USDA Natural Resources Conservation Service

Ecological site R053CY037SD
Deep Marsh

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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): 053C–Southern Dark Brown Glaciated Plains

The Southern Dark Brown Glaciated Plains (53C) is located within the Northern Great Plains Region. It is entirely in South Dakota encompassing about 3,990 square miles (Figure 1). The elevation ranges from 1,300 to 2,300 feet. The MLRA is level to gently rolling till plains including many areas of potholes. A terminal moraine occurs in the southern end of the MLRA. Moderately steep and steep slopes are adjacent to the major valleys. The headwaters of many creeks in central South Dakota occur in the high-lying MLRA. (USDA-NRCS 2006).

The dominant soil orders in this MLRA is Mollisols and Inceptisols. The soils in the area dominantly have a mesic soil temperature regime, an ustic soil moisture regime, and mixed or smectitic mineralogy. They generally are very deep, well drained, or moderately well drained, and are loamy or clayey. This area supports natural prairie vegetation characterized by western wheatgrass (Pascopyrum smithii), big bluestem (Andropogon gerardii), needleandthread (Hesperostipa comata), and green needlegrass (Nassella viridula). Little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), and prairie sandreed (Calamovilfa longifolia) are important species on steeper sites. Western snowberry (Symphoricarpos occidentalis) and prairie rose (Rosa arkansana) are commonly dispersed throughout the area. (USDA-NRCS 2006).

Classification relationships

Major Land Resource Area (MLRA): Southern Dark Brown Glaciated Plains (53C) (USDA-NRCS 2006)

USFS Subregions: Northeastern Glaciated Plains Section (331E); Missouri Coteau Subsection (331Ea); Western Great Plains Section (331F); Missouri Breaks Subsection (331Fe); Western Glaciated Plains Section (332B); Southern Missouri Coteau Slope Subsection (332Bd, 332Be); North Central Great Plains Section (332D); Southern Missouri Coteau Slope Subsection (332Dd); Southern Missouri Coteau Subsection (332De) - (Cleland et al. 2007).

US EPA Level IV Ecoregion: Missouri Coteau (42a); Southern Missouri Coteau (42e); Southern Missouri Coteau Slope (42f) - (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. Ponded water conditions and very slow permeability strongly influences the soil-water-plant relationship. Most uncultivated wetland basins in this MLRA have concentric bands of distinctly different vegetation corresponding with changes in soil and water depth.

Associated sites

R053CY002SD	**Linear Meadow** These sites occur in drainageways or along the edges of closed depressions. Soils are poorly and very poorly drained and 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 Lawet, but other series are included.
R053CY010SD	**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 are Agar, Glenham, and Highmore, but other series are included.
R053CY019SD	**Closed Depression** These sites occur in slight depressions on nearly level slopes in the upland areas. Soils are poorly drained and may have a claypan (columnar structure) within 6 inches of the soil surface or an abrupt texture change within 12 inches of the soil surface. The central concept soil series are Hoven and Plankinton, but other series are included.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Typha* (2) *Blysmus*

Physiographic features

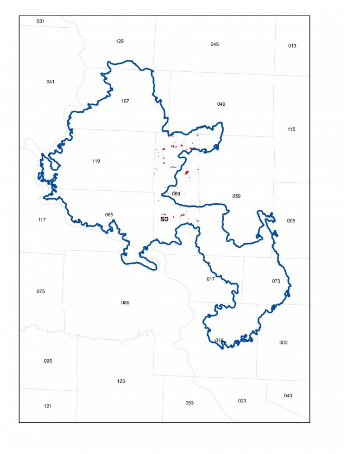

Figure 1. Distribution map

Table 2. Representative physiographic features

Landforms	(1) Plains > Depression
Ponding duration	Very long (more than 30 days)
Ponding frequency	Frequent
Elevation	1,300–2,300 ft
Slope	0–1%
Ponding depth	0–60 in
Water table depth	0–6 in

