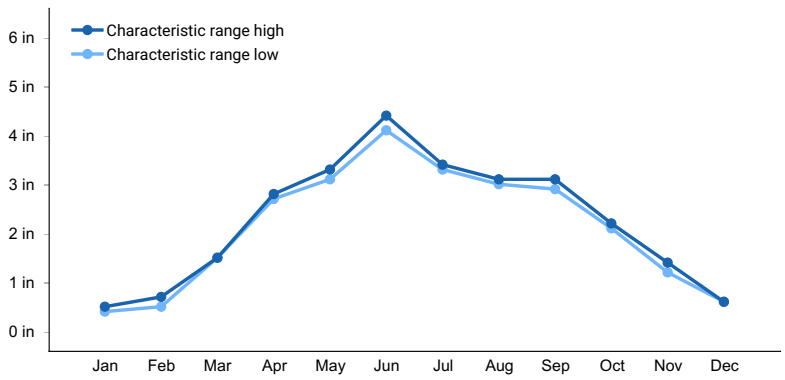

Figure 2. Monthly precipitation range

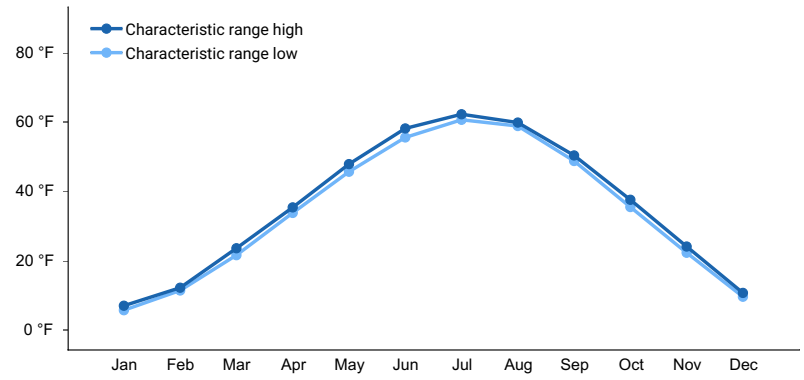

Figure 3. Monthly minimum temperature range

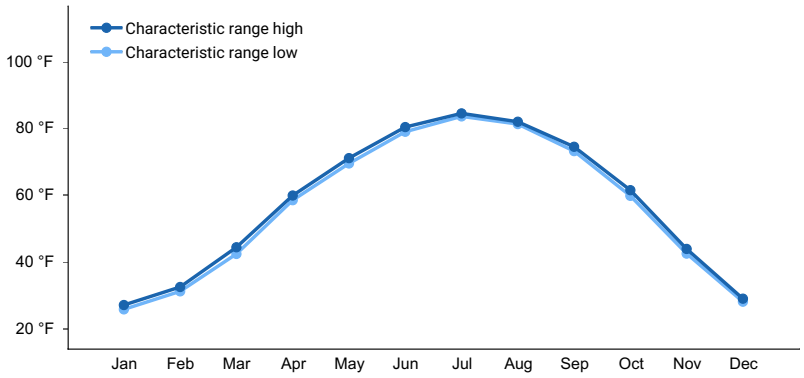

Figure 4. Monthly maximum temperature range

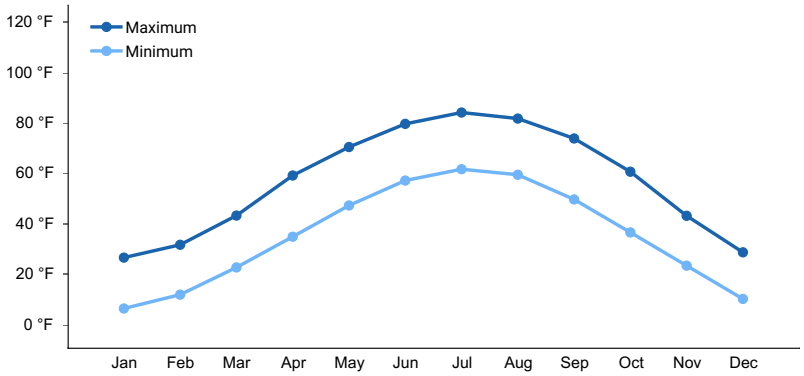

Figure 5. Monthly average minimum and maximum temperature

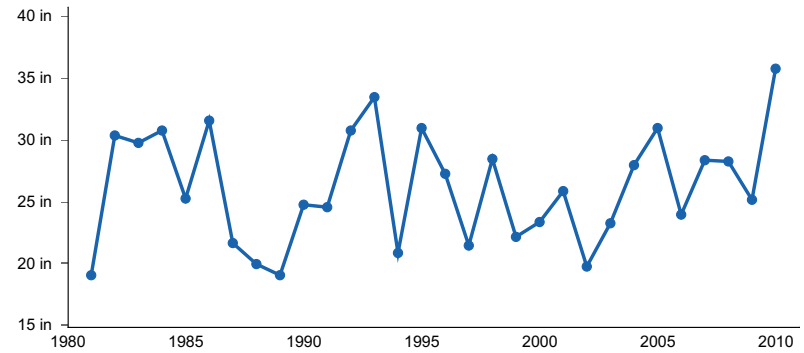

Figure 6. Annual precipitation pattern

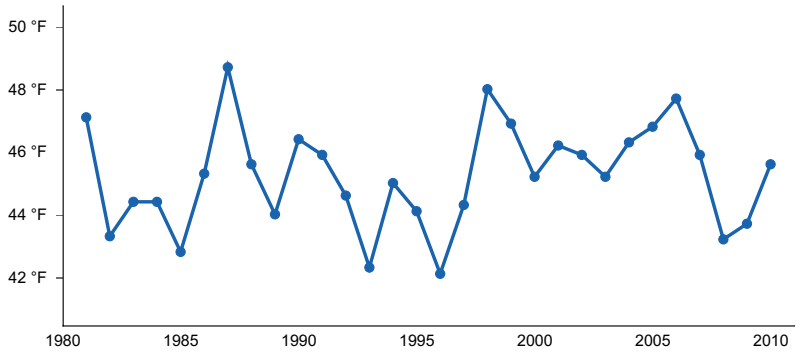

Figure 7. Annual average temperature pattern

Climate stations used

- (1) WENTWORTH 2.5 WNW [USC00399042], Wentworth, SD
- (2) MADISON 2SE [USC00395090], Madison, SD
- (3) MONTROSE 8N [USC00395738], Montrose, SD
- (4) CANTON [USC00391392], Canton, SD
- (5) CENTERVILLE 6 SE [USC00391579], Beresford, SD

Influencing water features

This site receives additional water as overflow from rivers or streams and can be rarely to frequently flooded.

Soil features

The common soil features of soils in this site are the loam subsoil and slopes 0 to 2 percent. The soils in this site are moderately drained and formed in alluvium. The loam surface layer is eight to 20 inches thick. The soils have a moderate infiltration rate. The central concept soil series is Bon, but others are included. The soils show no evidence of rills, wind scoured areas, or pedestalled plants. The soil surface is stable and intact. Subsurface soil layers are nonrestrictive to water movement and root penetration. These soils are not susceptible to water erosion. Flooding frequency strongly influences the soil-water-plant relationship.

Table 4. Representative soil features

Surface texture	(1) Loam
Family particle size	(1) Fine-loamy
Drainage class	Moderately well drained
Permeability class	Moderate
Soil depth	0–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	0.18–0.22 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–7.8

Subsurface fragment volume <=3" (0-40in)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

State and Community Phases
The information in this Ecological Site Description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The Loamy Overflow site which is located in the Till Plains developed under Northern Great Plains climatic conditions and included natural influence of large herding herbivores and occasional fire. Changes occur in the plant communities due to weather fluctuations and management actions. Under adverse impacts, a relatively rapid decline in vegetative vigor and composition can occur. Under favorable conditions, the site has the potential to resemble the Reference State. Interpretations for this site are based primarily on the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase. This community phase and the Reference State have 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 to lightly grazed areas, seasonal use pastures, and historical accounts also have been considered.

