United States Department of Agriculture Natural Resources Conservation Service Ecological Site Description

Section I: Ecological Site Characteristics

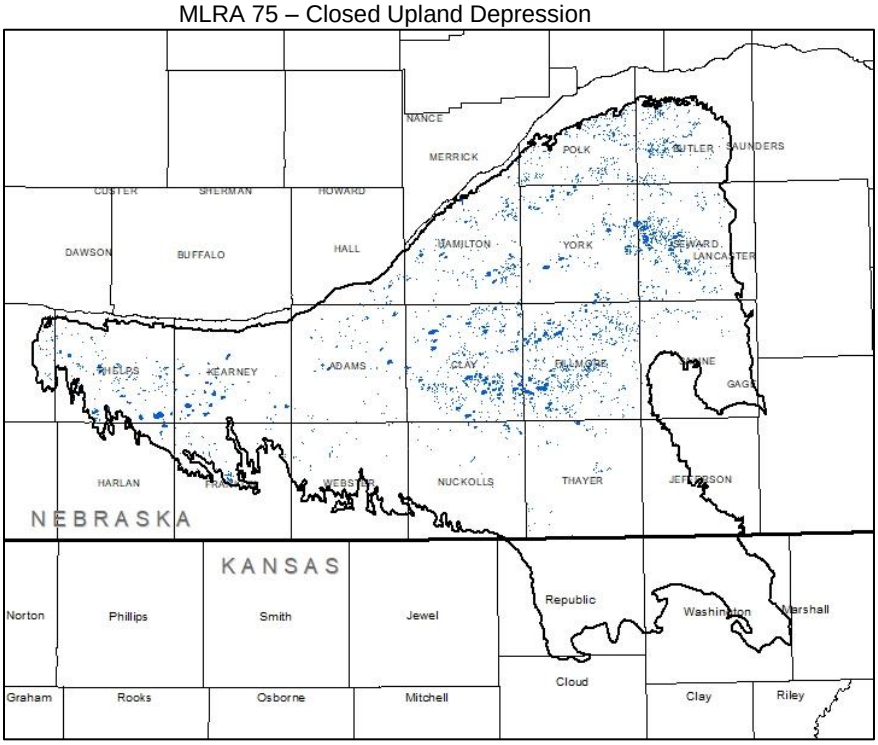
Ecological Site Identification and Concept

Site stage: **Provisional**

Provisional: an ESD at the provisional status represents the lowest tier of documentation that is releasable to the public. It contains a grouping of soil units that respond similarly to ecological processes. The ESD contains 1) enough information to distinguish it from similar and associated ecological sites and 2) a draft state and transition model capturing the ecological processes and vegetative states and community phases as they are currently conceptualized. The provisional ESD has undergone both quality control and quality assurance protocols. It is expected that the provisional ESD will continue refinement towards an approved status.

Site name: **Closed Upland Depression**
Pascopyrum - Carex (western wheatgrass - sedge)
Site type: Rangeland
Site ID: R075XY049NE
Major land resource area (MLRA): 075-Central Loess Plains

MLRA 75 – Closed Upland Depression



Closed Upland Depression Distribution in MLRA 75

Named the “Central Loess Plains,” MLRA 75 is located primarily in south-central Nebraska, with about 10 percent lying in north-central Kansas. The approximately 5.3-million-acre landscape covers all or parts of 23 counties, mainly Phelps, Kearney, Adams, Clay, Fillmore, York, Hamilton, Seward, Butler, Saline, Thayer, Nuckolls, and Webster in Nebraska, with a significant presence in Republic and Washington counties in Kansas. The physical appearance is primarily gently rolling plains, with a number of narrow, shallow stream valleys. The river valleys are broader, and most feature a number of terraces. The northern border is defined by the Platte River. This MLRA is home to the unique ecological system called the “Rainwater Basin,” which comprises a 24,000-acre network of playa wetlands and uplands that occupy portions of 19 of the northern counties.

The elevation in MLRA 75 ranges from nearly 3,000 to less than 1,100 feet above sea level. The local relief averages from 10 to 25 feet, but may stretch to a maximum of 165 feet in some areas. The predominate soil

order is mesic, ustic Mollisol, commonly represented by the Uly, Hord, Hall, and Holdrege soil series. Loess overlays the surface of almost all of the uplands in this MLRA. Alluvial clay, silt, sand, and gravel are deposited in the stream and river valleys, and can be extensive in the major drainages. Terraces are common in the valleys along the river systems. Average annual precipitation ranges from 23 to 36 inches, with the number of freeze-free days ranging from 150 to 200. The matrix vegetation type is mixed-grass prairie, with big and little bluestem, switchgrass, Indiangrass, and sideoats and blue grama making up the bulk of the warm-season species, while western wheatgrass is the dominant cool-season grass.

Seventy-two percent of the land in this MLRA has been broken out of native prairie and farmed, primarily corn, soybean, wheat, and grain sorghum; while only eighteen percent of the grasslands remain intact. Livestock grazing, primarily cattle, is the main industry on these remnant grasslands. Irrigation of croplands uses over 90 percent of the total annual water withdrawal.

Wildlife flourishes in this combination of crop and grassland environment, with both mule and white-tailed deer being the most abundant wild ungulates. A variety of smaller species, including coyote, raccoon, opossum, porcupines, muskrat, beaver, squirrel, and mink thrive in the region, as well as several upland bird species. Grassland bird populations are somewhat limited by the lack of contiguous native prairie and fragmented habitat created by the farmland. The rivers, streams, and lakes harbor excellent fisheries. During spring migration, an estimated 8.6 million waterfowl and 500,000 shorebirds rely on Rainwater Basin wetlands to rest and replenish nutrient reserves before continuing to the breeding grounds.

This landscape serves as a backdrop for a disturbance-driven ecosystem, evolving under the influences of herbivory, fire, and variable climate. Historically, these processes created a heterogenous mosaic of plant communities and structure heights across the region. Any given site in this landscape experienced fire every 6 to 8 years due to lightning strikes and Native Americans intentionally setting fires for warfare, signaling, and to rejuvenate the native grasses. Additionally, large ungulates such as bison fed en masse, causing short periods of intensive grazing. Variable climate would cause periods of drought and deluge, which are even more pronounced in wetlands than uplands.

European settlement significantly altered both the fire regime and herbivory in the region. As a result of the decreased disturbance regime, native and introduced shrubs and trees have encroached into the remaining native prairie and wetland areas. The lack of disturbance also promotes the spread of undesirable, perennial, monoculture forming species such as reed canarygrass, hybrid cattails, and river bulrush in the wetlands. Intentional planting of some of these species, particularly eastern redcedar and reed canarygrass, has exacerbated their spread.

Introduction of eastern redcedar as a windbreak species has facilitated the invasion by this species into the remaining grasslands. While eastern redcedar is native to Nebraska, the historic population in MLRA 75 was limited to isolated pockets in rugged river drainages that were subsequently insulated from fire, or non-existent. Widespread plantings of windbreaks with eastern redcedar as a primary component have provided a seed source for the aggressive woody plant. The ensuing encroachment into the native grasslands degrades the native wildlife habitat and causes significant forage loss for domestic livestock. However, since it is not a root sprouter, eastern redcedar is very susceptible to fire when less than six-feet tall. Management with prescribed fire is exceedingly effective if applied before this stage. Larger redcedars can also be controlled with fire, but successful application requires the use of specifically designed ignition and holding techniques. Fragmentation of the landscape by conversion to cropland, transportation corridors, and other development by humans has effectively disrupted the natural fire regime of this ecosystem. This has allowed encroachment by native and introduced shrubs and trees into the remnants of the native habitat throughout the MLRA. Aggressive fire suppression policies have exacerbated this process to the point that shrub and tree encroachment is a major ecological issue in the majority of both native and re-seeded grasslands.