Climatic features

MLRA 53C is considered to have a continental climate – cold winters and hot summers, low 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 15 to 25 inches per year. The average annual temperature is about 45°F. January is the coldest month with average temperatures ranging from about 15°F (Stephan, South Dakota (SD)), to about 16°F (Onida 4 NW, SD). July is the warmest month with temperatures averaging from about 72°F (Stephan, SD), to about 74°F (Onida 4 NW, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 58°F. This large annual range attests to the continental nature of this area's climate. Hourly winds are estimated to average about 12 miles per hour (mph) annually, ranging from about 13 mph during the spring to about 11 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)	107-127 days
Freeze-free period (characteristic range)	128-150 days
Precipitation total (characteristic range)	20-21 in
Frost-free period (actual range)	104-129 days
Freeze-free period (actual range)	127-159 days
Precipitation total (actual range)	19-24 in
Frost-free period (average)	117 days
Freeze-free period (average)	139 days
Precipitation total (average)	21 in

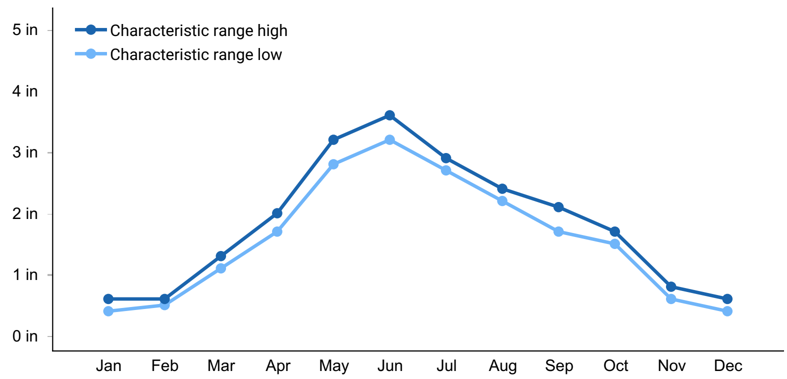

Figure 2. Monthly precipitation range