This ecological site (ES) has been grazed by domestic livestock since they have been introduced into the area. The removal of fire, the introduction of invasive species, the introduction of domestic livestock, and the use of fencing and reliable water sources have changed the ecological dynamics of this site. Continuous grazing without adequate recovery periods following each grazing occurrence over several years and lack of frequent fire caused this site to depart from the interpretive plant community. Trees and shrubs are a minor but consistent component in the Reference State occurring as scattered individuals or patches. Plains Cottonwood (*Populus deltoides*) establishment results from severe flooding events where scouring and sediment deposition allow for seed germination and establishment. This is not a frequently occurring plant community, but rather unique and dependent upon
a rare combination of flooding, bare soils, seed dispersal, and germination. Other shrub and tree species often establish as a result of high litter levels, bare ground, and the lack of fire, all of which favor woody plant establishment. Species such as green ash (*Fraxinus pennsylvanica*), and plains cottonwood will initially increase. Big bluestem and switchgrass will decrease in frequency and production. Increased woody species and heavy continuous grazing causes shade tolerant species like Kentucky bluegrass (*Poa pratensis*) to increase and eventually develop into a sod condition. The significant increase in invasive cool-season grasses, specifically Kentucky bluegrass and smooth bromegrass (*Bromus inermis*), on this site is the result of several factors including typically cold wet springs coupled with spring grazing deferment, high tolerance of grazing, shade tolerance, severe defoliation of native grasses in the growing season, and the elimination of fire from the system. Due to the spread of these species, the interpretive plant community no longer exist. Extended periods of non-use and no fire will result in a plant community of mature green ash or plains cottonwood with a shaded understory of Kentucky bluegrass, creating a park like appearance.