Ecological Site Concept

The features associated with the Closed Upland Depression ecological site are playa wetlands, which are embedded in an upland setting with no natural outlet. Each playa has an isolated watershed, not connected to any natural drainage. The closed watershed funnels water to the playa at the lowest point in the watershed. These wetlands generally exhibit temporary, seasonal, or semi-permanent water regimes, causing, in an average year, ponded water for weeks or months annually. However, these wetlands can occasionally remain ponded or dry for greater durations that may extend more than a year.

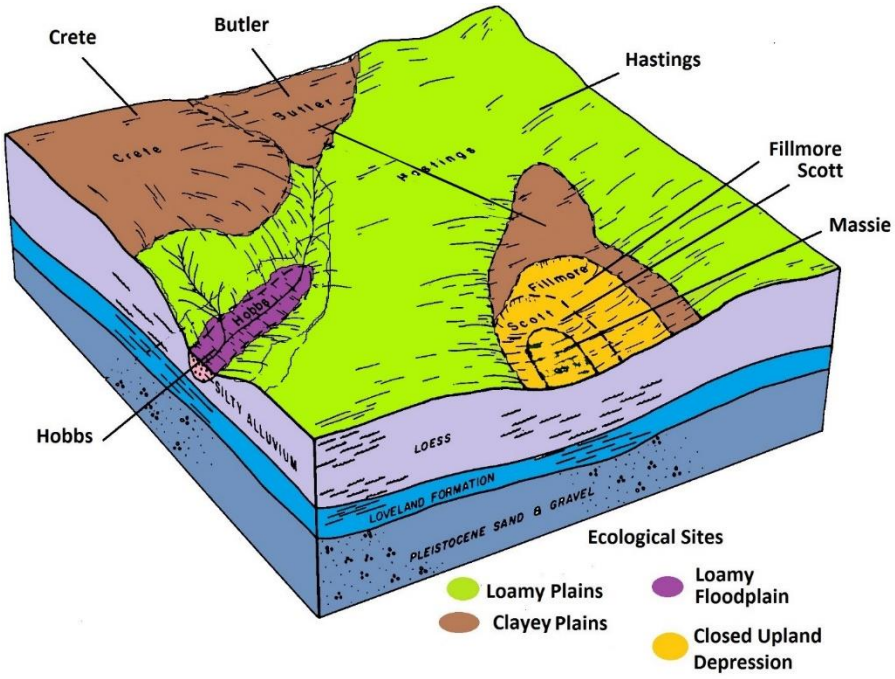
These sites shift between a variety of vegetation communities with distinctly different species. The species composition is driven largely by depth and length of inundation as well as the amount and level of disturbance. The deepest portions of playas that remain ponded for extended periods of time are often dominated by native and non-native bulrush and cattail species. Around the deep areas are the portions that are often saturated or pond water for shorter periods, and are dominated by moist soil species that oscillate between annual and perennial communities. The areas that are occasionally saturated but seldom pond water are considered the

wet meadow zone. The wetland-upland interface around the outer rim is often dominated by grass species. However, not all of these zones are found in every playa wetland and the boundaries of the different zones may shift from year to year depending on annual hydroperiod and disturbance.

Physiographic Features

These sites occur in playas and depressions of the uplands, and occasionally on a depression on a fan. They receive runoff from areas higher on the landscape and are ponded for brief to long periods from run-in water. They are not subject to flooding. However, anthropogenic features, such as reuse pits, concentration pits, ditches, and drains, may alter the functionality of Closed Upland Depressions by preventing water from reaching the sites, concentrating water on sites in unnaturally deep areas, or diverting water away from the sites.

Wind deflation can help maintain natural hydrology within the wetland by removing excessive culturally accelerated sediment from the site. This occurs when water drowns persistent vegetation followed by extended drought. This cycle causes the wetland vegetation to die and leaves the soil surface bare. Winds then scour the soil, removing the sediment from the wetland and depositing it in the upland.



Physiographic Image.—Block Diagram for Closed Upland Depression

Landform: (1) Playa
(2) Depression

	Minimum	Maximum
Elevation (feet):	1630	2650
Slope (percent):	0	2
Water table depth (inches):	>80	>80
Ponding		
Frequency:	Rare	Frequent
Duration:	Brief	Long
Runoff class:	Negligible	Negligible
Aspect:	No Influence on this site	

Climatic Features

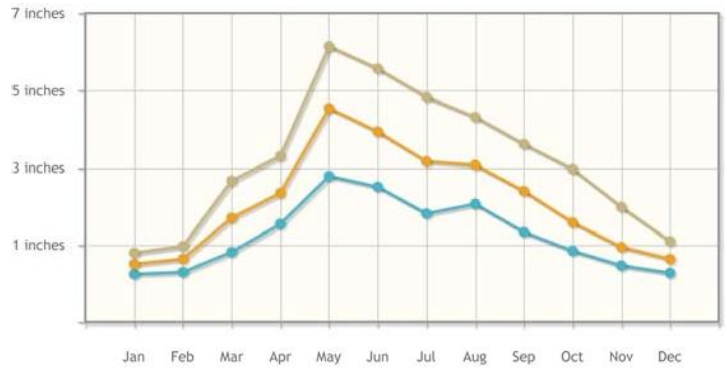
Like most Great Plains landscapes, the climate in this MLRA is under the sway of the continental effect. This creates a regime of extremes, with summer highs often in the triple digits, and winter lows plunging well below zero. Blizzards can occur anytime between early fall and late spring, often dropping the temperature more than 50 degrees in just a few hours. These events can pile up several feet of snow, often driven by winds in excess of 50 miles per hour. The resulting huge drifts can cause serious hardship for livestock, wildlife, and humans.

Winters can be open, with bare ground for most of the season, or closed, with up to several feet of snow persisting until March. Most winters have a number of warm days, interspersed with dropping temperatures, usually associated with approaching cold fronts. Spring brings violent thunderstorms, hail, and high winds. Tornadoes occur frequently. Daily winds range from an average of 14 miles per hour during the spring to 11 miles per hour during the late summer. Occasional strong storms bring brief periods of high winds with gusts to more than 80 miles per hour. Growth of native cool-season plants begins in early April and continues to about mid-June. Native warm-season plants begin growth in early June, and continue to early August. Green up of cool-season plants may occur in September and October.

	Average
Frost-free period (days):	155
Freeze-free period (days):	178
Mean annual precipitation (inches):	29.36

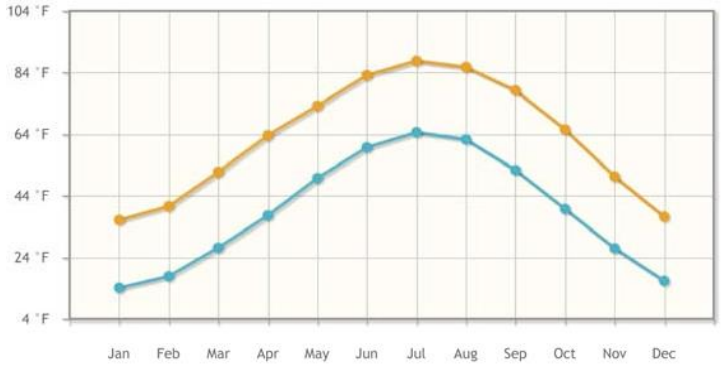
Monthly Precipitation (Inches):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	0.79	0.96	2.66	3.30	6.15	5.57	4.83	4.31	3.61	2.96	1.98	1.09
Medium	0.50	0.63	1.70	2.34	4.54	3.93	3.16	3.07	2.39	1.58	0.94	0.63
Low	0.24	0.29	0.81	1.54	2.78	2.50	1.81	2.06	1.33	0.84	0.46	0.27