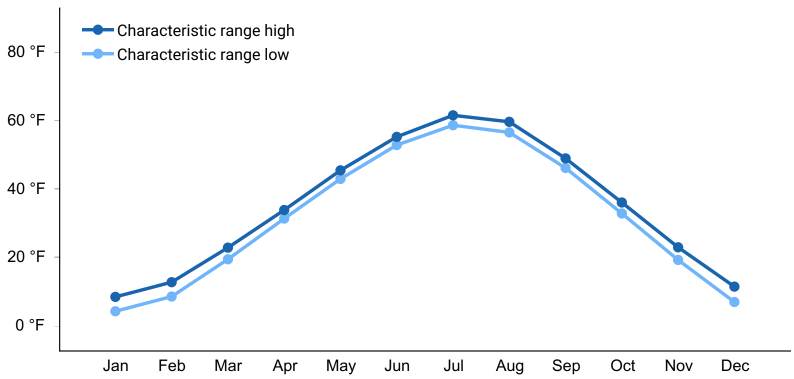

Figure 3. Monthly minimum temperature range

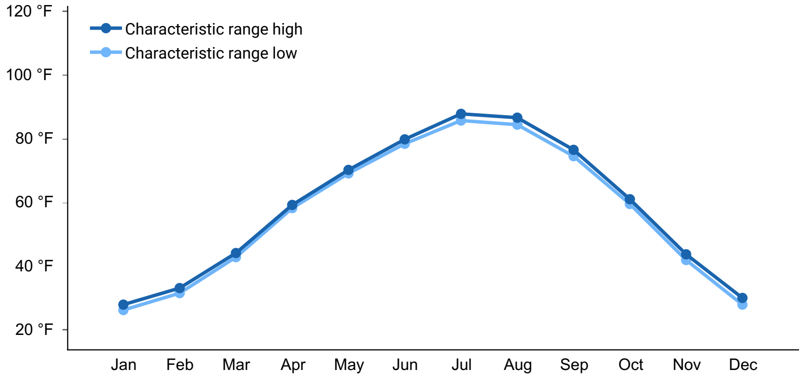

Figure 4. Monthly maximum temperature range

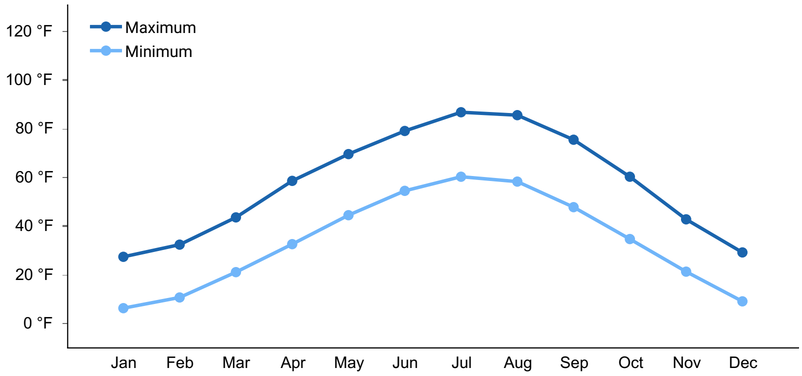

Figure 5. Monthly average minimum and maximum temperature

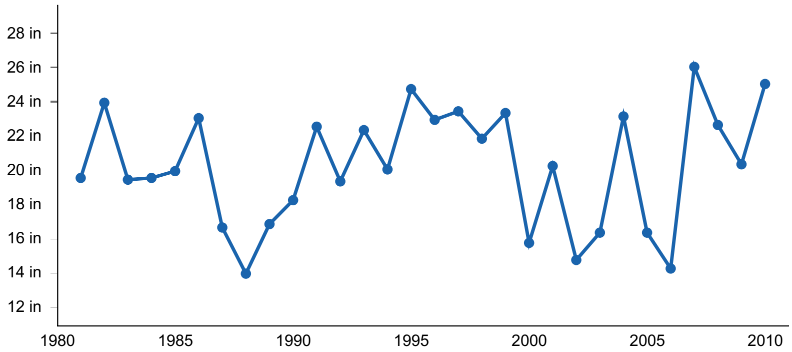

Figure 6. Annual precipitation pattern

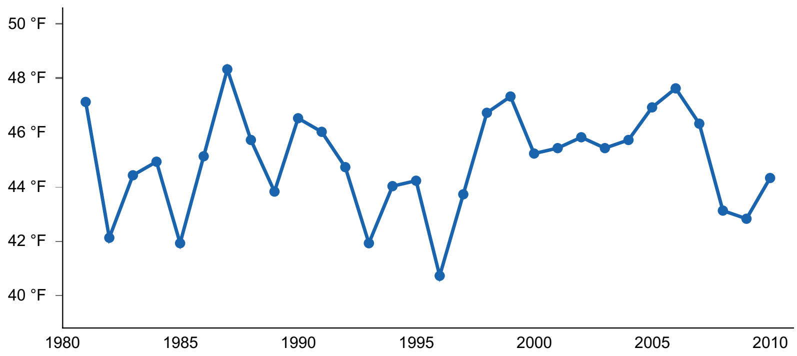

Figure 7. Annual average temperature pattern

Climate stations used

- (1) PIERRE RGNL AP [USW00024025], Pierre, SD
- (2) HARROLD 12 SSW [USC00393608], Pierre, SD
- (3) STEPHAN 2 NW [USC00397992], Highmore, SD

- (4) WESSINGTON SPRINGS [USC00399070], Wessington Springs, SD
- (5) GETTYSBURG 13W [USC00393302], Gettysburg, SD
- (6) GETTYSBURG [USC00393294], Gettysburg, SD
- (7) HIGHMORE 23 N [USC00393838], Highmore, SD
- (8) ONIDA 4 NW [USC00396292], Onida, SD

Influencing water features

The Deep Marsh ecological site has a combination of physical and hydrological features that: 1) provide season-long standing water on normal years, and retain ground water within one foot of the surface in drought years 2) allows relatively free movement of water and air in the upper part of the soil, and 3) are occasionally to frequently flooded.

