USDA Natural Resources Conservation Service

Ecological site R102CY047NE
SALINE SUBIRRIGATED

Last updated: 10/03/2024
Accessed: 12/04/2024

General information

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

MLRA notes

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

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

Classification relationships

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

General information for MLRA 102C:

Fenneman (1916) Physiographic Regions
Division - Interior Plains
East:
Province - Central Lowland
Section - Till Plains
West:
Province - Great Plains
Section - High Plains

USFS (2007) Ecoregions
Domain - Humid Temperate
Division - Prairie
Province - Prairie Parkland (Temperate)
Section - North-Central Glaciated Plains (251B)

EPA Ecoregions (Omernik 1997)
I - Great Plains (9)
II - Temperate Prairies (9.2)
III - Western Corn Belt Plains (9.2.3) IV - Loess Prairies (47a)

IV - Northeastern Nebraska Loess Hills (47k)
IV - Transitional Sandy Plain (47l)

Ecological site concept

This ecological site is subirrigated with saline soils and a reference community dominated by grasses. The foremost diagnostic feature of this site is the high salt levels that limit plants that can occupy these sites and a seasonally high-water table from 60 to 102 centimeters (24 to 40 inches), with additional moisture received from higher adjacent areas as run-on. This site predominantly occurs on nearly level to gently sloping floodplains and stream terraces (0-2% slopes). A few areas are in micro-lows on toeslopes or flat basins on uplands. It predominantly receives runoff from adjacent sites, has a seasonally high-water table from 60 to 102 centimeters (24 to 40 inches) from November-May, does not pond, and may flood occasionally. These are mostly very deep, somewhat poorly to moderately well drained soils. The surface texture is predominantly silt loam or silty clay loam or silty clay from 0 to 20 centimeters (0 to 8 inches) and the Subsurface Texture Groups are Loamy or Silty from 18 to 203 centimeters (7 to 80 inches). These are saline soils with sodium absorption rate of 0 to 99.. The plant community consists of 80-95% grasses and grass-likes, 5-10% forbs and 0-5% shrubs. Dominant grasses include Western wheatgrass, Switchgrass, Slender wheatgrass, Kentucky bluegrass, Plains bluegrass. Other grasses and grass-likes are Blue grama, Canada wildrye, Foxtail barley, Fowl mannagrass, and sedges. Forb species are diverse and often include Western ragweed and Dandelion.

Associated sites

R102CY048NE	**Loamy Overflow** Occurs on surrounding higher areas with significantly lower production.
R102CY053NE	**LIMY SUBIRRIGATED** Occurs on similar landforms but have secondary carbonates throughout the profile.
R102CY044NE	**WET LAND** Typically occurs in the lowest areas, or where hydrology otherwise supports a community heavily dominated by hydrophytic vegetation.
R102CY045NE	**WET SUBIRRIGATED** Occurs on lower relief with a seasonally high-water table within 24 inches and a marked increase in hydrophytic vegetation.

Similar sites

R102CY053NE	**LIMY SUBIRRIGATED** Seasonally saturated 24 to 40 inches of the surface and secondary carbonates throughout the profile.
R102CY046NE	**Subirrigated** Seasonally saturated 24 to 40 inches of the surface

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Panicum virgatum*

Physiographic features

This site predominantly occurs on nearly level to gently sloping floodplains and stream terraces (0-2% slopes). A few areas are in micro-lows on toeslopes or flat basins on uplands. It predominantly receives runoff from adjacent sites, has a seasonally high-water table from 60 to 102 centimeters (24 to 40 inches) from November-May, does not pond, and may flood occasionally.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Terrace
Runoff class	Negligible to medium
Flooding duration	Extremely brief (0.1 to 4 hours) to brief (2 to 7 days)
Flooding frequency	None to occasional
Elevation	341–576 m
Slope	0–2%
Water table depth	61–102 cm
Aspect	Aspect is not a significant factor

Climatic features

Most of the rainfall occurs as high-intensity, convective thunderstorms during the growing season. The maximum precipitation occurs from the middle of spring to early in autumn. Precipitation in winter occurs as snow. The annual snowfall ranges from about 60 centimeters (24 inches) in the southern part of the area to 85 centimeters (34 inches) in the northern part. The average annual temperature gradient trends higher from north (7°C / 45°F) to south (11°C / 51°F), and the average annual precipitation gradient trends higher from northwest (64 centimeters / 25 inches) to southeast (79 centimeters / 31 inches).