Monthly Temperature (°F):

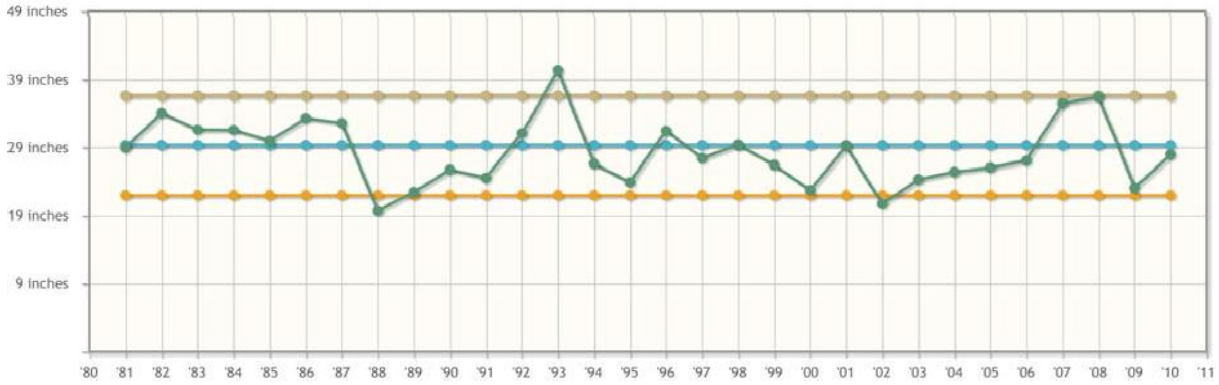
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	36.2	40.7	51.8	63.7	73.3	83.3	87.9	85.9	78.3	65.6	50.3	37.3
Low	14.1	17.9	27.2	37.7	49.8	59.8	64.7	62.4	52.4	39.8	27.0	16.4



30-Year Annual Rainfall (inches):

1981 N	1982 N	1983 N	1984 N	1985 N	1986 N	1987 N	1988 D	1989 N	1990 N	1991 N	1992 N	1993 H
28.97	34.2	31.7	31.65	29.99	33.42	32.7	19.67	22.51	25.8	24.6	31.16	40.42
1996 N	**1997 N**	**1998 N**	**1999 N**	**2000 N**	**2001 N**	**2002 D**	**2003 N**	**2004 N**	**2005 N**	**2006 N**	**2007 N**	**2008 N**
31.52	27.46	29.43	26.48	22.81	29.23	20.73	24.37	25.47	26.09	27.13	35.61	36.54

D-Drought N-Normal H-Heavy



Climate stations: (1) BELLEVILLE [USC00140682], Republic County KS 66935. Period of record 1981-2010
(2) AURORA [USC00250445], Hamilton County NE 68818. Period of record 1981-2010
(3) CLAY CTR [USC00251684], Clay County NE 68933. Period of record 1981-2010
(4) FAIRMONT [USC00252840], Fillmore County NE 68354. Period of record 1981-2010
(5) FRIEND 3E [USC00253065], Saline County NE 68359. Period of record 1981-2010
(6) GENEVA [USC00253175], Fillmore County NE 68361. Period of record 1981-2010
(7) HASTINGS 4N [USC00253660], Adams County NE 68901. Period of record 1981-2010
(8) MINDEN [USC00255565], Kearney County NE 68959. Period of record 1981-2010
(9) OSCEOLA [USC00256375], Polk County NE 68651. Period of record 1981-2010
(10) RAGAN [USC00257002], Harlan County NE 68969. Period of record 1981-2010
(11) RED CLOUD [USC00257070], Webster County NE 68970. Period of record 1981-2010
(12) SUPERIOR 4E [USC00258320], Nuckolls County NE 68978. Period of record 1981-2010
(13) SURPRISE [USC00258328], Butler County NE 68667. Period of record 1981-2010
(14) YORK [USC00259510], York County NE 68467. Period of record 1981-2010

Influencing Water Features

These sites are temporarily, seasonally, or semi-permanently ponded, filling as a result of runoff from snowmelt or precipitation events. These wetlands are independent of ground water influence. A site's hydroperiod depends on the size of the drainage area; infiltration rate; type and amount of vegetative cover of surrounding soils; the frequency, intensity, and total accumulation of rainfall; and the depth of the depression. Due to variable climatic conditions, the hydroperiod of a site can change annually.

Wetland Description
(Cowardin System)

System	Subsystem	Class
Palustrine	N/A	Emergent Wetland

Representative Soil Features

The features common to all soils in this site include a closed upland depression landform, frequent ponding, low saturated hydraulic conductivity, and slopes of 0 to 1 percent. The soils in this site are all formed in loess. The surface layer is almost always silt loam or silty clay loam and ranges from 2 to 17 inches thick. The texture of the subsurface is silty clay. Runoff as evidenced by patterns of rill, gully, or other water flow is negligible due to the low slope gradient. Pedestalling of plants does not typically occur on this site, however mucking by excessive hoof traffic can create an effect which appears exaggerated, but similar to pedestalling.

More information can be found in the various soil survey reports. Contact the local USDA Service Center for internet links to soil survey data that includes more details specific to your location.

Major soils series correlated to this ecological site include Massie, Scott, and Fillmore.

Soils Profile Image.—Fillmore Series Soil Profile

Parent materials
Kind: Loess
Surface texture: (1) Silty clay loam
(2) Silt loam

	Minimum	Maximum
Depth (inches):	20	80
Available water capacity (inches):	9.40	12.10
Sodium adsorption ratio:	0	0
Calcium carbonate equivalent (percent):	0	3
Soil reaction (1:1 water):	5.6	7.5

Plant Communities

Ecological Dynamics of the Site

These sites occur as depressions in an upland position and are subject to ponding. The vegetation communities evolved under a disturbance regime that included periods of sporadic but often intensive grazing by large transient herbivores, and occasional wildfires. They are often referred to as buffalo wallows.

Hydroperiods are the driving force that controls the type and extent of vegetation communities within the sites. Because hydroperiod can vary year to year, the boundaries between communities can fluctuate as hydroperiod fluctuates. Vegetation also shifts as a result of different grazing and disturbance regimes. In general, disturbance promotes annual communities, while lack of disturbance promotes perennial communities.

Additionally, not all playas contain all possible communities; they may contain as few as one vegetation community.

Similarly, wetland-upland interfaces are transient due to variable hydroperiods. During periods of above average precipitation, the wetland will move into the upland, while in periods of below average precipitation, the wetland will constrict.

Growth of native cool-season plants begins about April 1, and continues to about June 15. Native warm-season plants begin growth about May 15, and continue to about August 15. Green up of cool-season plants may occur in September and October if adequate moisture is available.

Land managers have begun to introduce the natural processes of grazing and fire when and where possible to create open areas that allow seed bearing annual plants to establish. These plants provide a critical food source for the millions of migratory birds that pass through the area annually. To facilitate reclamation of the more invaded sites, many managers have also begun using the more intensive practices of shredding, light disking, and applying herbicides.

Due to the small patch distribution of these sites and the degree of disturbance in the landscape, locating examples and reliable descriptions of examples of the pre-European reference plant community is difficult. The reference community description was determined by study of the best remaining relic examples, areas protected from excessive disturbance, research literature, expert opinions, and historical accounts.

