USDA Natural Resources Conservation Service

Ecological site R102AY037SD
Deep Marsh

Last updated: 8/20/2024
Accessed: 11/21/2024

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): 102A–Rolling Till Prairie

The Rolling Till Prairie (102A) is located within the Central Feed Grains and Livestock Land Resource Region. It spans 3 states (Minnesota 58 percent, South Dakota 42 percent, and small part in North Dakota), encompassing over 16,000 square miles (Figure 1). The elevation ranges from approximately over 2,000 feet above sea level (ASL) on the Prairie Coteau in Northeastern South Dakota to about 1,000 feet ASL on lowlands. The dominate landform in this area are stagnation moraines, end moraines, glacial outwash plains, terraces, and flood plains. The area is dominated by till covered moraines. The stagnation moraines are gently undulating to steep and have many depressions and poorly defined drainages. Small outwash areas are adjacent to the watercourses. The Cretaceous Pierre Shale underlies the till in the most of the area. Precambrian rocks also occur at depth. Granite is quarried near Milbank, South Dakota and outcrops of Sioux Quartzite are common. (USDA-NRCS 2006).

The dominant soil order in this MLRA is Mollisols. The soils in the area dominantly have a frigid soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. They generally are very deep, well drained to very poorly drained. This area supports true prairie vegetation characterized by big bluestem (Andropogon gerardii), little bluestem (Schizachyrium scoparium), porcupinegrass (Hesperostipa spartea), and green needlegrass (Nassella viridula). Prairie cordgrass (Spartina pectinata) commonly grows in wet areas. (USDA-NRCS 2006).

Classification relationships

Major Land Resource Area (MLRA): Rolling Till Prairie (102A) (USDA-NRCS 2006)

USFS Subregions: North Central Glaciated Plains Section (251B); Upper Minnesota River-Des Moines Lobe Subsection (251Ba); Outer Coteau des Prairies Subsection (251Bb); Northwest Iowa Plains Subsection (251Bd); Minnesota and Northeast Iowa Morainal-Oak Savannah Section (222M); Alexandria Moraine-Hardwood Hills Subsection (222Ma) (Cleland et al. 2007).

US EPA Level IV Ecoregion: Tewaukon/Big Stone Stagnation Moraine (46e), Prairie Coteau (46k), Prairie Coteau Escarpment (46l), Big Sioux Basin (46m), Minnesota River Prairie (46o), Des Moines Lobe (47b) , Lake Agassiz Plains (48d), Alexandria Moraines and Detroit Lakes Outwash Plain (51j) (USEPA 2013)

Ecological site concept

The Deep Marsh Ecological Site typically represents the central portion of a wetland basin or depression on a glaciated prairie landscape with standing water up to 5 feet deep, and at least some tall, emergent vegetation like cattails, bulrushes and reeds. In most years there is at least some standing water but in drought years the basin surface may dry out yet retain groundwater within 1 foot of the surface.

Associated sites

R102AY001SD	**Shallow Marsh** These sites occur in a basin or closed depression. Soils are very poorly drained and the site will pond water until early summer in most years. The central concept soil series is Parnell and Oldham, but other series are included.
R102AY002SD	**Linear Meadow** These sites occur in drainageways or along the edges of closed depressions. Soils are poorly and very poorly drained which have a water table within 0 to 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 Vallers and Colvin, but other series are included.
R102AY006SD	**Limy Subirrigated** These sites occur along the edges of 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. Soils will effervesce with acid at or near the surface. The central concept soil series is Cubden, Hamerly, McKranz, but other series are included.
R102AY010SD	**Loamy** These sites occur on upland areas. The soils are well drained and have less than 40 percent clay in the surface and subsoil. The central concept soil series is Barnes, Forman, and Poinsett, but other series are included.

Similar sites

R102AY001SD	**Shallow Marsh** The Shallow Marsh site is in a similar landscape position, but the site ponds water until early summer in most years. The Shallow Marsh site will have none to very little cattails and more prairie cordgrass than a Deep Marsh site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Typha latifolia* (2) *Schoenoplectus*

Physiographic features

This site occurs on nearly level to concave depressions on uplands and till plains.