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

Table 3. Representative climatic features

Frost-free period (characteristic range)	123-129 days
Freeze-free period (characteristic range)	144-156 days
Precipitation total (characteristic range)	686-762 mm
Frost-free period (actual range)	122-135 days
Freeze-free period (actual range)	141-165 days
Precipitation total (actual range)	686-762 mm
Frost-free period (average)	128 days
Freeze-free period (average)	151 days
Precipitation total (average)	737 mm

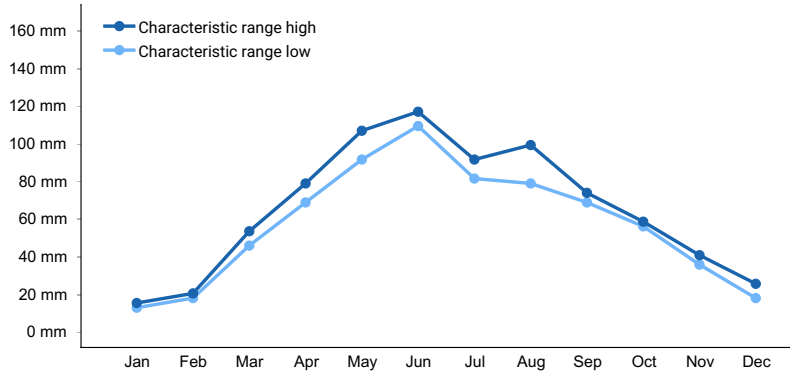


Figure 1. Monthly precipitation range

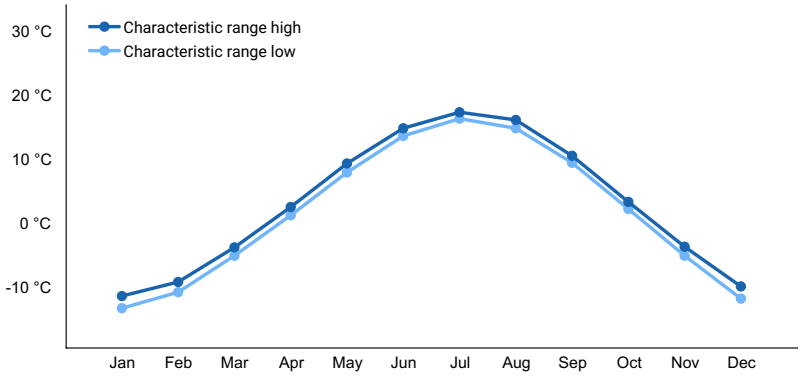


Figure 2. Monthly minimum temperature range

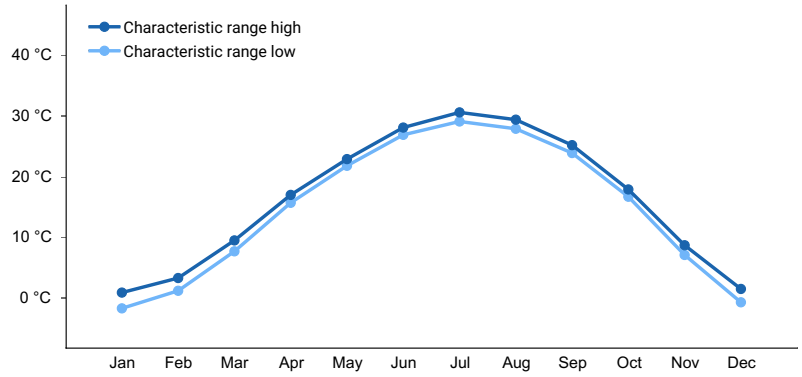


Figure 3. Monthly maximum temperature range

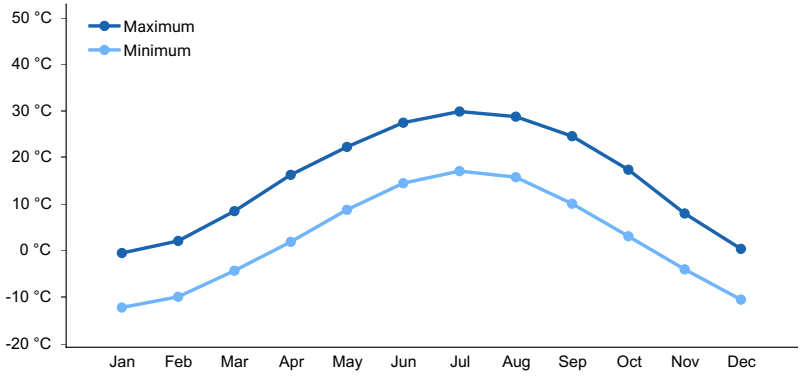


Figure 4. Monthly average minimum and maximum temperature

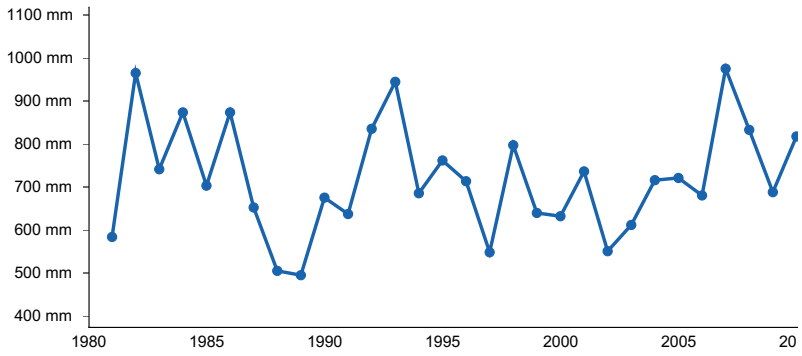


Figure 5. Annual precipitation pattern

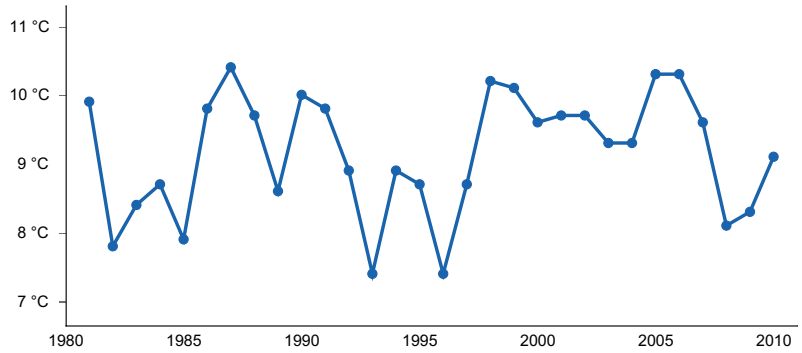


Figure 6. Annual average temperature pattern

Climate stations used

- (1) FLANDREAU [USC00392984], Flandreau, SD
- (2) YANKTON 2 E [USW00094911], Yankton, SD
- (3) WALTHILL 1E [USC00258935], Walthill, NE
- (4) ASHLAND NO 2 [USC00250375], Ashland, NE
- (5) ELGIN [USC00252595], Elgin, NE
- (6) NORFOLK 4W [USC00255997], Norfolk, NE
- (7) LUVERNE [USC00214937], Luverne, MN
- (8) GENOA 2 W [USC00253185], Genoa, NE
- (9) WAYNE [USC00259045], Wayne, NE

Influencing water features

This site has a seasonal high water table and may flood occasionally.

Soil features

These are mostly very deep, somewhat poorly to moderately well drained soils. The surface texture is predominantly silt loam or silty clay loam or silty clay from 0 to 20 centimeters (0 to 8 inches) and the Subsurface Texture Groups are Loamy or Silty from 18 to 203 centimeters (7 to 80 inches).

Rills, gullies, and water flow patterns are not inherent to this site. Pedestalling is none to slight. Soil aggregate stability should be low due to the high saline amounts.

Major soils assigned to this site include Gayville, Lute, Napa, Salmo and Saltine.