Currently, five states are used to describe the Closed Upland Depression site, including the Reference State, Grassy Invaded State, Cattail/Bulrush Invaded State, Cropped Wetland State, and the Drained Wetland State. These states are based on anthropogenic alteration, hydroperiod, and disturbance regime and intensity.

The following diagram illustrates the states and the plant communities within the states that can occur on the site. The transitions between the states and between the communities are represented by the arrows. The processes that cause the fluctuation between the states and communities are discussed in more detail in the plant community descriptions following the diagram.

State-and-Transition Diagram

MLRA 75 Closed Upland Depression

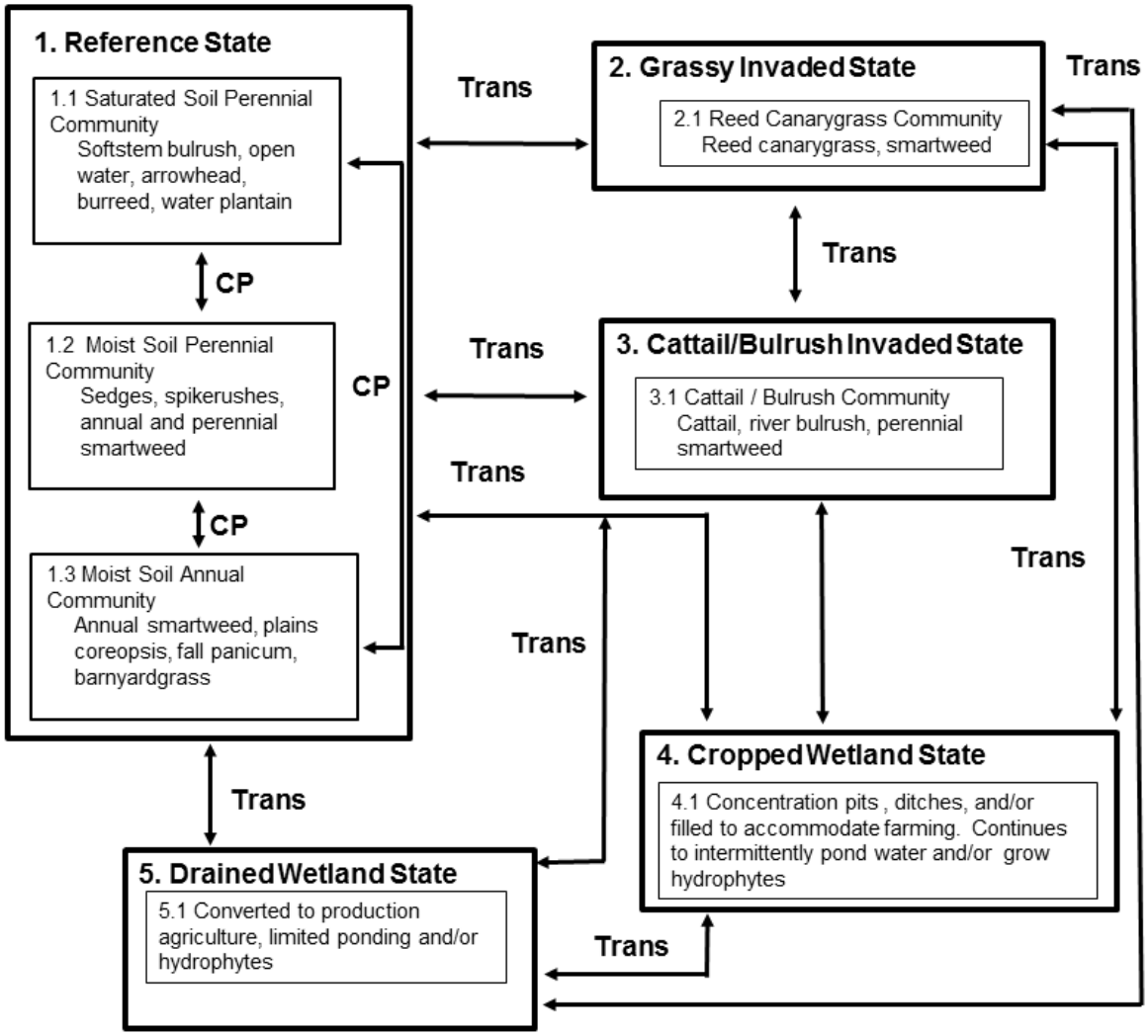


Diagram Legend	
Transition	**Driver**
State 1 (1.1, 1.2, 1.3), 2, 3, 4 - 5	Significant drainage activities (i.e., excavation of concentration pits, construction of surface or tile drainage features, placement of fill material). Rarely ponds water and hydrophytes generally not present. Site is cultivated.
State 1 (1.1, 1.2, 1.3), 2, 3 - 4	Site is cultivated. Almost always has drainage activities, excavated concentration pits, or drained or filled to accommodate farming. Wetland intermittently ponds water and/or grows hydrophytes.
State 5 - 4	Drainage features become less effective, hydrologic restoration by removing culturally accelerated sediment and/or fill material, filling concentration pit, plugging surface drains. Site remains cultivated.
State 1 (1.1, 1.2, 1.3), 2 - 3	Significant ponding depth (>12 inches), increased duration and frequency of ponding, increased nutrient loads from sedimentation, low intensity grazing, or no disturbance.
State 4, 5 - 3	Site no longer cultivated. Hydrologic restoration of the site by removing culturally accelerated sediment and/or fill material, filling concentration pit(s), and plugging surface drain(s). If site is not disturbed and has long-term ponding and deep depth (>12 inches), the Cattail/Bulrush Invaded State can become established.
State 1 (1.1, 1.2, 1.3), 3 - 2	Short-term ponding, shallower ponding depth (<12 inches), saturated soil conditions, and a combination of increased nutrient loads from sedimentation, low intensity or no grazing, annual haying.
State 4, 5 - 2	Site no longer cultivated. Hydrologic restoration of the site. Often involves removing culturally accelerated sediment and/or fill material, filling concentration pit(s), and plugging surface drain(s). If site remains saturated or has limited short-term ponding and shallow depth (<12 inches), and/or seeded to reed canarygrass, the Grassy Invaded state can become established.
State 2 - 1 (1.1, 1.2, 1.3)	Multiple disturbance treatments within and over multiple years (chemical, mechanical, high intensity grazing) and/ or sediment removal.
State 3 - 1 (1.1, 1.2, 1.3)	Multiple disturbance treatments within and over multiple years (chemical, mechanical, high intensity grazing) and/ or sediment removal. Decreased ponding depth, duration, and frequency.
State 4, 5 - 1 (1.1, 1.2, 1.3)	Site no longer cultivated. Hydrologic restoration of the site. Often involves removing culturally accelerated sediment and/or fill material, filling concentration pit(s), and plugging surface drain(s). Moist Soil Annual Community will usually colonize the site post restoration.

Community Pathway	**Driver**
1.1 - 1.2	Decrease ponding frequency and duration.
1.1 - 1.3	Decrease ponding frequency and duration coupled with disturbance (e.g., grazing, herbicide application, light disking).
1.2 – 1.1	Increase ponding frequency and duration.
1.2 – 1.3	Increase disturbance regime with grazing, haying, disking, and/or herbicide treatments.
1.3 – 1.1	Increase ponding frequency and duration and reduce disturbance regime.
1.3 – 1.2	Short-term inundation to maintain moist soil conditions and limited disturbance from grazing or other management treatments.