Mechanical removal, catastrophic fire, or inundation of woody species due to flooding with very long duration (greater than 30 days) beyond normal ponding and drying patterns will create a community dominated by big bluestem, switchgrass, and Indiangrass. This community will be invaded with lesser amounts of non-native species such as Kentucky bluegrass and smooth bromegrass.

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

The following is a diagram that illustrates the common plant community phases that can occur on the site and the transition and community pathways between them. The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Loamy Floodplain – MLRA 102B (8/21/19)

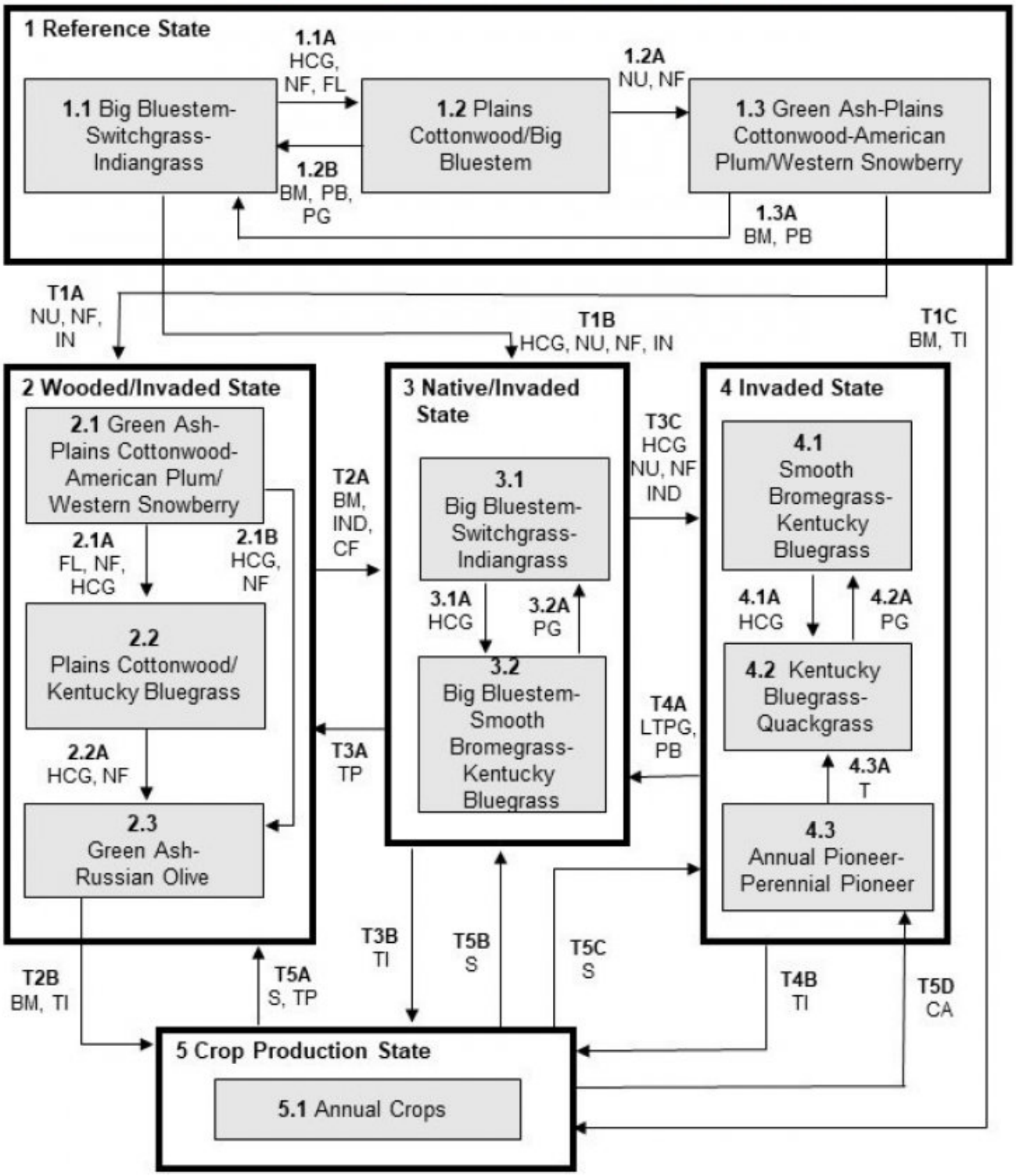

Figure 8. State-And-Transition Model for the Loamy Floodplain site in MLRA 102B.