Table 2. Representative physiographic features

Slope shape across	(1) Concave
Slope shape up-down	(1) Concave
Landforms	(1) Upland > Plain
Runoff class	Very low
Flooding duration	Brief (2 to 7 days) to very long (more than 30 days)
Flooding frequency	None to frequent
Ponding duration	Long (7 to 30 days) to very long (more than 30 days)
Ponding frequency	Frequent
Elevation	287–635 m
Slope	0–1%
Ponding depth	15–119 cm
Water table depth	0–13 cm

Aspect	Aspect is not a significant factor

Climatic features

MLRA 102A is considered to have a continental climate – cold winters and relatively hot summers, low to moderate humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the Northern Great Plains and air masses move freely across the plains and account for rapid changes in temperature.

Annual precipitation typically ranges from 21 to 27 inches per year. The average annual temperature is about 43°F. January is the coldest month with average temperatures ranging from about 5°F (Mahnomen 1 W, Minnesota (MN)), to about 14°F (Tracy, MN). July is the warmest month with temperatures averaging from about 69°F (Mahnomen 1 W, MN), to about 73°F (Tracy, MN). The range of normal average monthly temperatures between the coldest and warmest months is about 62°F. This large annual range attests to the continental nature of this area's climate. 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. Greenup 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)	112-127 days
Freeze-free period (characteristic range)	137-151 days
Precipitation total (characteristic range)	635-711 mm
Frost-free period (actual range)	99-131 days
Freeze-free period (actual range)	130-153 days
Precipitation total (actual range)	610-711 mm
Frost-free period (average)	120 days
Freeze-free period (average)	143 days
Precipitation total (average)	660 mm

