USDA Natural Resources Conservation Service

Ecological site R065XY026NE
Deep Wetland

Last updated: 2/04/2025
Accessed: 05/12/2025

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.

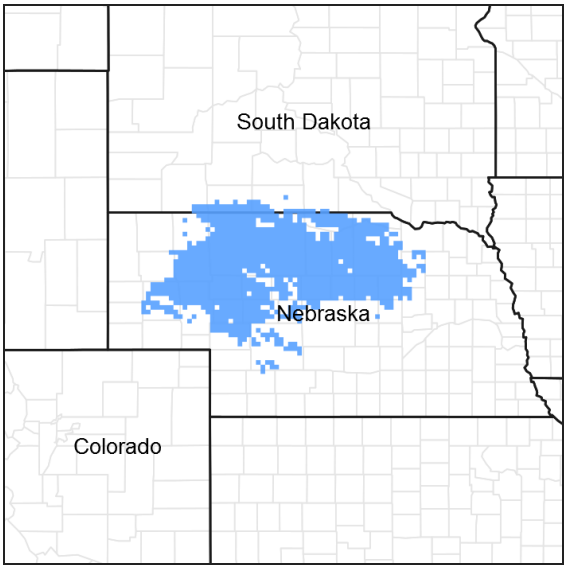


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 065X–Nebraska Sand Hills

The Nebraska Sand Hills (MLRA 65) is located in Nebraska (98 percent) and South Dakota (2 percent) and encompasses approximately 13.2 million acres (534,201 hectares) or 20,625 square miles (53,420 square kilometers). The largest town in the MLRA is North Platte, Nebraska and numerous small towns and villages are located within the MLRA, including the county seats of Arthur, Bartlett, Bassett, Brewster, Greeley, Hyannis, Mullen, Thedford, and Tryon, Nebraska. The Niobrara River is near the northern boundary while the North Platte River flows along the southwest boundary of the area. The North Loup, Middle Loup, Calamus, Snake, and Dismal Rivers and Long Pine Creek occur in the central and eastern portion of the area.

Fort Niobrara, Crescent Lake, and Valentine National Wildlife Refuges and portions of the Nebraska National Forest, including the Bessey Ranger District and Samuel R. McKelvie National Forest, are located within this MLRA. The Bessey Ranger District includes the largest human-planted forest in the United States and is home to the Bessey Tree Nursery which is listed on the National Register of Historic Places.

This MLRA is defined by an 8,000 year-old landscape of sand hills dominated by rolling to steep sand dunes with narrow, elongated, nearly level to steeply sloping valleys between the dunes. Dune heights range from 10 to 400 feet (3 to 130 meters) and slopes may exceed twenty-five percent. Dune complexes often extend for several miles in a northwest to southeast direction. These Quaternary sand dunes are derived from the underlying Tertiary

Ogallala and Arikaree Groups, which formed when rivers deposited sediments from erosional detritus after the uplift of the Rocky Mountains to the west. The Nebraska Sand Hills are the largest sand dune area in the Western Hemisphere and one of the largest grass-stabilized dune regions in the world. The soils of the MLRA are principally derived from deep eolian sand.

The Ogallala aquifer underlies the MLRA and is the most extensive and heavily used aquifer of the high plains between the Rocky Mountains and Mississippi River. The aquifer is at its thickest in the Sand Hills which are a primary recharge are for the aquifer. Numerous small permanent and intermittent lakes and wetlands occur in the MLRA. While the dominant source of water for these lakes is precipitation, groundwater discharge is important to maintaining these lakes especially in drier years. A number of these lakes, especially in the western portion of the MLRA are alkaline.

Considered to be a western extension of the tallgrass prairie, the matrix vegetation is a unique mix of species that is sometimes identified as Sandhills Prairie. Sand bluestem, prairie sandreed, Indiangrass, switchgrass, sand lovegrass, little bluestem, and needle and thread are the primary grasses. Porcupinegrass is a significant cool-season grass in the eastern portion of the MLRA while blue grama and hairy grama are important warm-season grasses in the western portion due to differences in precipitation. Soils which have a high water table support a tallgrass prairie dominated by big bluestem, switchgrass, Indiangrass, prairie cordgrass, and a variety of grass-likes. The endangered plant blowout penstemon (Penstemon haydenii) is found in this MLRA.

More than ninety percent of the land in MLRA 65 is native grassland utilized by grazing livestock. Areas along streams and in subirrigated valleys are utilized for prairie hay. Wetlands, legume hay, and irrigated cropland make up the balance of the land area with corn being the principal irrigated crop.