Loamy Floodplain – R102BY040SD

LEGEND
Loamy Floodplain – R102BY040SD

BM – Brush management
CA – Cropped and abandoned
CF – Catastrophic fire
FL – Flooding
HCG – Heavy, continuous grazing
IN – Invasion
IND – Inundation
LTPG – Long-term prescribed grazing
NU – Non-use
NF – No fire
PB – Prescribed burning
PG – Prescribed grazing
S – Seeding
T – Time w/wo disturbances
TI - Tillage
TP – Tree planting

Figure 9. Legend for the Loamy Floodplain site in MLRA 102B.

Code	Process
T1A	Non-use, no fire, invasion
T1B	Heavy, continuous grazing, non-use, no fire, invasion
T1C	Brush management, tillage
T2A	Brush management, inundation, catastrophic fire
T2B	Brush management, tillage
T3A	Tree planting
T3B	Tillage
T3C	Heavy, continuous grazing, non-use, no fire, inundation
T4A	Long term prescribed grazing, prescribed burning
T4B	Tillage
T5A	Seeding, tree planting
T5B	Seeding
T5C	Seeding
T5D	Abandonment of cropping
1.1A	Heavy, continuous grazing, no fire, Flooding
1.2A	Non-use, no fire
1.2B	Prescribed grazing with recovery periods, prescribed burning, brush management
1.3A	Brush management, prescribed burning
2.1A	Heavy continuous grazing, no fire, Flooding
2.1B	Heavy, continuous grazing, no fire
2.2A	Heavy, continuous grazing, no fire
3.1A	Heavy, continuous grazing
3.2A	Prescribed grazing with recovery periods
4.1A	Heavy, continuous grazing
4.2A	Prescribed grazing with recovery periods
4.3A	Time w/wo disturbances

Figure 10. Matrix for the Loamy Floodplain site in MLRA 102B.

State 1
Reference State

This state would include community phases 1.1, 1.2 and small areas of 1.3. The extent of each would be dependent upon recent growing conditions. Drought and increased fire frequency would favor the herbaceous community while periods of above normal precipitation and reduced fire frequency would have favored the shrub and woody community phase. Due to change in microclimate within the wooded patches, fire intensity would have been lessened, thereby permitting this community to escape normal fire events. Extreme fire events may have resulted in these areas being burned over and reverting to more of a herbaceous and shrub dominated plant community. Invasion of conifers such as eastern redcedar (*Juniperus virginiana*) and Rocky Mountain juniper (*Juniperus scopulorum*) is possible over time on areas with reduced fire frequency. These areas occur typically in the upper reaches of the watershed.

Community 1.1
Big Bluestem-Switchgrass-Indiangrass

Interpretations are based primarily on the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase (this is also considered to be Reference). The community was dominated by warm-season grasses. Due to spring flooding events, warm-season species have competitive advantage. The major grasses included big bluestem, switchgrass, and Indiangrass. Other grass or grass-like species included green needlegrass (*Nassella viridula*), Canada wildrye (*Elymus canadensis*), porcupinegrass and sedge (Carex). This plant community was resilient and well adapted to the Northern Great Plains climatic conditions. This was a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity. Shrub communities were scattered throughout the site and consisted of western snowberry (*Symphoricarpos occidentalis*), American plum (Prunus Americana), and chokecherry (*Prunus virginiana* L.). Trees were also found scattered across the site and consisted of plains cottonwood and green ash. The diversity in plant species allowed for great tolerance of variable environmental conditions. This plant community phase is diverse, stable, and productive, and is well adapted to the Northern Great Plains. The water table supplies much of the moisture for native plants with deep root systems. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement off-site and natural plant mortality is very low. The variability of both the fluctuations of water table and reoccurring ponding allows for the diversity in plant species. This is a sustainable plant community in terms of soil stability, watershed function, and biologic integrity.