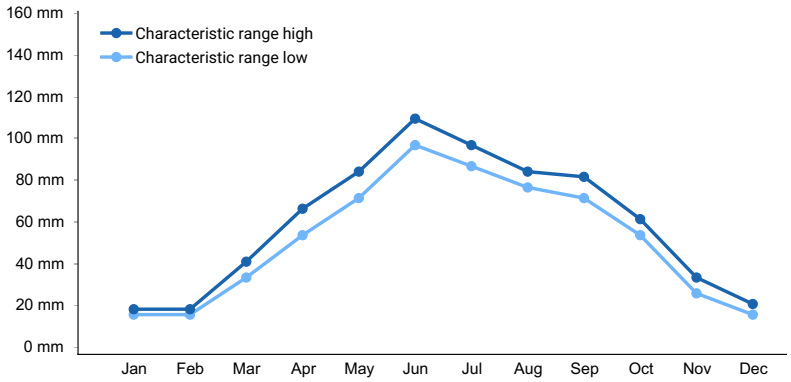


Figure 1. Monthly precipitation range

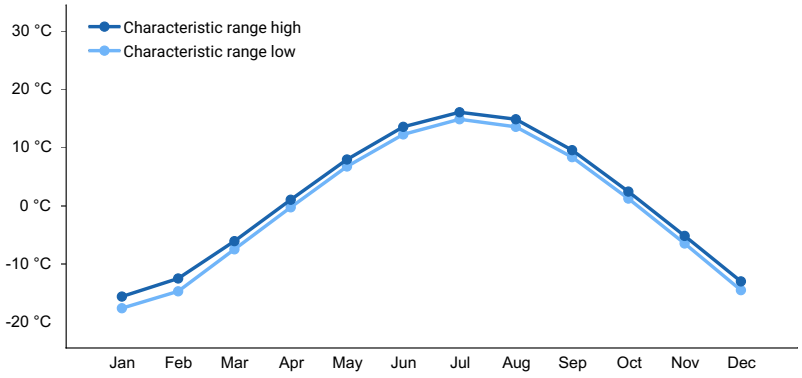


Figure 2. Monthly minimum temperature range

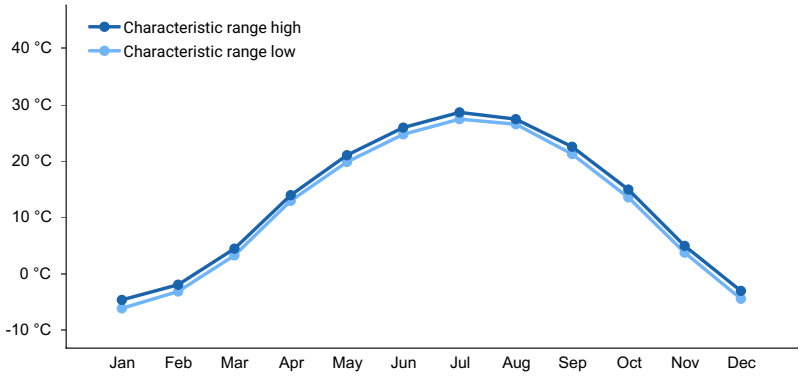


Figure 3. Monthly maximum temperature range

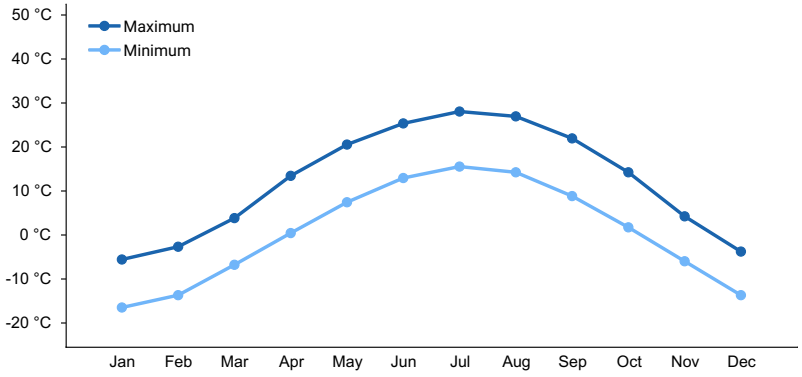


Figure 4. Monthly average minimum and maximum temperature

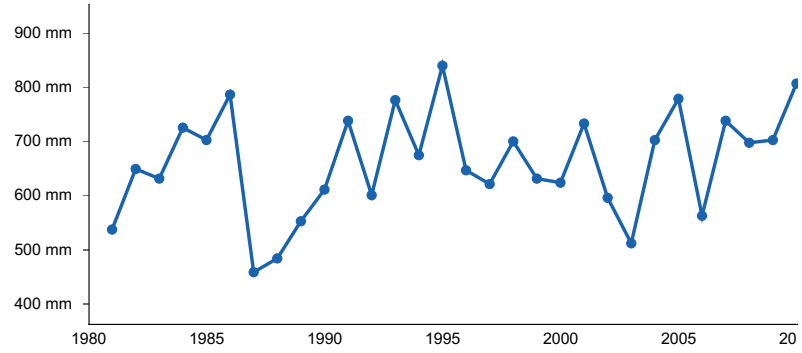


Figure 5. Annual precipitation pattern

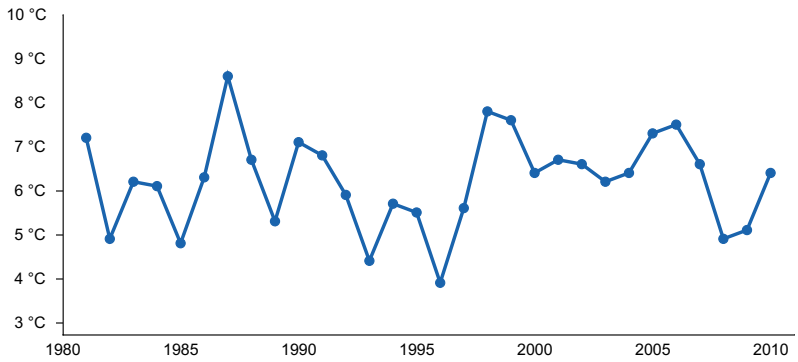


Figure 6. Annual average temperature pattern

Climate stations used

- (1) ARTICHOKE LAKE [USC00210287], Correll, MN
- (2) ARLINGTON 1 W [USC00390281], Arlington, SD
- (3) BENSON [USC00210667], Benson, MN
- (4) BROOKINGS 2 NE [USC00391076], Brookings, SD
- (5) BROWNS VALLEY [USC00211063], Beardsley, MN
- (6) CASTLEWOOD [USC00391519], Castlewood, SD
- (7) CLARK [USC00391739], Clark, SD
- (8) CLEAR LAKE [USC00391777], Clear Lake, SD
- (9) FERGUS FALLS [USC00212768], Fergus Falls, MN
- (10) FOSSTON 1 E [USC00212916], Fosston, MN
- (11) GLENWOOD 2 WNW [USC00213174], Glenwood, MN
- (12) LAKE WILSON [USC00214534], Lake Wilson, MN
- (13) MAHNOMEN [USC00215012], Mahnomen, MN
- (14) MELROSE [USC00215325], Melrose, MN
- (15) MILAN 1 NW [USC00215400], Milan, MN
- (16) MILBANK 4 NW [USC00395536], Milbank, SD
- (17) MORRIS WC EXP STN [USC00215638], Hancock, MN
- (18) PIPESTONE [USC00216565], Pipestone, MN
- (19) ROY LAKE [USC00397326], Lake City, SD
- (20) SISSETON [USC00397742], Sisseton, SD
- (21) SUMMIT 1 W [USC00398116], Summit, SD