State 1: Reference State

The Reference State is found in playas that have a high level of hydrologic function. The high level of function is a result of limited modifications within the watershed and wetland, as well as lack of cultivation. Within the wetland, surface drains and/or concentration pits have not been excavated, upland soils or fill material have not been placed in the wetland, and significant amounts of culturally accelerated sediment have not accumulated above the native soil profile. The watersheds of these wetlands have a limited number of irrigation reuse pits that store water that would otherwise make it to the wetland, and sufficient culverts in the

road network to allow runoff to reach the wetland.

The Reference State is dynamic and transitions between three vegetation communities. At any given time, a single wetland in the Reference State could have all three communities present or be dominated by a single community. The three communities that make up the Reference State are the Saturated Soil Perennial Community, Moist Soil Perennial Community, and Moist Soil Annual Community. The spatial border between the three communities is directly linked to the duration and depth of ponding. This is driven seasonally, and by local rainfall events. Implementation of management practices like grazing, herbicide application, disking, shredding, haying, etc. can also influence community presence. Some of these areas may pond water long enough to drown out vegetation, leaving bare soil during dry cycles or sparse annual vegetation.

Implementation of management actions (e.g., prescribed fire, disking, haying, grazing, herbicide application) or the lack of disturbance can result in community phase changes within the reference state. In the absence of historical intensive grazing by bison and elk herds, and the disruption of the fire regime, land managers have intentionally engaged in practices to create and maintain a more disturbed phase within the reference state to achieve wildlife management goals.

The Reference State can transition to four other states as a result of human alteration (e.g., ditching or excavating concentration pits), very severe disturbance (e.g., plowing), and/or naturally occurring ecological processes. These other states include the Grassy Invaded State, Cattail/Bulrush Invaded State, Cropped Wetland State, and Drained Wetland State.

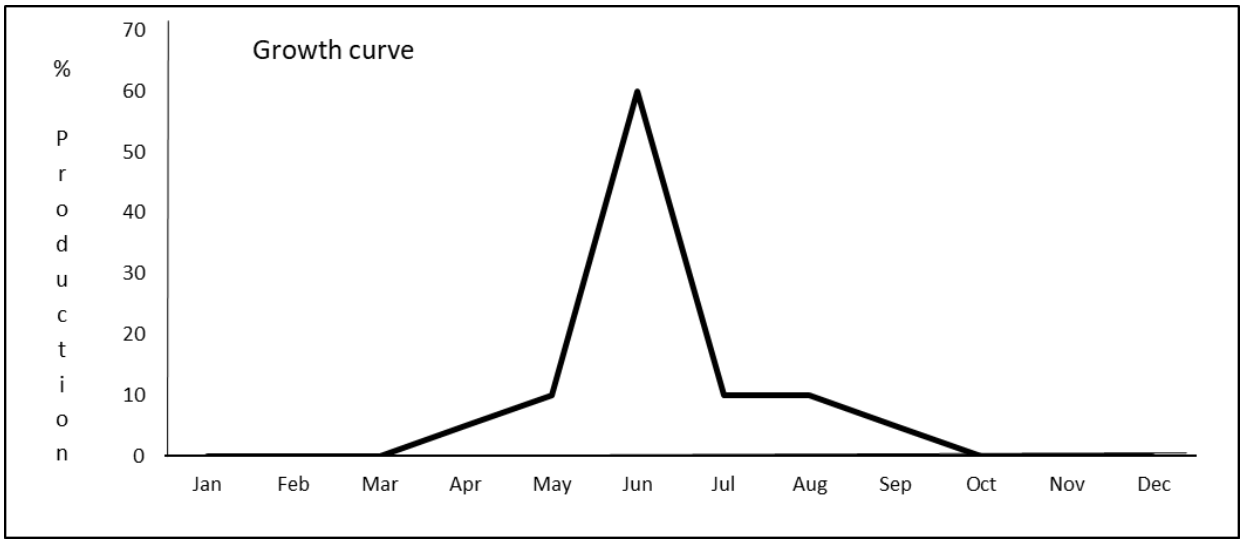
Plant Growth Curve

Growth curve number: CUD MLRA 75- State 1
Growth curve name: Moist-Soil and Saturated-Soil annuals and perennials
Growth curve description: Moist-Soil and Saturated-Soil annuals and perennials plant community.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	10	60	10	10	5	0	0	0

Estimated annual production: 3900 lbs/acre



Community Phase 1.1: Saturated Soil Perennial Community

This community serves as the reference community in sites that have been inundated for extended periods of time. This zone is often characterized as a hemi-marsh. Dominant species in the hemi-marsh zone include arrowhead, burreed, native cattail, softstem bulrush, and water plantain. As long as the site continues to be ponded and has moderate disturbance through grazing with adequate recovery periods, this community will persist. If the community has excessive sedimentation and lack of disturbance, it is susceptible to invasion by river bulrush, cattails, and if the hydroperiod decreases, reed canarygrass. Under average climatic conditions, this community can be correlated to the Massie soil component of Closed Upland Depressions. The Massie soil is the major component of Massie map units and therefore this should be the dominant community of these delineations. It can be found as a minor inclusion in Scott map units and rarely in Fillmore map units. Excessive irrigation runoff can also promote the Saturated Soil Perennial Community regardless of soil type.

Saturated Soil Community Phase 1.1

Community Phase Pathway CP 1.1-1.2
As saturated conditions subside with little additional disturbance, this community will transition to the Moist Soil Perennial Community. Annual haying and/or light grazing can also cause this transition.

Community Phase Pathway CP 1.1-1.3
This community will shift to the Moist Soil Annual Community if the hydroperiod shortens and disturbance increases. Disturbance often involves the implementation of one or a combination of management treatments. Common management treatments include grazing, fire, shredding, disking, and spraying.

Community Phase 1.2: Moist Soil Perennial Community

The Moist Soil Perennial Community is the reference community for wetlands with saturated soil for extended periods or shallow ponding (i.e., <12 inches) intermittently. The dominant species for this community are spikerushes, sedges, rushes, western wheatgrass, foxtail barley, switchgrass, and annual and perennial smartweeds. Moderate disturbance through grazing with adequate recovery periods or annual haying when the site is dry help maintain this community. If the site experiences excessive sedimentation, lack of disturbance, and an increase in ponding frequency and duration, this community is susceptible to invasion by bulrush and cattails. If the site experiences sedimentation, lack of disturbance, and a decrease in hydroperiod, then reed canarygrass can colonize the site. Under average climatic conditions, this community can be correlated to the Scott soil component of Closed Upland Depressions. The Scott soil is the major component of Scott map units and therefore this should be the dominant community of these delineations. It can be found as a minor inclusion in Massie map units and Fillmore map units.

Moist Soil Perennial Community Phase 1.2

Community Phase Pathway CP 1.2-1.1
When ponding duration and depth (i.e., >12 inches) increases, this community can transition to the Saturated Soil Perennial Community. This generally occurs on sites that do not have a large sediment load and that routinely receive moderate disturbance.

Community Phase Pathway CP 1.2-1.3
Increased disturbance, such as disking, chemical application, and/or grazing, will shift this community to the Moist Soil Annual Community. For grazing to transition the community, it must be at a rate and intensity high enough to remove sufficient biomass and generate bare ground for germination of the annual species.