Community 1.2
Plains Cottonwood/Big Bluestem

This plant community will slowly develop from the adverse effects of heavy, continuous grazing, without adequate recovery periods between each grazing event during the growing season, and/or no surface fire. This phase would occupy those areas which escaped several fire events. Flooding that causes erosion and or sediment deposit and bare soil moves the plant community toward a plant community that includes species that responded favorably to those soil disturbances, and that could spread quickly through seed dispersal or rhizomes. The plains cottonwood component is restricted to those areas where and when the soil disturbances allow for air dispersed cottonwood seeds to settle in on bare soils and germinate within the same growing season. This may be an environment only large enough to support a single tree or a larger location (more catastrophic event) where numerous seedlings establish a colony of same aged trees. When compared to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase, native warm-season tallgrasses have decreased. The woody species, such as plains cottonwood have increased and tend to dominate this plant community.

Community 1.3
Green Ash-Plains Cottonwood-American Plum/Western Snowberry

This plant community will slowly develop from the side effects of non-use and no surface fire. Presence of woody species in the 1.2 Plains Cottonwood/Big Bluestem Community phase will continue to take over the site when lack of fire and non-use are used in the management practices. Patches of this plant community phase would be found scattered across the site, most likely in slight depressions or other small areas where fire behavior is minimized due to microclimate or terrain. The green ash and plains cottonwood will grow large and begin to shade out other low growing species and close up the canopy.

Pathway 1.1A

Community 1.1 to 1.2

Heavy, continuous grazing and/or no fire which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, periods of below normal precipitation, no surface fire for extended periods of time (typically for 10 years or more), and flooding with inundation 30 days or less will shift this community to the 1.2 Plains Cottonwood/Big Bluestem Plant Community Phase.

Pathway 1.2B
Community 1.2 to 1.1

Any combination of prescribed grazing (alternating season of use and providing adequate recovery periods), periodic light to moderate grazing, prescribed burning occurring at relatively frequent intervals (every 3 to 5 years), a return to normal disturbance regime levels and frequencies, and brush management will shift this plant community to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase.

Pathway 1.2A
Community 1.2 to 1.3

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, will lead this state over a threshold to the 1.3 Green Ash-Plains Cottonwood-American Plum/Western Snowberry Plant Community Phase.

Pathway 1.3A
Community 1.3 to 1.1

Brush management which would include the mechanical removal of the woody and shrub vegetation, coupled with prescribed burning occurring at relatively frequent intervals (every 3 to 5 years), and a return to normal disturbance regime levels and frequencies will shift this plant community to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase.

State 2
Wooded/Invaded State

This state is characterized by an increase in bare ground due to trampling caused by excessive use or by inundation for extended periods which causes a temporary shift in the plant composition and cover. Severe flooding events cause scouring and sediment deposition which allows for seed germination and establishment. This facilitates the invasion of woody species which, with continued heavy grazing and no surface fire, can increase to eventual dominance. Loss or reduction of native cool-season and warm-season species can negatively impacted energy flow and nutrient cycling. Small amount of shade tolerant non-native species such as smooth bromegrass and Kentucky bluegrass would be present. Infiltration will be reduced and native plant mortality will increase. As the disturbance level increases, native plant density decreases even more, giving way to annual species and invasive perennial species, a further increase in woody species, and bare ground. Invasion of conifers such as eastern redcedar and/or Rocky Mountain juniper is possible over time on areas with reduced fire frequency. These areas occur typically in the upper reaches of the watershed. Invasion of conifers such as eastern redcedar and Rocky Mountain juniper is possible over time on areas with reduced fire frequency. These areas occur typically in the upper reaches of the watershed.

Community 2.1
Green Ash-Plains Cottonwood-American Plum/Western Snowberry

This plant community developed with non-use and/or no surface fire for extended periods of time (typically for 10 or more years). Green Ash, Plains Cottonwood, American Plum, and Western Snowberry dominate the community. This plant community phase is similar to the 1.3 Green Ash-Plains Cottonwood-American Plum/Western Snowberry Plant Community Phase but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 15 percent by air-dry weight). Native warm-season tallgrasses like big bluestem and switchgrass will be virtually eliminated from the plant community and replaced with woody vegetation and sedges. Areas of bare ground can be present throughout the site. Loss or reduction of native grasses, grass-likes, and forbs has negatively impacted energy flow and nutrient cycling. It will take a long time to

restore this plant community with improved management or return of more normal precipitation patterns and return of regular fire regime.