- (22) TRACY [USC00218323], Tracy, MN
- (23) TYLER [USC00218429], Tyler, MN
- (24) WATERTOWN 1W [USC00398930], Watertown, SD
- (25) WEBSTER [USC00399004], Webster, SD

Influencing water features

This ecological site is heavily influenced by hydrology. Water accumulates in this site from landscape position run off from above and provides the foundational soil and plant relationships found on this site.

Wetland description

This ecological site may be classified as a Palustrine Emergent Semi-permanently flooded to intermittently exposed wetland according to Cowardin et al, 1979.

Soil features

The soils of the Deep Marsh ecological site formed in alluvium in depressions on uplands and plains, they are very poorly drained and have very low runoff and slow to very slow permeability. The soils on this site often have a ponded phase. The major soil series included in this ecological site are the Bigstone, Southam, Rauville, and Urness Soil Series, among others.

Table 4. Representative soil features

Parent material	(1) Till
Surface texture	(1) Silt loam (2) Silty clay loam
Drainage class	Very poorly drained to poorly drained
Permeability class	Slow to very slow
Depth to restrictive layer	183 cm
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-152.4cm)	19.05–25.4 cm
Calcium carbonate equivalent (0-101.6cm)	3–14%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Soil reaction (1:1 water) (0-101.6cm)	7.1–8.4
Subsurface fragment volume <=3" (0-101.6cm)	0–5%
Subsurface fragment volume >3" (0-101.6cm)	0–1%