Table 4. Representative soil features

Parent material	(1) Alluvium
Surface texture	(1) Silt loam (2) Silty clay loam (3) Silty clay
Drainage class	Somewhat poorly drained to moderately well drained
Permeability class	Very slow to moderately slow
Depth to restrictive layer	203 cm
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	2.54–20.32 cm

Calcium carbonate equivalent (Depth not specified)	0–25%
Electrical conductivity (Depth not specified)	0–16 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–99
Soil reaction (1:1 water) (Depth not specified)	6.1–9.6
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The foremost diagnostic feature of this site is the high salt levels that limit plants that can occupy these sites and a seasonally high-water table from 60 to 102 centimeters (24 to 40 inches), with additional moisture received from higher adjacent areas as run-on. The high-water table increases plant production while also “buffering” variability caused by fluctuating weather conditions, but the salt content is a detriment to many plants. Relatively minor changes in local elevation can dramatically affect the plant community. This site often occurs in complex with other sites, particularly Loamy Overflow, Limy Subirrigated, and Wet Subirrigated. Plant community composition may also experience similar changes through disturbances that affect the water table itself, such as extended dry or wet cycles.

This site developed with occasional fires being part of the ecological processes. It is presumed that the historic fires generally occurred every 3-4 years, were randomly distributed, and started by lightning at various times throughout the season when thunderstorms were likely to occur. It is also believed that pre-European inhabitants may have used fire as a management tool for attracting herds of large migratory herbivores (bison, elk, and/or deer.) The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool.

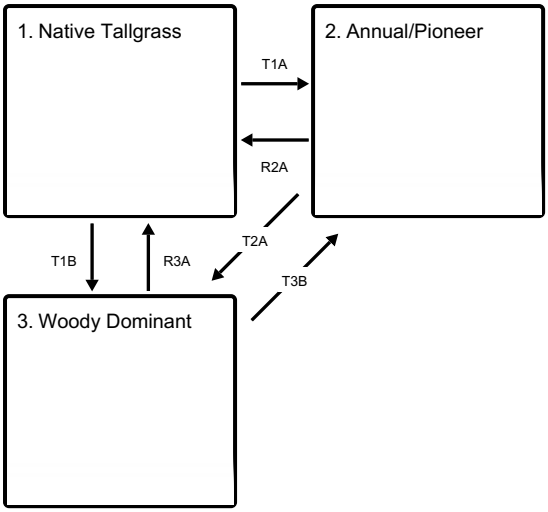
The degree of herbivory (feeding on herbaceous plants) has a significant impact on the dynamics of the site. Historically, periodic grazing by herds of large migratory herbivores was a primary influence. Secondary influences of herbivory by species such as grasshoppers and root feeding organisms impacted the vegetation historically and continue to this day. The management of herbivory by humans through grazing of domestic livestock and/or manipulation of wildlife populations has been a major influence on the ecological dynamics of the site. This management coupled with climate largely dictates the plant communities for the site.

The plant community for this site is dynamic due to the complex interaction of many ecological processes. The interpretive plant community for this site is the reference state. The reference state has been determined by the study of rangeland relic areas, areas protected from excessive disturbance and areas under long term rotational grazing strategies. Trends in plant community dynamics ranging
from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

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

State and transition model

Ecosystem states



T1A - Disturbances makes resources available to opportunistic species.

T1B - Woody encroachment leading to woody dominance

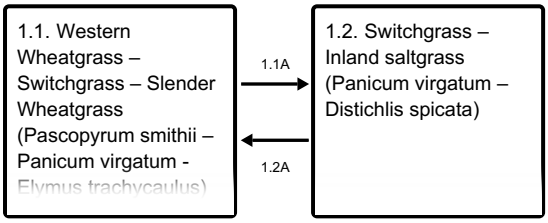
R2A - Restoration inputs; state transitioned to grassland

T2A - Woody encroachment leading to woody dominance

R3A - Woody removal for return to native herbaceous dominance

T3B - Woody removal for return to herbaceous dominance

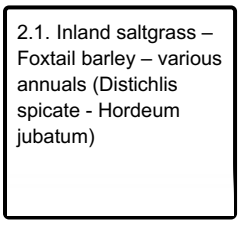
State 1 submodel, plant communities



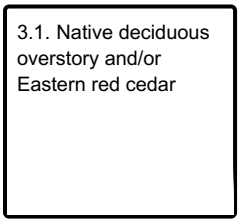
1.1A - Reduced tallgrass vigor due to excessive defoliation intensity and frequency; drought.