Wetland description

Wetland Description: Cowardin, et. al., 1979
System: Palustrine
Subsystem: N/A
Class: Emergent Wetland
Subclass: Semi-permanently flooded, to intermittently exposed

Soil features

The common soil features of soils in this site are the silty clay loam to clay subsoil and slopes 0 to 1 percent. The soils in this site are very poorly drained and formed in local alluvium. The silty clay loam surface layer is 2 to 4 inches thick. The soils have a very slow infiltration rate. The central concept soil series is Macken, ponded, 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. Ponded water conditions and very slow permeability strongly influences the soil-water-plant relationship.

Table 4. Representative soil features

Surface texture	(1) Silty clay loam
Family particle size	(1) Clayey
Drainage class	Very poorly drained
Permeability class	Very slow
Soil depth	0–80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-40in)	0.11–0.23 in
Calcium carbonate equivalent (0-40in)	0–25%
Electrical conductivity (0-40in)	0–8 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	6.6–8.4
Subsurface fragment volume <=3" (0in)	Not specified
Subsurface fragment volume >3" (0in)	Not specified

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 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. These hydrologic cycles and vegetation changes have been described in detail by Stewart and Kantrud (1971), who subdivided them into four phases: 1) Normal Emergent Phase. Historically, this phase of deep marsh vegetation consisted of scattered patches of broadleaf cattail or stands of bulrushes like hardstem, slender, softstem, or prairie bulrush separately or the combination of both together, 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.

In wet years, the water depth in Deep Marsh basins would increase and subsequently drowned out the emergent cattails and bulrushes, leading to the 2) Open-water Phase. There may still be cattails and bulrushes on the periphery of the wetland basin during this phase, but the central portion of the basin would have open water with various submerged and floating-leaved aquatic plants, like those mentioned above. With the onset of drought, the wetland basin dries up and enters the 3) Drawdown Bare-soil Phase.

With the newly exposed and mostly bare soils, weedy annual and short-lived perennial plants like cockleburs, swamp ragwort, rough barnyardgrass, and foxtail barley invade the wetland basin. Prolonged drought alone (completely dry soils for two years) is also apparently enough to kill broadleaf cattail (Nelson and Dietz 1966). With the return of normal precipitation and runoff, water levels rise, inundating the standing annuals and other plants, leading to the 4) Natural Drawdown Emergent Phase. Seeds of emergent wetland plants like cattails and bulrushes are once again able to germinate and grow on any mudflats or areas of very shallow, standing water (the seeds of most emergent plant species cannot germinate in water deeper than a couple inches). After the drawdown (which also tends to kill any minnows or other aquatic animals) and reflooding, there is a pulse of nutrients from all the recently decomposing vegetation leading to an explosion of aquatic invertebrates. With the return of standing water, the germination of upland plant seeds and most emergent plant seeds is inhibited, while the germination of submerged and floating-leaved plant seeds are stimulated. With time, the young emergent cattails and bulrushes spread by rhizomatous growth into clonal patches and the cycle repeats itself. Van der Valk and Davis (1978) suggest that these wet-dry vegetation transitions can take from 5 to 30 years or more to complete a full cycle.

Ecological Dynamics of Deep Marshes.
Besides the effects of wet-dry cycles, Deep Marsh habitats historically were subjected to substantial herbivory from muskrats, in particular; also the grazing and trampling by large ungulates like bison and elk. Muskrats consume cattail and bulrush tubers as food, but also cut the stems for the construction of their mounds and dens. In most circumstances, muskrats maintain open water patches surrounding their mounds within a larger stand of cattails

and bulrushes, but occasionally it is possible for muskrats to overpopulate and virtually eliminate the emergent cattails and bulrushes from a wetland basin (Errington et al. 1963). Prairie fires were a frequent phenomenon on the northern Great Plains and would burn wetland vegetation during drawdown conditions and even consume dry, dense, emergent vegetation standing over shallow water or ice (Kantrud 1986).