Ecological dynamics

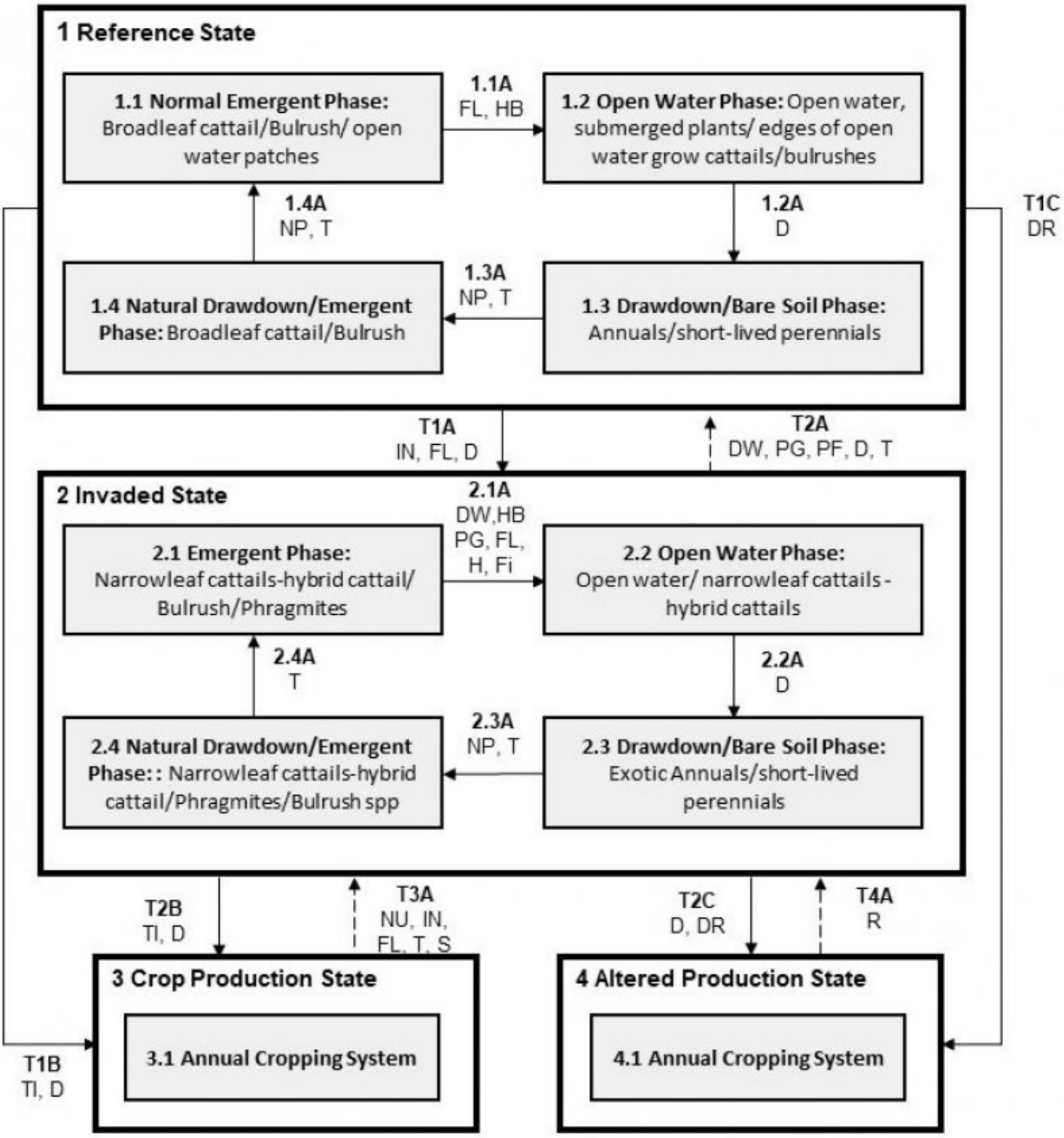
The Deep Marsh Ecological Site typically represents the central portion of a wetland basin or depression on a glaciated prairie landscape with standing water up to 5 feet deep, and at least some tall, emergent vegetation like cattails, bulrushes and reeds. In most years there is at least some standing water but in drought years the basin surface may dry out yet retain groundwater within 1 foot of the surface. Within other classification systems, this ecological site generally corresponds with Stewart and Kantrud's (1971) "Type IV wetland basin," also called a "semipermanent pond or lake"; and with the "Palustrine Emergent Semipermanently Flooded to Intermittently Exposed Wetland" of Cowardin, et al. (1979).

Most uncultivated wetland basins in this MLRA have concentric bands of distinctly different vegetation corresponding with changes in soil and water depth. For example, while the center of the basin supports deep marsh vegetation, it is often surrounded by a zone of shallow marsh vegetation, which is in turn surrounded by a zone of wet meadow vegetation, eventually grading outward into upland soils and vegetation. Degree of slope, type of soils, and nature of the local hydrology tend to dictate the number and width of these concentric zones of vegetation.

Given the climatic extremes of the Great Plains with precipitation that ranges from drought to deluge, Deep Marsh wetland basins undergo cycles of flooding and drawdown with corresponding changes in vegetation.

State and transition model

Deep Marsh – R102AY037SD



Code	Process
T1A	Invasion of nonnative vegetation, flooding, drought
T1B	Tillage, drought
T1C	Drainage
T2A	Deep water, prescribed grazing, prescribed fire, drought, time
T2B	Tillage, drought
T2C	Drought, drainage
T3A	Non-use, invasion of nonnative vegetation, flooding, time, seeding
T4A	Renovation/restoration
1.1A	Flooding, herbivory
1.2A	Drought
1.3A	Return to normal precipitation patterns, time
1.4A	Return to normal precipitation patterns, time
2.1A	Deep water, herbivory, prescribed grazing, flooding, haying/chopping, fire
2.2A	Drought
2.3A	Return to normal precipitation patterns, time
2.4A	Time

State 1
Reference State

This state represents what is believed to show the natural range of variability that dominates the dynamics of the ecological state prior to European settlement. This site, in the Reference State (State 1), is dominated by cattails and grass-like vegetation. Drought and flooding are major drivers between plant community phases, while herbivory by native ungulates and other wildlife and fire played a more minor role. Invasion of nonnative or hybrid cattails during the drawdown/bare soil phase will result in a transition to the Invaded State (State 2).