Community 2.2
Plains Cottonwood/Kentucky Bluegrass

This plant community developed with heavy, continuous grazing without adequate recovery periods between grazing events, no surface fire, or a flooding event that caused erosion of the top soil and left bare soil for the plains cottonwood to establish. The dominant vegetation includes Plains Cottonwoods, Kentucky Bluegrass, and other native and non-native shade tolerant grasses and shrubs. Grasses may include, Kentucky bluegrass, smooth bromegrass, and sedges. This is due to the loss of diversity (including the loss of the seed bank) within the existing plant community and the plant communities on adjacent sites, and increased shade from mature cottonwood trees shading out native species. Significant economic inputs, management, and time would be required to move this plant community toward a higher successional stage. Secondary succession is highly variable, depending upon availability and diversity of a viable reproductive source of higher successional species.

Community 2.3
Green Ash-Russian Olive

This plant community phase is characterized by a dense understory of grasses with an overstory of green ash and Russian olive. As mature trees die, they are replaced by Russian olive. The herbaceous understory consists of Kentucky bluegrass, Smooth Bromegrass, and various native grass species. Significant economic inputs, management, and time would be required to move this plant community toward a higher successional stage. Secondary succession is highly variable, depending upon availability and diversity of a viable reproductive source of higher successional species.

Pathway 2.1A
Community 2.1 to 2.2

Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, periods of below normal precipitation, no surface fire for extended periods of time (typically for 10 years or more), and flooding with inundation 30 days or less will shift this community to the 2.2 Plains Cottonwood/Kentucky Bluegrass Plant Community Phase.

Pathway 2.1B
Community 2.1 to 2.3

Heavy, continuous grazing and/or no surface fire will encourage establishment of green ash and Russian olive (*Elaeagnus angustifolia*), with an understory of Kentucky bluegrass or smooth bromegrass. These invasive species alter regeneration rates of native species by out-competing them for resources. Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, periods of below normal precipitation, no surface fire for extended periods of time (typically for 10 years or more), and flooding with inundation 30 days or less will shift this community to the 2.3 Green Ash-Russian Olive Plant Community Phase.

Pathway 2.2A
Community 2.2 to 2.3

Heavy, continuous grazing and/or no surface fire will encourage establishment of green ash and Russian olive (*Elaeagnus angustifolia*), with an understory of Kentucky bluegrass or smooth bromegrass. These invasive species alter regeneration rates of native species by out-competing them for resources. Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, periods of below normal precipitation, no surface fire for extended periods of time (typically for 10 years or more), and flooding with inundation 30 days or less will shift this community to 2.3 Green Ash-Russian Olive Plant Community Phase.

State 3

Native/Invaded State

This state represents the more common range of variability that exists with higher levels of grazing management but in the absence of periodic fire due to fire suppression. This state is dominated by warm-season grasses, with cool-season grasses being subdominant. It can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. Taller warm-season species can decline and a corresponding increase in short statured grass will occur. Invasion of conifers such as eastern redcedar or Rocky Mountain juniper is possible over time on areas with reduced fire frequency. These areas occur typically in the upper reaches of the watershed.

Community 3.1
Big Bluestem-Switchgrass-Indiangrass

This plant community phase is similar to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase but it also contains minor amounts of non-native invasive grass species such as Kentucky bluegrass and smooth bromegrass (up to about 10 percent by air-dry weight). The potential vegetation is about 80 percent grasses or grass-like plants, 10 percent forbs, and 10 percent shrubs. This community is dominated by warm-season grasses. The major grasses include big bluestem, switchgrass, and Indiangrass. Other grass or grass-like species include porcupinegrass, green needlegrass, and slender wheatgrass. This plant community is resilient and well adapted to the Northern Great Plains climatic conditions. The diversity in plant species allows for high tolerance to drought . This is a sustainable plant community in regards to site and soil stability, watershed function, and biologic integrity.

Community 3.2
Big Bluestem-Smooth Bromegrass-Kentucky Bluegrass

This plant community is a result of heavy, continuous grazing or from over utilization during extended drought periods. The potential plant community is made up of approximately 75 percent grasses and grass-like species, 15 percent forbs, and 10 percent shrubs. Dominant grasses include big bluestem, smooth bromegrass, and Kentucky bluegrass. Grasses of secondary importance include Indiangrass, sideoats grama, green needlegrass, tall dropseed (*Sporobolus compositus*), slender wheatgrass, and sedge. Forbs commonly found in this plant community include cudweed sagewort (*Artemisia ludoviciana*), heath aster (*Symphyotrichum ericoides*), Canada goldenrod (Solidago Canadensis), stiff goldenrod (Solidago rigida), scurfpea (Psoralidium), Indian hemp (*Apocynum cannabinum*), and western yarrow (*Achillea millefolium*). When compared to the 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase, big bluestem has increased, smooth bromegrass and Kentucky bluegrass has invaded and become a co-dominant. Production of tall warm-season grasses is reduced. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. Most of the components of the ecological processes are functioning at optimum levels. However, the vigor and reproductive capability of the tall warm-season grasses are reduced due to grazing pressure or a combination of stressors. A reduction of this dominant functional group allows for an increase in shorter-statured (and shallower rooted) species. The introduction of non-native invasive species such as Kentucky bluegrass and smooth bromegrass results in alterations to the soil profile. Organic matter levels tend to decrease and begin to be concentrated more in the surface layers and the structure will begin to be modified. These changes favor the shallow-rooted species and hasten their eventual dominance if steps are not taken to reduce these species.