The invasion of Deep Marsh wetlands by narrowleaf cattail and hybrid cattail has dramatically altered the ecology of these wetland basins. Narrowleaf cattail is presumed to be an exotic species in much, if not all of North America (Stukey and Salamon 1987), and appears to have been absent from the northern Great Plains until the 1920s and 1930s, based upon the absence of this species in early floristic lists for the region (Rydberg 1896, Saunders 1899, Rosco & Clements 1900, Visher 1912, 1914, McIntosh 1931, Metcalf 1931). It appears to have been introduced into the Black Hills (Hayward 1928) and eastern South Dakota (Over 1932) by the late 1920s. Once introduced, narrowleaf cattail began to hybridize with the native broadleaf cattail and formed a new, taller, more aggressive, more persistent "hybrid cattail" (Typha X glauca).

Our native broadleaf cattail is killed by water depths exceeding about 64 cm when kept submerged for most of the growing season. In contrast, narrowleaf and hybrid cattail require depths exceeding 100 cm for at least 1 year or more before they will drown (Steenis et al. 1959, Miklovic 2000). The roots and rhizomes of cattails require oxygen to survive, and obtain most of this oxygen through the aerenchyma tissue of cattail stems and leaves. Thus, the susceptibility to drowning of all cattail species can be enhanced by cutting, grazing or burning to remove these tissues followed by inundation (Nelson and Dietz 1966, Apfelbaum 1985).

Narrowleaf cattail is also less sensitive to salt concentrations which enables it to grow in more brackish waters than broadleaf cattail. In at least one study (Jarchow and Cook 2009), it was shown that narrowleaf cattail produced allelopathic compounds that inhibited the growth of river bulrush, suggesting yet another competitive advantage against other Deep Marsh emergent plants. The end result is that most Deep Marsh habitats are now dominated by narrowleaf and hybrid cattails and in at least the shallower wetland basins, the cyclic rotation of vegetational phases due to drought and deluge has been simplified if not entirely replaced by a monoculture of exotic cattails.