Community Phase 1.3: Moist Soil Annual Community

The Moist Soil Annual Community is the result of an intensive disturbance regime coupled with saturated soil for extended periods or shallow ponding intermittently. Common species include annual smartweeds, barnyardgrass, bidens, cocklebur, fall panicum, pigweeds, plains coreopsis, ragweeds, and sumpweed. A heterogeneous mix of annual forbs and grasses provide ideal foraging habitat for migrating waterfowl during spring migration due to species diversity and high seed production of many of these species. Because of its habitat quality for migrating waterfowl, wildlife managers often focus efforts on creating and maintaining the Annual Moist Soil Community. To promote and maintain this community, a variety of management treatments can be implemented. These treatments can include grazing, disking, and chemical application. If grazing is implemented, it needs to be conducted with a sufficient number of animals to remove aboveground biomass and create bare ground to promote germination of annual species. Animals should be removed from the site by July 15 to maximize time for plant growth and seed germination. If the site is rested for multiple years or has light to moderate annual disturbance, it will transition to a perennial community. If there is excessive sedimentation with an increase in ponding frequency bulrush and cattails can invade the site; if the site has excessive sedimentation and a normal hydroperiod, reed canarygrass can colonize the site. Under average climatic conditions, this community can be correlated to the Fillmore soil component of Closed Upland Depressions. The Fillmore soil is the major component of Fillmore map units and therefore this should be the dominant community of these delineations. It can be found as a minor inclusion in Scott map units and and rarely in Massie map units.

Moist Soil Annual Plant Community Phase 1.3

Community Phase Pathway CP 1.3-1.1
When ponding duration and depth (>12 inches) increases and disturbance decreases, this community can transition to the Saturated Soil Perennial Community. This generally occurs on sites that do not have a large sediment load and routinely have light to moderate disturbance.

Community Phase Pathway CP 1.3-1.2
If this community remains undisturbed for several years, light to moderately grazed annually, and/or hayed annually, it will likely transition to the Moist Soil Perennial Community.

Transition State 1 to State 2
This transition occurs when the duration and intensity of disturbance is significantly reduced and where the hydrology promotes saturated conditions. Sites that have had a significant deposition of culturally accelerated sediment above the native soil profile can also transition to the Grassy Invaded State. This transition can also occur when sites are seeded to reed canarygrass.

Transition State 1 to State 3
This transition occurs when disturbance is decreased to little or none and/or culturally accelerated sedimentation occurs. On areas that would normally be Moist Soil Annual or Moist Soil Perennial under average climatic conditions, ponding duration and frequency is increased through watershed restoration activities or as a result of excessive irrigation runoff. On areas that would normally be Saturated Soil Perennial, no change in hydroperiod is required.

Transition State 1 to State 4
This transition occurs when the site is plowed or disked and planted to a commodity crop. The transition almost always requires wetland or watershed modifications. Some examples include excavation of concentration pits, construction of surface drains, placement of fill material within the hydric soil, and/or excessive sedimentation above the natural soil profile. Despite active cultivation and, generally, the presence of wetland modifications, the Cropped Wetland State continues to occasionally pond water and grow hydrophytes.

Transition State 1 to State 5
The Drained Wetland State will result when significant wetland modifications are constructed to facilitate production agricultural practices. These sites rarely pond water outside of concentration pits.

State 2: Grassy Invaded State

The Grassy Invaded State is dominated by reed canarygrass and generally occurs in areas that have little or no disturbance. Sites in the Grassy Invaded State may have been seeded to reed canarygrass or naturally colonized. Annual haying and/or moderate grazing throughout the growing season with sufficient rest can promote dominant stands of reed canarygrass. Excessive sedimentation and/or areas in the wetland that have been land leveled with fill material can also promote the Grassy Invaded State. It has been hypothesized that the nutrient loads associated with sediment promotes vigorous growth of reed canarygrass. Saturated conditions and ponding generally less than 12 inches for prolonged periods also encourage Grassy Invaded State growth. Under average climatic conditions, this community can be correlated to the Fillmore and Scott soil components of Closed Upland Depressions. The Fillmore soil is the major component of Fillmore map units and the Scott soil is the major component of Scott map units. Therefore this may be the dominant community of these delineations. It can rarely be found as a minor inclusion in Massie map units. This community does occur in Massie map units when the associated watershed is significantly modified resulting in a more seasonal or temporary water regime.

Grassy Invaded State – Reed Canarygrass Dominated Plant Community

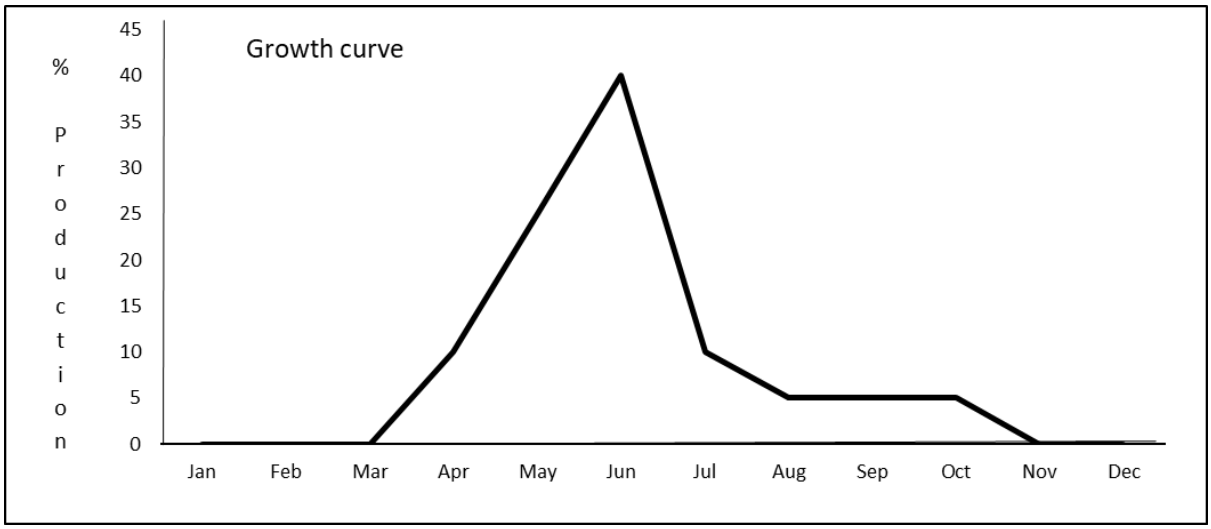
Plant Growth Curve

Growth curve number: CUD MLRA 75-State 2
Growth curve name: Reed canarygrass dominant
Growth curve description: Reed canarygrass dominant with occasional moist-soil plants in the plant community.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	10	25	40	10	5	5	5	0	0

Estimated annual production: 10,400 lbs/acre



Transition State 2 to State 1
This transition occurs when the site receives a variety of disturbance treatments. A transition out of this state often requires a combination of spraying and disking treatments. The first spraying treatment kills a majority of the adult plants. A follow-up disking treatment kills the remaining adult plants and prepares the seedbank for germination of reed canarygrass seeds. A follow-up chemical treatment kills the sprouting seedlings. Maximum label rates of glyphosate approved for use over water have demonstrated good success. Both aerial and ground rig treatments have been successful for application. If sites are too wet to be successfully disked, heavy grazing in combination with chemical applications can be substituted. Restoration of hydrology may also be required to promote desired vegetation communities. If there is a large sediment load, heavy equipment can be used to excavate the material out of the wetland. Sediment surveys should be completed to determine the amount and location of the deposition.

Transition State 2 to State 3
The transition from the Grassy Invaded Site to the Bulrush/Cattail Invaded State often results from an increase in hydroperiod. Ponding depth, duration, and/or frequency increase as a result of the extended hydroperiod. Cattail/Bulrush sites often also have an accumulation of sediment and are not routinely disturbed.

Transition State 2 to State 4
This transition occurs when the site is plowed or disked, and planted to a commodity crop. Usually, hydrologic modifications (e.g., concertation pits, excavation of surface drains or road ditches, and/or placement of fill material) are constructed to negatively impact hydroperiod and facilitate cultivation of crops. Despite active cultivation and, generally, the presence of wetland modifications, the Cropped Wetland State continues to occasionally pond water and grow hydrophytes.