1.2A - Improved tallgrass vigor with adequate rest periods; return of normal precipitation.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Native Tallgrass

This state comprises the communities within the range of natural variability under historic conditions and disturbance regimes. Patterns created by wildlife use and fire would have created a mosaic of communities across

the landscape; however, warm-season tallgrasses are dominant, with a subdominant to minor contribution from native cool- season grasses, forbs, and shrubs. Fire and bison herbivory were the dominant disturbance regimes that historically maintained the tallgrass dominance with a diverse forb component. Furthermore, bison grazing was closely linked to fire patterns as the animals preferred grazing burned areas offering lush regrowth devoid of decadence and of higher nutritive quality. Thus, historic plant communities were subjected to occasional burning and grazing, with substantial rest/recovery periods as the fuel load rebuilt to eventually start this process again. Fire return intervals of 3-4 years served to suppress woody species, particularly the various tree and shrub species prevalent in adjacent riparian corridors. The degree to which observed conditions represent this state largely depends on how closely the management has mimicked these past disturbance effects.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- switchgrass (*Panicum virgatum*), grass
- slender wheatgrass (*Elymus trachycaulus*), grass

Community 1.1
Western Wheatgrass – Switchgrass – Slender Wheatgrass (Pascopyrum smithii – Panicum virgatum - Elymus trachycaulus)

This is the interpretive plant community and can be found on areas that are properly managed with prescribed grazing that allows for adequate recovery periods following each grazing event. The plant community consists of 80-95% grasses and grass-likes, 5-10% forbs and 0-5% shrubs. Dominant grasses include Western wheatgrass, Switchgrass, Slender wheatgrass, Kentucky bluegrass, Plains bluegrass. Other grasses and grass-likes are Blue grama, Canada wildrye, Foxtail barley, Fowl mannagrass, and sedges. Forb species are diverse and often include Western ragweed and Dandelion. This plant community is diverse, stable, and productive. Plant community dynamics, nutrient cycles, water cycles, and energy flow are functioning properly. Plant litter is properly distributed with negligible movement off-site and natural plant mortality is very low. This community is resistant to many disturbances except continuous, season-long heavy grazing, tillage, or non-use. Broadcast herbicide application will dramatically reduce forb diversity and abundance. Total annual production, during an average year, ranges from 4300 to 5600 pounds per acre air-dry weight and will average 5100 pounds. (USDA/NRCS 2012)

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- switchgrass (*Panicum virgatum*), grass
- slender wheatgrass (*Elymus trachycaulus*), grass

Community 1.2
Switchgrass – Inland saltgrass (Panicum virgatum – Distichlis spicata)

Switchgrass has replaced Western wheatgrass as the dominant species. Other species, such as Inland saltgrass, and Little bluestem, have also increased. While still within the range of natural variability, energy capture, nutrient cycling, and hydrology are not functioning at their full potential relative to the reference condition.

Dominant plant species

- switchgrass (*Panicum virgatum*), grass
- saltgrass (*Distichlis spicata*), grass

Pathway 1.1A
Community 1.1 to 1.2

Grazing management which does not provide adequate recovery periods will cause a shift from Western wheatgrass, Switchgrass and Slender wheatgrass towards less palatable species, particularly Inland saltgrass.

Pathway 1.2A
Community 1.2 to 1.1

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

State 2
Annual/Pioneer

Nutrient cycling, hydrologic function, and/or soil stability have been severely altered, and possibly compromised. This is a highly variable state in which the specific plants observed will depend largely on the original community and the nature of the disturbance. This condition encompasses (but is not necessarily limited to) events such as severe fire impacts, heavy continuous grazing, heavy nutrient inputs, and abandoned cropland.

Dominant plant species

- saltgrass (*Distichlis spicata*), grass
- foxtail barley (*Hordeum jubatum*), grass

Community 2.1
Inland saltgrass – Foxtail barley – various annuals (Distichlis spicate - Hordeum jubatum)

This community is heavily dominated by Inland saltgrass, Foxtail barley and various annual plants that thrive in disturbed areas and often includes annual ragweed, hoary verbena, or amaranths. It is also particularly vulnerable to noxious weed invasion with the most common species being Leafy spurge, Musk and Canada thistles.