State and transition model

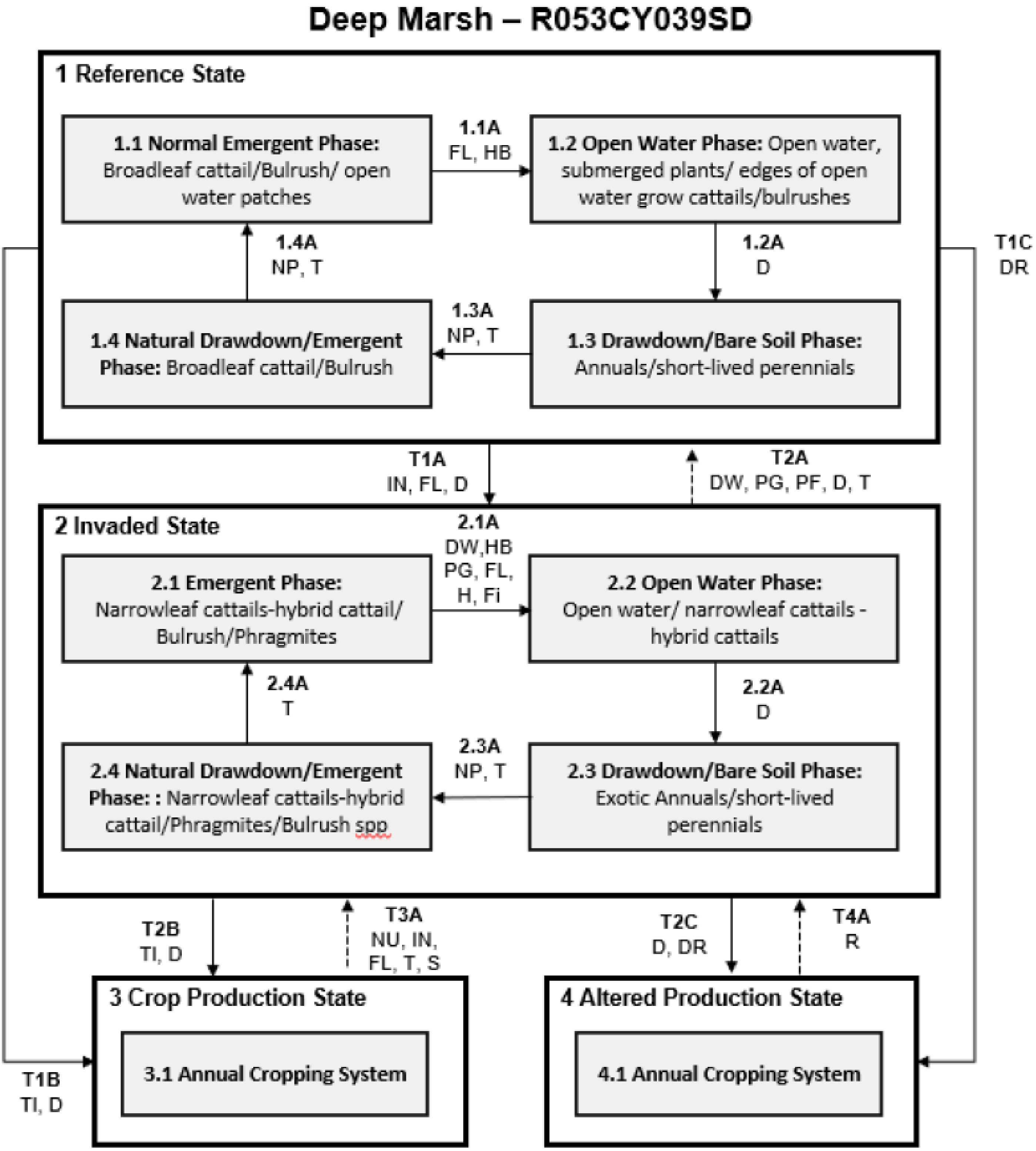

Figure 8. State-and-Transition Model

Deep Marsh – R053CY039SD

LEGEND

Deep Marsh – R053CY039SD

D – Drought
DR – Drainage
DW – Deep Water
H – Haying/Chopping
HB - Herbivory
Fi - Fire
FL – Flooding
IN – invasion of nonnative vegetation
NP – Return to normal precipitation patterns
NU – Non use
PG – Prescribed Grazing
PF – Prescribed Fire
R – Renovation/Restoration
S – Seeding
T – Time
TI – Tillage

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Transition may not be fast and/or feasible