Wildlife flourishes in this native grassland environment. Historically large bison herds occupied the landscape. White-tailed deer, mule deer, pronghorn, black tailed jackrabbit, and coyote are now the major mammalian species. Upland sandpiper, lark bunting, grasshopper sparrow, western meadowlark, long-billed curlew, sharp-tailed grouse, and greater prairie chicken are common avian species. The mosaic of grassland and wetlands provide excellent habitat for wading and shorebird species as well.

This landscape serves as a backdrop for a disturbance-driven ecosystem, which developed under the influences of herbivory, fire, and periodic long-term drought. Historically, these processes created a heterogeneous mosaic of plant communities and vegetative structure across the region. Any given site in this landscape experienced fire every six to ten years. Fires were caused by lightning strikes and also were set by Native Americans, who used fire for warfare, signaling, and to refresh the native grasses. Indigenous peoples understood the value of fire as a tool and that the highly palatable growth following a fire provided excellent forage for their horses and attracted grazing animals such as bison, elk, and pronghorn.

The natural fire regime has been disrupted by aggressive fire suppression policies which have facilitated woody species encroachment by both native and introduced shrubs and trees into the native prairie. The most common encroacher is eastern redcedar. While eastern redcedar is native to the landscape, it was present only in trace amounts due to the periodic fires. Widespread plantings of windbreaks with eastern redcedar as a primary component have provided a seed source for this aggressive woody plant causing encroachment into native grasslands, especially in the eastern and central Sand Hills. This encroachment causes significant forage loss for domestic livestock and degrades the native wildlife habit. Since it is not a root-sprouter, eastern redcedar is very susceptible to fire when under six feet tall making management with prescribed fire very effective when applied before trees reach this stage.

Classification relationships

►USDA-NRCS (2022)◄
Land Resource Region – G, Central Feed Grains and Livestock Region
Major Land Resource Area (MLRA) –65, Nebraska Sand Hills

►Fenneman (1916) Physiographic Regions ◄
Division – Interior Plains
Province – Great Plains
Section – High Plains

►USDA-USFS (2007) Ecoregions◄
Domain – Dry
Division – Temperate Steppe
Province – Great Plains Steppe (332)
Section – Mixed Grass Steppe

►EPA Ecoregions (Omernik 1997)◄
I – Great Plains (9)
II – West-Central Semi-Arid Prairies (9.3)
III – Nebraska Sandhills (44)
IV – Sandhills (44a), Alkaline Lakes Area (44b), Wet Meadow and Marsh Plain (44c), Lakes Area (44d)

Ecological site concept

The Deep Wetland ecological site is a run-on site found primarily on interdunes and stream valleys. Slopes are one percent or less. Soils are very deep and very poorly drained. The site is saturated or ponded for a very long duration at or near the surface during the growing season to a depth of up to 24 inches.

Vegetation in the Reference Community (1.1) is dominated by species that can withstand ponding and saturated soils including cattails, rushes, spikerushes, and bulrushes. Due to the influence of ponded water during much to all of the growing season, this site is rarely grazed or hayed.

Associated sites

R065XY022NE	**Wet Land** Wet Land ecological sites may be found in association with Deep Wetland ecological sites in interdunes and stream valleys.
R065XY023NE	**Wet Subirrigated** The Wet Subirrigated ecological site may be found interspersed with Deep Wetland ecological sites in interdunes and stream valleys.

Similar sites

R065XY022NE	**Wet Land** Wet Land ecological sites are similar to Deep Wetland ecological sites; however, water is ponded for longer periods of time and the ponding is deeper on Deep Wetland sites.

Table 1. Dominant plant species

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

Physiographic features

This Deep Wetland ecological site occurs on nearly level interdunes, depressions, or fens in the sandhills landscape. Soils are very poorly drained. Water is at or above the surface for very long periods of time and ponding may be present for most of the year.

Table 2. Representative physiographic features

Landforms	(1) Sandhills > Interdune (2) Sandhills > Depression (3) Sandhills > Fen
Runoff class	Negligible to low

Flooding duration	Very long (more than 30 days)
Flooding frequency	None to frequent
Ponding duration	Very long (more than 30 days)
Ponding frequency	Frequent
Elevation	980–4,600 ft
Slope	0–1%
Ponding depth	12–24 in
Water table depth	0–12 in
Aspect	Aspect is not a significant factor

Climatic features

The mean average annual precipitation varies from 14-25 inches but has varied from 12 to 34 inches in the driest to wettest seasons. Approximately 65 percent of the annual precipitation occurs during the growing season of mid-April to late September. The average annual snowfall varies from about 30 inches to about 55 inches. The wind velocity is high throughout the year, averaging 10 to 12 miles per hour. Maximum wind velocities generally occur in the spring.