Dominant plant species

- saltgrass (*Distichlis spicata*), grass
- foxtail barley (*Hordeum jubatum*), grass
- leafy spurge (*Euphorbia esula*), other herbaceous
- thistle (*Cirsium*), other herbaceous

State 3
Woody Dominant

Under historic disturbance regimes, frequent and uncontrolled fire and wildlife browsing served to keep woody species in check. However, in the absence of fire (either wild or prescribed), it's not uncommon for the woody trees and shrubs normally limited to riparian areas to expand into the floodplains, regardless of herbaceous community composition. Wildlife may introduce a seed source to areas not associated with a waterway, such as interdunal depressions.

Dominant plant species

- maple (*Acer*), tree
- eastern cottonwood (*Populus deltoides*), tree
- boxelder (*Acer negundo*), tree
- ash (*Fraxinus*), tree

Community 3.1
Native deciduous overstory and/or Eastern red cedar

Woody species have encroached and established, typically with species such as maples, cottonwood, boxelder, green ash, eastern red cedar and swamp oak.

Dominant plant species

- maple (*Acer*), tree
- eastern cottonwood (*Populus deltoides*), tree
- boxelder (*Acer negundo*), tree
- ash (*Fraxinus*), tree

Transition T1A
State 1 to 2

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

Transition T1B
State 1 to 3

All herbaceous communities are vulnerable to woody encroachment in the absence of fire and/or browsing and hoof action impacts. This is particularly prominent in areas adjacent to riparian corridors which supply a constant seed source. As tree establishment progresses, the conditions grow increasingly favorable for woody germination and growth.

Restoration pathway R2A
State 2 to 1

Restoration strategies will depend on the nature of the disturbance and the viability of the seedbank. On pastures, changes to gazing management and favorable moisture conditions may produce a perennial community. However, in abandoned cropland range seeding will likely be necessary to recolonize desirable perennial species.

Transition T2A
State 2 to 3

All herbaceous communities are vulnerable to woody encroachment in the absence of fire and/or browsing and hoof action impacts. This is particularly prominent in areas adjacent to riparian corridors which supply a constant seed source. As tree establishment progresses, the conditions grow increasingly favorable for woody germination and growth.

Restoration pathway R3A
State 3 to 1

The combination of tree size, reduced herbaceous understory, and more mesic conditions makes it increasingly difficult for natural disturbances to restore/maintain the historic tallgrass community, and mature woodlands can no longer be restored with fire. Intensive brush management will be required to mechanically remove the established overstory. Woody control and maintenance will be an ongoing process and may also require chemical methods if sprouting species are present.

Restoration pathway T3B
State 3 to 2

Any type of natural act or management practices that kill off the woody species can transition the woody dominant site back to a native / invaded mix as the remaining herbaceous plants and seed source thrive due to the introduction of more sunlight and less woody competition.

Additional community tables

Inventory data references

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

Nebraska NRCS:
Nadine Bishop, State Rangeland Management Specialist
Patrick Cowsert, Resource Soil Scientist
Cassidy Gerdes, Biologist
Dirk Schultz, Soil Conservationist
Dan Shurtliff, Asst. State Soil Scientist (retired)

South Dakota NRCS:
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Shane Deranleau, Area Rangeland Management Specialist
Kevin Luebke, State Biologist

Iowa NRCS:
Jess Jackson, Area Grazing Specialist

Minnesota NRCS:
Lance Smith, Area Grazing Specialist

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Nebraska Game & Parks Commission:
Gerry Steinauer, Botanist
Scott Wessel, Biologist
Russ Hamer, Biologist
Rebekah Jessen, Biologist

Nebraska Forest Service:
Steve Rasmussen, District Forester

Other references

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Contributors

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Nadine Bishop
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Approval

Suzanne Mayne-Kinney, 10/03/2024

Acknowledgments

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document.

Vegetative states represented in the state and transition models (STMs) need to be evaluated and updated by a trained botanist or ecologist to verify the accuracy. Additional field work needs to be conducted to check the vegetation populations and to test the soil sorts and groupings for the PESDs as part of completing the approved ESDs. The details of this additional work still need to be fleshed out.

Some discrepancies in NASIS between the drainage class and the wet layer depth for some components noticed during the soil sorting. This needs to be corrected at some future point.

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	12/04/2024

Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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:

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