Pathway 3.1A
Community 3.1 to 3.2

Heavy continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites will shift this community to the 3.2 Big Bluestem-Smooth Bromegrass-Kentucky Bluegrass Plant Community Phase.

Pathway 3.2A
Community 3.2 to 3.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to

moderate grazing possibly including periodic rest will convert this plant community to the 3.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase.

State 4
Invaded State

This state is a result of encroachment mainly by invasive introduced cool-season grasses. The ecological processes are not functioning, especially the biotic processes and the hydrologic functions. The introduced cool-season grasses cause reduced infiltration and increased runoff. Preliminary studies would tend to indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition. The opportunity for high intensity spring burns is severely reduced by early green-up and increased moisture and humidity at the soil surface. Grazing pressure cannot cause a reduction in sod grass dominance. Production is limited to the sod forming species. Infiltration continues to decrease, runoff increases, and energy capture into the system is restricted to early season low producing species. Nutrient cycling is limited by root depth of the dominant species. Invasion of conifers such as eastern redcedar and Rocky Mountain juniper is possible over time on areas with reduced fire frequency. These areas occur typically in the upper reaches of the watershed.

Community 4.1
Smooth Bromegrass-Kentucky Bluegrass

This plant community phase is a result of extended periods of nonuse and no fire, or occasionally light levels of grazing over several years. It is characterized by dominance of smooth bromegrass and to a lesser extent Kentucky bluegrass. The dominance is at times so complete that other species are difficult to find on the site. A thick duff layer also accumulates at or above the soil surface and eventually a thatch-mat layer may develop at the surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. When dominated by smooth bromegrass, infiltration is moderately reduced and runoff is moderate. Production can be equal to or higher than the interpretive plant community. However, when dominated by Kentucky bluegrass, infiltration is greatly reduced and runoff is high. Production in this case will likely be significantly less. In either case, the period that palatability is high is relatively short as these cool-season species mature rapidly. Energy capture is also reduced. The dominance of these introduced species has been shown to alter the biotic component of the soil, as well as, organic matter levels and eventually the soil structure. These alterations perpetuate the dominance of Kentucky bluegrass and smooth bromegrass, and tend to make establishment of native species extremely difficult.

Community 4.2
Kentucky Bluegrass-Quackgrass

This plant community phase is a result of heavy, continuous seasonal grazing or heavy, continuous season-long grazing. It is characterized by a dominance of Kentucky bluegrass and quackgrass (*Elymus repens*). The dominance is at times so complete that other species are difficult to find on the site. A relatively thick duff layer can sometimes accumulate at or above the soil surface and a thatch-mat layer often develops at the surface. Nutrient cycling is greatly reduced and native plants have great difficulty becoming established. Infiltration is greatly reduced and runoff is high. Production will be significantly reduced when compared to the interpretive plant community. The period that palatability is high is relatively short as Kentucky bluegrass matures rapidly. Energy capture is also reduced. Biological activity in the soil is likely reduced significantly in this phase.

Community 4.3
Annual Pioneer-Perennial Pioneer

This plant community developed under continuous, heavy grazing or other excessive disturbances. The potential plant community is made up of approximately 40 to 80 percent grasses and grass-like species, 20 to 60 percent forbs, and zero to five percent shrubs. The species present in this phase are highly variable but often include non-native invasive and early seral species. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant

economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank), within the existing plant community, and the plant communities on adjacent sites. This community can be renovated to improve the production capability; however, if management changes are not made the vegetation could revert back to early seral species.

Pathway 4.1A
Community 4.1 to 4.2

Heavy, continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability will shift this community to the 4.2 Kentucky Bluegrass-Quackgrass Plant Community Phase.

Pathway 4.2A
Community 4.2 to 4.1

Prescribed grazing (alternating season of use and providing adequate recovery periods) or periodic light to moderate grazing possibly including periodic rest will convert this plant community to the 4.1 Smooth Bromegrass-Kentucky Bluegrass Plant Community Phase.