The average length of the growing season is 138 days, but the growing season has varied from 114 to 168 days. The average date of first frost in the fall is September 25, and the last frost in the spring is about May 10. July is the hottest month and January is the coldest. It is not uncommon for the temperature to reach 100 ºF during the summer. The winters are characterized with frequent northerly winds, producing severe cold with temperatures dropping to as low as -30 ºF.

Growth of native cool-season plants begins mid to late March and continues to late June. Native warm-season plants begin growth in early May and continue to late August. 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)	109-126 days
Freeze-free period (characteristic range)	131-143 days
Precipitation total (characteristic range)	19-26 in
Frost-free period (actual range)	103-129 days
Freeze-free period (actual range)	129-146 days
Precipitation total (actual range)	18-27 in
Frost-free period (average)	118 days
Freeze-free period (average)	137 days
Precipitation total (average)	22 in

Climate stations used

- (1) ALLIANCE MUNI AP [USW00024044], Alliance, NE
- (2) ARTHUR [USC00250365], Arthur, NE
- (3) ATKINSON 3SW [USC00250420], Atkinson, NE
- (4) BARTLETT 1S [USC00250525], Bartlett, NE
- (5) BREWSTER [USC00251130], Brewster, NE
- (6) CHAMBERS [USC00251590], Chambers, NE
- (7) CRESCENT LAKE NWR [USC00252000], Oshkosh, NE
- (8) ELLSWORTH 15 NNE [USC00252647], Ellsworth, NE

- (9) ELSMERE 9 ENE [USC00252680], Johnstown, NE
- (10) ERICSON 8 WNW [USC00252770], Burwell, NE
- (11) GREELEY [USC00253425], Greeley, NE
- (12) HYANNIS [USC00254100], Hyannis, NE
- (13) KILGORE 1NE [USC00254432], Kilgore, NE
- (14) KINGSLEY DAM [USC00254455], Keystone, NE
- (15) MERRIMAN [USC00255470], Merriman, NE
- (16) MULLEN [USC00255700], Mullen, NE
- (17) MULLEN 21 NW [USC00255702], Whitman, NE
- (18) NEWPORT [USC00255925], Newport, NE
- (19) NORTH PLATTE RGNL AP [USW00024023], Maxwell, NE
- (20) PURDUM [USC00256970], Purdum, NE
- (21) ROSE 10 WNW [USC00257318], Long Pine, NE
- (22) SWAN LAKE [USC00258360], Amelia, NE
- (23) VALENTINE NWR [USC00258755], Valentine, NE
- (24) WHITMAN 5 ENE [USW00094079], Whitman, NE

Influencing water features

The Deep Wetland ecological site has a combination of physical and hydrological features that: 1) normally has season-long groundwater near or above the soil surface (0.5 feet to 2 or more feet), 2) restricting free movement of water and air (anaerobic conditions) in the entire root zone, and 3) is ponded or flooded during for very long periods during the growing season in most years.

Soil features

The soils associated with the Deep Wetland ecological site are very deep and very poorly drained. Slopes are 0 to 1 percent. These soils were formed in sandy eolian deposits over alluvium and may be found in interdunes, depressions, or on fens. Soils typically have an organic horizon of mucky peat. The surface layer is typically 15 inches thick. Soil textures of the A-horizon range from sand to very fine sandy loam while subsurface textures range from sand to fine sandy loam. Soils are interspersed with thin to thick layers of mucky loam, muck, or mucky peat. Soils associated with fens have moderately deep to very deep layers of muck and/or mucky peat.

Runoff as evidenced by patterns of rill, gully or other water flow is negligible due to the low slope gradient and high intake rate of these soils. Cryptobiotic crusts are present. Pedestalling of plants does not occur on this site. However, frost-heave mounding and/or mucking by excessive hoof traffic is common and can result in a rough and uneven land surface.

The Marlake soil series is the only soils series correlated to the Deep Wetland ecological site but fluvaquents and Histosols are also correlated to this site. Additional information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more details specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