Dominant plant species

- cosmopolitan bulrush (*Bolboschoenus maritimus*), grass
- broadleaf cattail (*Typha latifolia*), grass
- hardstem bulrush (*Schoenoplectus acutus*), grass
- softstem bulrush (*Schoenoplectus tabernaemontani*), grass
- slender bulrush (*Schoenoplectus heterochaetus*), grass
- white water crowfoot (*Ranunculus aquatilis*), other herbaceous
- common bladderwort (*Utricularia macrorhiza*), other herbaceous
- sago pondweed (*Stuckenia pectinata*), other herbaceous
- water smartweed (*Polygonum amphibium var. stipulaceum*), other herbaceous
- duckweed (*Lemna*), other herbaceous

Community 1.1
Normal Emergent Phase

Historically, this phase of deep marsh vegetation consisted of scattered patches of broadleaf cattail and/or stands of bulrushes like hardstem, slender, softstem or prairie bulrush, interspersed with patches of open water supporting submerged or floating leaved aquatic plants like white water-crowfoot, common bladderwort, sago pondweed, water smartweed, and various duckweeds.

Community 1.2
Open-water Phase

The transition to an open water phase is due to increased precipitation during wet years. Flooding will drown out cattails and bulrushes in certain areas, but some will still be present on the periphery of the wetland basin during this phase. Herbivory by muskrats or other native ungulates may also help speed the transition to this state. The central portion of the basin will have open water with various submerged and floating-leaved aquatic plants, like those mentioned above.

Community 1.3
Drawdown Bare-soil Phase

The transition from an open water phase or normal emergent phase due to drought will result in bareground. Weedy annuals and short-lived perennials will invade the basin. Species such as cockleburs, swamp ragwort, rough barnyardgrass, and foxtail barley will replace the cattails and bulrushes.

Community 1.4
Natural Drawdown / Emergent Phase

The return of normal precipitation and runoff will inundate the basin killing the annuals and other plants. Seeds of emergent wetland plants like cattails and bulrushes will be able to germinate and grow on mudflats or areas of very shallow standing water. As the water levels return to normal, cattails and bulrushes will colonize the site through rhizomatous growth and submerged and floating aquatic plants will be supported once again, leading to a transition back to the 1.1 Normal Emergent Community Phase with in the Reference State (State 1).

Pathway 1.1A
Community 1.1 to 1.2

Excessive flooding results in an open water phase with mostly submerged species, and cattails/bulrushes around the periphery of the open water. Herbivory by muskrats or other native species may also decrease the amounts of cattails and lead to open water phases as well will shift this community to the 1.2 Open Water Phase within the Reference State (State 1).

Pathway 1.2A
Community 1.2 to 1.3

Drought leads to a drawdown phase, where open water changes to bareground. Annuals and short-lived perennials colonize the bareground areas will shift this community to the 1.3 Drawdown/Bare Soil Phase within the Reference State (State 1).

Pathway 1.3A
Community 1.3 to 1.4

Normal precipitation and time allows cattails to recolonize areas and will shift this community to the 1.4 Natural Drawdown/Emergent Phase within the Reference State (State 1).

Pathway 1.4A
Community 1.4 to 1.1

Normal precipitation and time allows cattails and other vegetation to return to a normal emergent phase with areas of open water and will shift this community back to the 1.1 Normal Emergent Phase within the Reference State (State 1).

State 2
Invaded State

This state is characterized by a shift from broadleaf cattail dominance to narrowleaf (*Typha angustifolia*) and hybrid (Typha x glauca) cattail dominance – both more invasive cattail species. The transition leads to a more cattail dominated state, decreasing the amount of bulrush species present in this state, and also allowing for Phragmites to invade as well. This state incorporates the same drought and deluge cycles as the reference state, but this state is dominated by invasive/nonnative vegetation.

Dominant plant species

- narrowleaf cattail (*Typha angustifolia*), grass
- hybrid cattail (*Typha ×glauca*), grass
- reed (*Phragmites*), grass

Community 2.1
Emergent Phase

This phase is dominated by narrowleaf/hybrid cattails with minor amounts of bulrush. Phragmites may also invade during this state. This phase has less open water and more continuous stands of cattails.

Community 2.2
Open Water Phase

This phase is similar to Reference State (State 1) condition except water must be deeper or cattails must be grazed cut or crush down and then inundated in order to reach a deep-water phase.