Pathway 4.3A
Community 4.3 to 4.2

This community pathway occurs with the passage of time as successional processes take place and perennial plants gradually begin to establish on the site again. This pathway will lead to the 4.2 Kentucky Bluegrass-Quackgrass Plant Community Phase.

State 5
Crop Production State

This state is characterized by the production of annual crops using a variety of tillage and cropping systems along with management practices. Cropping on this site is enabled during years with drier than normal precipitation or with artificial drainage (surface or subsurface).

Community 5.1
Annual Crops

This plant community developed with the use of a variety of tillage systems and cropping systems for the production of annual crops including corn, soybeans, wheat, and a variety of other crops.

Transition T1A
State 1 to 2

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density or invasion of non-native plant species will likely lead this 1.3 Green Ash-Plains Cottonwood-American Plum/Western Snowberry Plant Community Phase within the Reference State (State 1) over a threshold leading the Wooded/Invaded State (State 2).

Transition T1B
State 1 to 3

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, and/or heavy continuous grazing or invasion of non-native plant species will likely lead this 1.1 Big Bluestem-Switchgrass-Indiangrass Plant Community Phase within the Reference State (State 1) state over a threshold resulting in the Native/Invaded State (State 3).

Transition T1C
State 1 to 5

Brush management such as removing woody vegetation and tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

Transition T2A
State 2 to 3

Brush management such as removing woody vegetation, catastrophic fire which burns with high intensity to kill a majority of the trees in the canopy, and/or inundation due to flooding with very long duration (greater than 30 days) beyond normal ponding and drying patterns will cause a shift over a threshold leading to the Native/Invaded State (State 3).

Transition T2B
State 2 to 5

Brush management such as removing woody vegetation and tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

Restoration pathway T3A
State 3 to 2

Tree Planting will likely lead this state over a threshold leading to the Wooded/Invaded State (State 2). This will take significant resources and years of monitoring and management.

Transition T3C
State 3 to 4

Non-use and/or no surface fire for extended periods of time (typically for 10 or more years) causing litter levels to become high enough to reduce native grass vigor, diversity, and density, heavy continuous grazing (stocking levels well above carrying capacity for extended portions of the growing season and often at the same time of year each year), and/or inundation due to flooding with very long duration (greater than 30 days) beyond normal ponding and drying patterns will likely lead this state over a threshold leading to the Invaded State (State 4).

Transition T3B
State 3 to 5

Tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

Restoration pathway T4A
State 4 to 3

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or other grazing systems such as high-density, low-frequency intended to treat specific species dominance, or periodic light to moderate stocking levels possibly including periodic rest) coupled with prescribed burning occurring at relatively frequent intervals (3 to 5 years) and a return to normal disturbance regime levels and frequencies may lead this plant community phase over a threshold to the Native/Invaded State (State 3).

Transition T4B
State 4 to 5

Tillage will cause a shift over a threshold leading to the 5.1 Annual Crops Plant Community Phase within the Crop Production State (State 5).

Restoration pathway T5A

State 5 to 2

Seeding combined with tree planting may lead this Crop Production State (State 5) over a threshold leading to the Wooded/Invaded State (State 2). This will take significant resources and years of monitoring and management.

Restoration pathway T5B
State 5 to 3

Seeding may lead this Crop Production State (State 5) over a threshold leading to the Native/Invaded State (State 3).

Restoration pathway T5C & T5D
State 5 to 4

Seeding may lead this Crop Production State (State 5) over a threshold to the Invaded State (State 4). Cropping followed by abandonment may lead this plant community phase over a threshold to the Invaded State (State 4) and more specifically to the 4.3 Annual Pioneer-Perennial Pioneer Plant Community Phase.

Additional community tables

Other information

Ecological Site Correlation Issues and Questions:

• SD127 Union County, SD did not use the (EpD) Ethan-Bon, channeled, loams, 0 to 20 percent slopes (national symbol gyno) as used in the adjoining SD027 Clay County, SD.
• Reference and alternative states within the state and transition model are may not be fully documented and may require additional field sampling for refinement.

Inventory data references

There is no NRCS clipping data and other inventory currently available for this site. Information presented here has been derived using field observations from range-trained personnel. Those involved in developing this site include: Stan Boltz, Range Management Specialist, NRCS; Jason Hermann, Area Rangeland Management Specialist, USDA-NRCS, Redfield, SD.

Data Source Sample Period State County
None

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This Provisional Ecological Site concept has passed both Quality Control and Quality Assurance processes. It was officially approved for publication by David Kraft as of 11/12/2020.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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

Indicators

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

   _____

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

   _____

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

   _____

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

   _____

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

   _____

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

   _____

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

   _____

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

   _____

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**