Table 4. Representative soil features

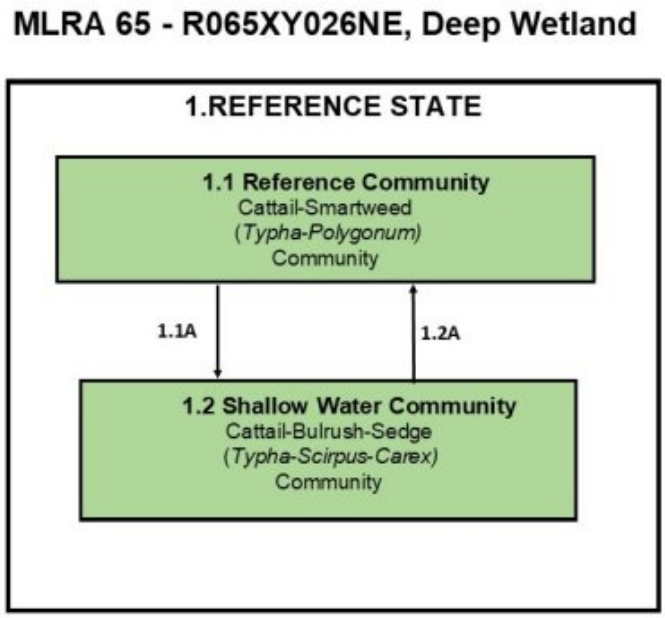
Parent material	(1) Eolian deposits
Surface texture	(1) Very fine sandy loam (2) Fine sandy loam (3) Loamy fine sand (4) Loamy sand (5) Sand
Family particle size	(1) Sandy
Drainage class	Very poorly drained
Permeability class	Moderately slow to very rapid
Soil depth	80 in
Surface fragment cover <=3"	0%

Surface fragment cover >3"	0%
Available water capacity (0-40in)	3.1–6.7 in
Calcium carbonate equivalent (0-40in)	0–5%
Electrical conductivity (0-40in)	0–2 mmhos/cm
Sodium adsorption ratio (0-40in)	0
Soil reaction (1:1 water) (0-40in)	5.3–8.4
Subsurface fragment volume <=3" (0-40in)	0–1%
Subsurface fragment volume >3" (0-40in)	0%

Ecological dynamics

Deep Wetland ecological sites developed under Northern Great Plains climatic conditions. Due to the saturated nature of the soil and the extensive ponding, grazing and fire typically do not impact the site. Plant species composition and production does not fluctuate greatly under most management strategies but may shift with wet and dry cycles. Human disturbance, including drainage which is common on other wet sites in the MLRA, is generally not a factor on this site due to the depth of the water present on the site. Typically, this site is extremely stable. The State and Transition Model (STM) is depicted below and includes a Reference State (1).

State and transition model



Community Pathways:
1.1A: Drier precipitation pattern.
1.2A: Wetter precipitation pattern.

Figure 8. State and Transition Diagram, Deep Wetland ecological site, MLRA 65.

State 1
Reference State

The Reference State (1) describes the range of vegetative communities that occur on the Deep Wetland ecological site where the range of natural variability under historic conditions and disturbance regimes is mostly intact. The Reference State developed under the combined influences of climatic conditions, periodic fire activity, grazing by large herbivores, and impacts from small mammals and insects. Drainage by ditching, while common on Wet Land ecological sites, is uncommon on Deep Wetland sites. Deep Wetlands occupy the lowest landscape position, and it is generally not cost effective to excavate the long distances required to drain the water to an adjacent, lower elevation watershed. The Reference State is a very stable state that is very resistant to any change that does not affect the associated water table. The Reference State includes the Reference Community (1.1) and the Shallow Water Community (1.2). These communities fluctuate with wetter and drier precipitation patterns.

Dominant plant species

- broadleaf cattail (*Typha latifolia*), other herbaceous
- bulrush (*Scirpus*), other herbaceous
- sedge (*Carex*), other herbaceous
- swamp smartweed (*Polygonum hydropiperoides*), other herbaceous

Community 1.1
Reference Community

Interpretations are primarily based on the Reference or Cattail-Smartweed (Typha-Polygonum) Community (1.1). This plant community serves as a description of the native plant community that occurs on the site during a wetter than normal precipitation pattern. Fluctuations in plant community are primarily driven by different responses of the species to changes in precipitation timing and abundance and fluctuations in the water table. This plant community consists chiefly of cattails and smartweeds. Historically, broadleaf cattail was the predominant cattail but today many areas have been invaded by narrowleaf cattail (*Typha angustifolia*) or hybrids of narrow-leaf and broadleaf cattail. Natural fire played a less significant role in the succession of this site than on other ecological sites in the MLRA. Due to the wetness of the site woody invasion is not an issue. This plant community can be found during periods of above normal precipitation.