Transition State 2 to State 5
The Grassy Invaded State will transition to the Drained Wetland State if significantly modified to facilitate production agriculture practices. Common wetland modifications include excavation of concentration pits or surface drains, placement of fill material in the wetland or excessive sedimentation into the wetland. The Drained Wetland State sites rarely pond water outside of concentration pits.

State 3: Bulrush/Cattail Invaded State

The Cattail/Bulrush Invaded State contains hybrid cattails and/or river bulrush. It generally occurs in wetlands that have little or no disturbance and ponding is deep, for long periods, and/or frequent. Hydrology of these sites generally promotes ponded conditions as a result of a highly functional watershed or supplemental water from irrigation runoff. Because of how wet these sites are, they are not routinely disturbed with grazing, disking, or haying. Sites that promote the Cattail/Bulrush Invaded State can have high sediment loads that provide excessive nitrogen and phosphorus. Under average climatic conditions in wetlands with intact watersheds, this community can be correlated to the Massie and Scott soil components of Closed Upland Depressions. The Massie soil is the major component of Massie map units and the Scott soil is the major component of Scott map units. Therefore this may be the dominant community of these delineations. It can rarely be found as a minor inclusion in Fillmore map units. Excessive irrigation runoff that results in a more semi-permanent water regime can allow this community to persist on Fillmore map units.

Bulrush/Cattail Invaded State-Cattail Dominated Community

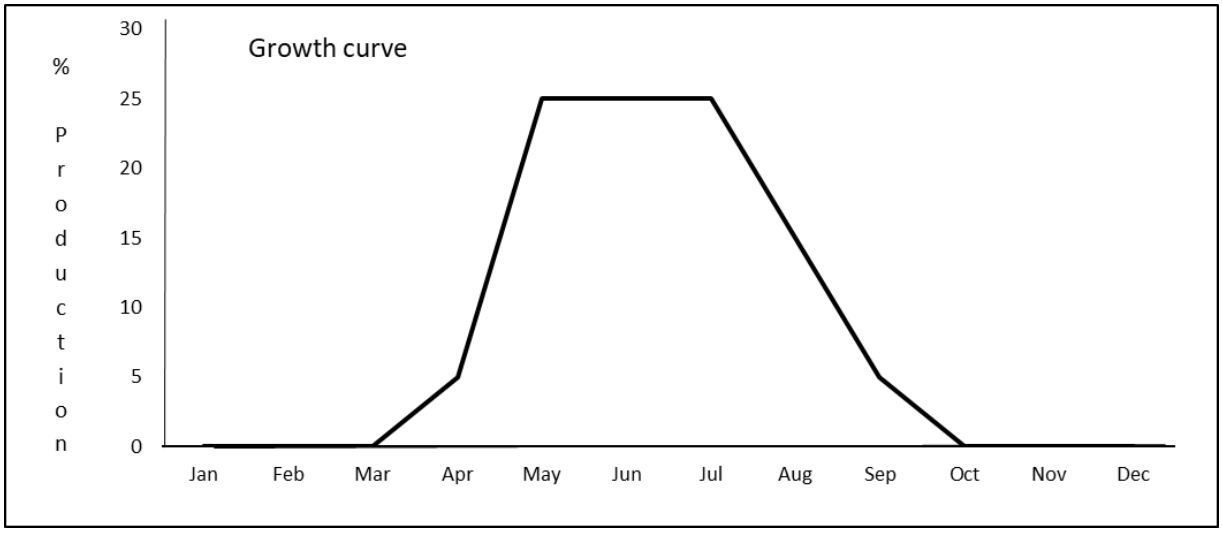
Plant Growth Curve

Growth curve number: CUD MLRA 75-State 3
Growth curve name: Bulrush/Cattail dominant
Growth curve description: Bulrush/Cattail dominate with moist-soil plants in the plant community.

Percent Production by Month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	25	25	20	15	5	5	0	0

Estimated annual production: 12,500 lbs/acre



Transition State 3 to State 1

This transition occurs when the site receives a variety of disturbance treatments implemented over multiple years. If the site would naturally be Moist Soil Annual or Perennial, ponding duration and frequency is

reduced. The transition from gravity to pivot irrigation or alternations in the watershed (i.e., excavation of road ditches) that reduce runoff to the wetland can promote this transition. If there is a large sediment load, heavy equipment can be used to excavate the material out of the wetland. Sediment surveys should be completed to determine the amount and location of the deposition. Once in the Reference State, the Saturated Soil Perennial Community usually dominates if no change in hydroperiod occurred. If a change in hydroperiod occurred, the site usually transitions to Moist Soil Annual Community due to increased disturbance.

Transition State 3 to State 2
The transition from the Bulrush/Cattail Invaded State to the Grassy Invaded State often results from a decrease in hydroperiod. Sites that are not routinely disturbed and have an accumulation of sediment will often transition to the Grassy Invaded State.

Transition State 3 to State 4
This transition occurs when the site is plowed or disked, and planted to a commodity crop. Generally, hydrologic modifications (e.g., concertation pits, excavation of surface drains or road ditches, and/or placement of fill material) are constructed to negatively impact hydroperiod and facilitate cultivation of crops. Despite active cultivation and, generally, the presence of wetland modifications, the Cropped Wetland State site continues to pond water and grow hydrophytes such as barnyardgrass and smartweeds.

Transition State 3 to State 5
State 3 will transition to State 5 if significantly altered by hydrologic modifications to facilitate production agricultural practices. The Drained Wetland State sites rarely pond water outside of concentration pits.

State 4: Cropped Wetland State

This state is actively cultivated and generally contains hydrologic modifications, such as concertation pits, excavation of surface drains or road ditches, and/or placement of fill material. Despite active cultivation and, generally, the presence of wetland modifications, these sites continue to pond water and grow hydrophytes.

Transition State 4 to State 1
This transition occurs as a result of the site no longer being cultivated. If hydrologic modifications are on site, wetland restoration is usually required. Wetland restoration actions often include filling concentration pits, plugging surface drains, and/or removing culturally accelerated sediment. After the site is no longer cultivated and restored, annual disturbance through grazing or other treatments can be implemented to maintain the Reference State. The Moist Soil Annual Community is the most likely community after cultivation and restoration due to the extreme disturbance caused by these activities.

Transition State 4 to State 2
The transition of wetlands in the Cropped Wetland State to the Grassy Invaded State often occurs on those sites that are no longer cropped, but are not routinely disturbed. If hydrologic modifications are on site, wetland restoration is usually required. This transition takes several years to occur post restoration because the extreme disturbance due to cultivation and restoration generally promotes the Moist Soil Annual Community initially.

Transition State 4 to State 3
The transition of wetlands in the Cropped Wetland State to the Bulrush/Cattail Invaded State often occurs on those sites that are no longer cropped, but are not routinely disturbed. For this transition to occur, the hydroperiod must be significantly increased and result in ponded water on the site. Hydroperiod can be increased by wetland restoration, an increase in natural precipitation for an extended period, or a change in surrounding land that increases runoff to the site (e.g., converting neighboring fields from dryland to gravity irrigation, or diverting a ditch into the wetland). Establishment of this state generally takes several years to occur post restoration because the extreme disturbance due to cultivation and restoration generally promotes the Moist Soil Annual Community initially.

Transition State 4 to State 5
Transition from the Cropped Wetland Site to the Drained Wetland State is often the result of either constructing new wetland hydrologic modifications or maintenance of existing wetland drainage features. As a result of these features, sites have reduced wetland function and rarely pond water or grow hydrophytes.