Figure 9. State-and-Transition Model Key

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

Figure 10. Matrix

USDA Common Name	Scientific Name (from USDA Plants)	USDA Plant Code	Dominant or Abundant	Comments
	Emergent Grass-like Plants			
River Bulrush	Bolboschoenus fluviatilis	BOFL3		
Cosmopolitan/Prairie Bulrush	Bolboschoenus maritimus ssp. paludosus	BOMAP4	X	(Scirpus paludosus)
Common Spikerush	Eleocharis palustris	ELPA3		
American Common Reed	Phragmites australis ssp. americanus	PHAU6	Locally	Expanding native
European Common Reed	Phragmites australis ssp. australis	PHAU7		Invasive exotic
Hardstem Bulrush	Schoenplectus acutus	SCAC3	X	
Slender Bulrush	Schoenplectus heterochaetus	SCHE5		
Softstem Bulrush	Schoenoplectus			
Common Rivergrass	Scolochloa festucacea	SCFE		(Whitetop)
Broadfruit Bur-reed	Sparganium eurycarpum	SPEU		
Prairie Cordgrass	Spartina pectinata	SPPE		
Narrowleaf Cattail	Typha angustifolia	TYAN	X	Exotic
Broadleaf Cattail	Typha latifolia	TYLA	X	Native
Hybrid Cattail	Typha x glauca	TYGL	X	Exotic
Common Name	Scientific Name (from USDA Plants)	USDA Plant Code	Dominant or Abundant	Comments
	Emergent Forbs			
Tufted Loosestrife	Lysimachia thyrsiflora	LYTH2		
Purple Loosestrife	Lythrum salicaria	LYSA2		Invading exotic
Hemlock Water Parsnip	Sium suave	SISU2		
Common Name	Scientific Name (from USDA Plants)	USDA Plant Code	Dominant or Abundant	Comments
	Submerged or Floating-leaved Aquatic Plants			
Coon's Tail (Coontail)	Ceratophyllum demersum	CEDE4		
Turion Duckweed	Lemna turionifera	LETU2		
Shortspike Watermilfoil	Myriophyllum sibiricum	MYSI		(Northern Water-
Water Knotweed	Polygonum amphibium	POAMS		
Water Smartweed	Polygonum amphibium var. emersum	POAME		(Polygonum coccineum)
Small Pondweed	Potamogeton pusillus	POPU7		
Richardson's Pondweed	Potamogeton richardsonii	PORI2		
Flatstem Pondweed	Potamogeton zosteriformis	POZO		
Longbeak Buttercup	Ranunculus longirostris	RALO2		(White Water-
Sago Pondweed	Stuckenia pectinata	STPE15		(Potamogeton pectinatus)
Common Bladderwort	Utricularia macrorhiza	UTMA		

Figure 11. Vascular plant list page 1

Common Name	Scientific Name (from USDA Plants)	Plant Code	Dominant or Abundant	Comments
A few of the common drawdown plants that colonize dry wetland basins				
Tumble Pigweed	Amaranthus albus	AMAL		
Spearscale	Atriplex patula	ATPA4		
Burning Bush (Kochia)	Bassia scoparia	BASC5		(Kochia scoparia)
Red Goosefoot	Chenopodium rubrum	CHRU		
Barnyardgrass	Echinochloa crus-galli	ECCR		exotic
Rough Barnyardgrass	Echinochloa muricata	ECMU2		native
Foxtail Barley	Hordeum jubatum	HOJU		

Figure 12. Vascular plant list page 2

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 play 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).

Community 1.1
Normal Emergence Phase

Historically, this phase of deep marsh vegetation consisted of scattered patches of broadleaf cattail or stands of bulrushes like hardstem, slender, softstem or prairie bulrush separately or a combination of both cattails and bulrushes together, 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 within 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. This 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 that 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 and nonnative vegetation.

Community 2.1
Invaded Emergent Phase

This phase is dominated by narrowleaf and 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, or flooding, separately, or the combination of any or all will lead to an open water phase. Deeper water than the Reference State (State 1) is needed to drown out narrowleaf and hybrid cattails. An alternative to deeper water is haying or chopping, fire, or crushing cattails separately, or the combination of any or all (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.

This 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.

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

Characteristics and indicators. 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).

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).

Restoration pathway 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 and 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 may allow for the basin to be cropped and 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).

Restoration pathway T3A
State 3 to 2

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

Restoration pathway T4A
State 4 to 2

Restoration and 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 restoration back to the Reference State (State 1).

Additional community tables

Other information

Ecological Site Correlation Issues and Questions:

• SD049 Faulk County, SD did not use the (Mb) Macken silty clay loam, ponded (national symbol cw5l) as used in the adjoining SD069 Hyde County.
• 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; and Dave Ode, Botanist/Plant Ecologist (retired) State of South Dakota.

Data Source Sample Period State County
NONE

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Approval

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This Provisional Ecological Site concept has passed both Quality Control and Quality Assurance processes. Quality Assurance was approved by David Kraft, NRCS Regional Ecologist as of 11/12/2020.

Non-discrimination Statement

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	01/22/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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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:**