Community 2.3
Drawdown Bare-soil Phase

The transition from an open water phase to the drawdown/bare ground phase occurs due to drought. The bare ground will be invaded by exotic weedy annuals and short-live perennials such as barnyardgrass, foxtail barley, and chenopods.

Community 2.4
Natural Drawdown / Emergent Phase

Once normal precipitation patterns have returned, the native wetland seedbank will try to recolonize the site with bulrushes and cattails, but windblown seeds from narrowleaf and hybrid cattails and Phragmites will most likely compete with the natives for space.

Pathway 2.1A
Community 2.1 to 2.2

Deep water, herbivory, prescribed grazing, and/or flooding lead to an open water phase. Deeper water than than the Reference State (State 1) is needed to drown out narrowleaf/hybrid cattails. An alternative to deeper water is haying/chopping, fire, and/or crushing cattails prior to flooding to drown out those cattail species will shift this community to the 2.2 Open Water Phase within the Invaded State (State 2).

Pathway 2.2A
Community 2.2 to 2.3

Drought leads to bareground, and exotic annual weeds compete with native annuals to colonize the bareground will shift this community to the 2.3 Drawdown/Bare Soil Phase within the Invaded State (State 2).

Pathway 2.3A
Community 2.3 to 2.4

Normal precipitation and time is needed to recolonize the basin with emergent vegetation. Native seed bank species compete with wind-blown seeds of narrowleaf cattail and Phragmites to colonize the area and will shift this community to the 2.4 Natural Drawdown/Emergent Phase within the Invaded State (State 2).

Pathway 2.4A
Community 2.4 to 2.1

Time allows cattails and other vegetation to return to a normal emergent phase with areas of open water and will shift this community back to the 2.1 Emergent Phase within the Invaded State (State 2).

State 3
Crop Production State

This state is characterized by the production of annual crops. This community phase only occurs during extreme drought years when basin is dry enough to be cropped.

Dominant plant species

- corn (*Zea mays*), grass
- common wheat (*Triticum aestivum*), grass
- common oat (*Avena sativa*), grass
- soybean (*Glycine max*), other herbaceous

Community 3.1
Annual Cropping System

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

State 4
Altered Production State

This state is characterized by the production of annual crops due to drainage by mechanical means. This state is highly altered and will never return to the Reference State (State 1).

Dominant plant species

- corn (*Zea mays*), grass
- common wheat (*Triticum aestivum*), grass
- common oat (*Avena sativa*), grass
- soybean (*Glycine max*), other herbaceous

Community 4.1
Annual Cropping System

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

Transition T1A
State 1 to 2

Invasion of nonnative cattails and phragmites along with flooding and drought may lead to the Invaded State (State 2).

Transition T1B
State 1 to 3

Times of drought will dry out the site, which may allow tillage and annual cropping to commence and may lead to the Crop Production State (State 3).

Transition T1C
State 1 to 4

Drainage of basin may allow for the basin to be cropped and may lead to the Altered Production State (State 4). Restoration of this state may occur, but natural pathways have been altered and site will never return to Reference State (State 1).

Transition T2A
State 2 to 1

Deep water or drought may help the invaded phase return to a more native state within the Reference State (State

1). Narrowleaf/hybrid cattails cannot withstand deep water phases, or drought. A combination of many management types such as prescribe grazing, prescribe burning, and well-timed climate occurrences may allow the site to return to a non-native state (but not likely).

Transition T2B
State 2 to 3

Time and drought will dry out the site, which may allow tillage and annual cropping to commence and may lead to the Crop Production State (State 3).

Transition T2C
State 2 to 4

Drainage and drought of basin may allow for the basin to be cropped and may lead to the Altered Production State (State 4). Restoration of this state may occur, but natural pathways have been altered and site will never return to Reference State (State 1).

Transition T3A
State 3 to 2

Non-use and flooding will allow invasive water-loving plants to revegetate the site over time. Seeding with native vegetation may also speed this process.

Transition T4A
State 4 to 2

Restoration/renovation of the site by plugging ditches will return this site back to a vegetated state. The site will have been altered too much to allow a restoration back to the Reference State (State 1).

Additional community tables

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; and Dave Ode, Botanist/Plant Ecologist (retired) State of South Dakota.

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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	11/21/2024

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:**