State 5: Drained Wetland State

This state is actively cultivated and generally contains significant hydrologic modifications, such as concertation pits, excavation of surface drains or road ditches, and/or placement of fill material. Hydrologic modifications are so significant that hydrophytes rarely grow and ponding rarely occurs except, potentially, in a concentration pit. These sites are also generally cultivated.

Transition State 5 to State 1, State 2, State 3
This transition occurs as a result of wetland restoration and change in landuse. Wetland restoration actions often include filling concentration pits, plugging surface drains, and/or removing culturally accelerated sediment. After restoration, disturbance regime and ponding frequency and duration will drive the vegetation state that occurs on the site. The Moist Soil Annual Community is the most likely community immediately after restoration due to the extreme disturbance caused by restoration.

Transition State 5 to State 4
Transition from the Drained Wetland State to the Cropped Wetland State is often the result of wetland modifications failing, but the site remaining cropped. This has occurred when concentration pits have silted in resulting in lost storage capacity, or when tile drains have collapsed. With the reduced function of these modifications, wetland features will often pond water and grow hydrophytes.

Section II: Ecological Site Interpretations

Animal Community

LIVESTOCK – GRAZING INTERPRETATIONS:

Closed Upland Depressions are a small-patch community in the matrix of the landscape, and grazing is usually in conjunction with adjacent upland sites. The Closed Upland Depression sites can provide good forage, although generally not to the extent that native tallgrass prairies can. The protein levels in Reference State plants can sustain body condition at all growth stages. When sites are dry, they can provide hay.

Grazing can also be used as a management tool for the vegetation. Historically, elk and bison tended to concentrate near water sources during drier periods and the associated lush vegetative communities. This could lead to overgrazing, and a reduction of the perennial species. More recently, land managers have begun to use livestock as tools to create annual forb and grass communities that produce an abundance of seeds, which provide an important forage source for the migratory birds passing through the area. This type of management tries to mimic the historical boom and bust grazing regime of the bison and elk herds, creating a heterogeneous mosaic of vegetative communities throughout the region.

WILDLIFE HABITAT INTERPRETATIONS:
Historically these sites were often utilized for extended periods by herds of large grazers such as elk and bison. This was primarily driven by high forage production and ample water supply. It is no less true today that these sites can support significant numbers of livestock. The variation in grazing timing, intensity, and duration can have significant impact on the plant communities and species composition. Other species of wildlife also utilize these sites during periods of inundation. Mammals such as raccoons, coyotes, and badgers take advantage of the abundant small mammal prey, as do raptors such as short-eared owls and northern harriers. These areas also provide excellent habitat for ground nesting grassland birds when in the Reference State.

These depressions remain critically important to migratory birds. The aquatic vegetation and associated invertebrates such as non-biting midges, fairy shrimp, tadpole shrimp, and clam shrimp provide a high energy source for several groups of migratory birds such as shorebirds, ducks, and geese during their stops in the spring and fall. These sites also provide important breeding habitat for many species of amphibians during periods of inundation in the spring.

These sites are of critical importance to many species of waterbirds, especially when the sites' inundated periods coincide with spring and fall migrations. Shorebirds take advantage of the abundant invertebrates like fairy shrimp, whose eggs can remain viable in the soil for up to 15 years until a rainfall event. Ducks, geese, and cranes will use these sites as roosting areas as well as feeding areas, taking advantage of a high energy food source supplied by seeds from wetland plants such as annual smartweed. Waterfowl will often winter on these sites until the water freezes. Ring-necked pheasants may use these sites for nesting, brood-rearing, and roosting if adequate cover and forbs are present.

Several small mammal species will thrive under these conditions. Due to the abundance of these small mammals, these sites are often favorite hunting areas for predators including coyotes, short-eared owls, red-tailed hawks, and northern harriers. Whitetail deer will use these depressions for water, when present, and as a food source, mainly utilizing the wide diversity of forbs.

Hydrology Functions
This ecological site is found on nearly level uplands and is characterized by slight depressions that pond water from direct precipitation and runoff, but not groundwater. The amount of water and length of inundation will depend on the drainage area, the frequency of rainfall, and the depth of the depression.

Historically, the soil had an A and E horizon that overlaid a thick clay pan that significantly slowed permeability once the soils were saturated. When the soil dries out, deep cracks can form through the soil profile. At the first flush of rain, water will flow down the cracks to the deep soil and eventually help recharge the groundwater. As the clay swells with additional moisture, the cracks shrink until the clay pan seals, at which point water starts to pond and groundwater recharge becomes negligible. Researchers determined that the initial flush of water down the cracks in playa soils before the clay pan seals is an important source of groundwater recharge.

Most of these upland depressions have been farmed because of the productivity of the adjacent soils. Farming can significantly increase sedimentation into the wetlands, which can alter their hydrology. A significant number of hydrologic modifications such as concentration pits, road ditches, drains, tiles, and fill material have been used in an attempt to drain and/or fill the sites to increase production of commodity crops. These practices can be detrimental to the proper functioning of the sites, altering the hydrology to the extent that the beneficial plant community structure and diversity are greatly diminished.

These sites are found in areas susceptible to drought and, as a result, offer an unpredictable yet highly important source of water for wildlife, especially waterfowl.

Recreational Uses
Because of the standing water that is sometimes present, these sites are popular for hunting, bird watching, plant collecting, etc.

These sites exhibit some visual contrast and present a panoramic view of the wide-open spaces cherished by many in the Great Plains states.

Wood Products
This site is not an important wood producing site.

Other Products
No other products are produced in quantity.

Other Information
Revision Notes: “This PROVISIONAL ecological site concept has been QC’d and QA’d to ensure that the site meets the NESH standards for a provisional ecological site that provides basic compiled information in one location. This site should not be considered an Approved ESD until further data entry and editing is completed.

Supporting Information

Associated Sites

Site name	Site ID	Site narrative
Clayey Upland	R075XY057NE	Clayey Plains- Adjacent to Closed Upland Depression, but occupies a run-off position on the landscape.
Loamy Upland	R075XY058NE	Loamy Plains- May be adjacent to Closed Upland Depression, but occupies a run- off position on the landscape.
Limy Upland	R075XY059NE	Limy Loess Slopes- May be adjacent to the site, but occupies a run-off position on the landscape.

Similar Sites

Site name	Site ID	Site narrative
Saline Depression	*R075XY083NE*	Similar landscape position to the Closed Upland Depression site, but has higher soil salinity.

State Correlation
This site has been correlated with the following states: Kansas and Nebraska

Inventory Data References
Information presented here has been derived from field observations by trained and experienced range personnel.

Hierarchical Classification Relationships
NRCS FOTG Section 1 - Nebraska Vegetation Zone 3.

Major Land Resource Area (MLRA): Major Land Resource Area (MLRA) 75 (USDA-Natural Resources

Conservation Service, 2006)

Revision Notes:
A PROVISIONAL ECOLOGICAL SITE is a conceptual grouping of soil map unit components within a Major Land Resource Area (MLRA) based on the similarities in response to management. Although there may be wide variability in the productivity of the soils grouped into a Provisional Site, the soil vegetation interactions as expressed in the State and Transition Model are similar and the management actions required to achieve objectives, whether maintaining the existing ecological state or managing for an alternative state, are similar. Provisional Sites are likely to be refined into more precise group during the process of meeting the APPROVED ECOLOGICAL SITE DESCRIPTION criteria.

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Site Authors

Doug Whisenhunt, Andy Bishop, Eleanor Nugent, Nadine Bishop

Quality Assurance

Provisional Status Verfied by David Kraft (1/10/2018)