Dominant plant species

- broadleaf cattail (*Typha latifolia*), other herbaceous
- swamp smartweed (*Polygonum hydropiperoides*), other herbaceous

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Forb	3200	3800	4050
Grass/Grasslike	1500	2000	2250
Total	**4700**	**5800**	**6300**

Community 1.2
Shallow Water Community

The Shallow Water or Cattail-Bulrush-Sedge (Typha-Scirpus-Carex) Community (1.2) serves as a description of the native plant community that naturally occurs on the site during a drier than normal precipitation pattern. Fluctuations in plant community are primarily driven by different responses of the species to changes in precipitation timing and abundance and fluctuations in the water table. This plant community consists chiefly of cattails, bulrushes, and sedges. Historically, broad-leaf cattail was the predominant cattail but today many areas have been invaded by narrowleaf cattail (*Typha angustifolia*) or hybrids of narrowleaf and broadleaf cattail. Natural fire played a less significant role in the succession of this site than on other ecological sites in the MLRA. Due to the wetness of the site woody invasion is not an issue. This plant community can be found during periods of below normal precipitation.

Dominant plant species

- broadleaf cattail (*Typha latifolia*), other herbaceous

- bulrush (*Scirpus*), other herbaceous
- sedge (*Carex*), other herbaceous

Table 6. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	3000	3480	3800
Forb	2000	2320	2500
Total	**5000**	**5800**	**6300**

Pathway 1.1A
Community 1.1 to 1.2

A period of drier than normal precipitation will move the Reference Community (1.1) to the Shallow Water Community (1.2)

Pathway 1.2A
Community 1.2 to 1.1

A period of wetter precipitation will move the Shallow Water Community (1.2) to the Reference Community (1.1).

Additional community tables

Animal community

"Wetlands provide migration, breeding, nesting, and feeding habitat for millions of waterfowl, shorebirds, songbirds, and other wildlife. Wetlands are home to thousands of different plant and animal species including many that are threatened or endangered. Nine of Nebraska’s 12 federal endangered and threatened species use wetland areas, as do 19 of Nebraska’s 27 state listed endangered and threatened species. Many wetlands provide important feeding and rearing habitat for fish. All the state’s amphibians, as well as many reptiles and invertebrates, use wetlands. Wetlands also provide important winter cover for pheasants, deer and other resident wildlife. They also provide a watering source for both domestic livestock and wildlife." (LaGrange, 2004).

Hydrological functions

Excessive water is the principal factor limiting forage production on the Deep Wetland ecological site. Soils on this site are in Hydrologic Soil Group D due to high water tables. Although soils are permeable, high water tables limit infiltration. Surrounding upland areas tend to have very permeable soils that cause surface inflow peaks to these sites to be muted. Outflows generally occur only after very intense storms or from seepage inflows during very wet years. Many areas are frequently to continuously flooded.

For the interpretive plant community, rills and gullies are not typically present. Water flow patterns should be barely distinguishable if at all present. Pedestals are not typically present. Litter falls in place, and signs of movement are not common. Litter often accumulates to create muck peat like conditions. Chemical and physical crusts are rare. Overall, this site has the appearance of being stable and productive.

Recreational uses

This site provides hunting opportunities for upland game and waterfowl species.

Wood products

Not a viable source of wood products.

Other products

Wetlands in general have potential as sites for entrepreneurial endeavors such as raising fish, crayfish and frogs or growing alternative crops like wild rice or new strains of crops adapted to wetlands. There may also be potential for using wetland plants for biomass or ethanol production.

Other information

Revision Notes: “This PROVISIONAL ecological site concept has been through the Quality Control and Quality Assurance processes 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.

Site Development and Testing Plan:
Future work is needed to validate the information in this Provisional Ecological Site Description. Additional data collection and evaluation may also be needed to develop this ESD to the Approved, then Correlated level. This could include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Field reviews of the project plan should be completed by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team. The project plan is ES-R065XY013NE - MLRA 65.

Inventory data references

There is no inventory data available for this site.

Other references

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Contributors

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Approval

Suzanne Mayne-Kinney, 2/04/2025

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)	Original Author: Stan Boltz. Version V participants: Dave Cook, Emily Helms, Jeff Nichols, Myra Richardson, Nadine Bishop
Contact for lead author	Jeff Nichols: jeffrey.nichols@usda.gov
Date	11/30/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None. Rills are not expected on this site.

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2. **Presence of water flow patterns:** None. Water flow patterns are not expected on this site.

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3. **Number and height of erosional pedestals or terracettes:** None. Erosional pedestals or terracettes are not expected.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground typically less than 5 percent.

   Bare ground is exposed mineral soil that is not covered by vegetation (basal and/or foliar canopy), standing dead vegetation, gravel/rock, and visible biological crust (e.g., lichen, mosses, algae).

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5. **Number of gullies and erosion associated with gullies:** None. Gullies are not expected on this site.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind-scoured areas and depositional areas are not expected on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Litter movement is not expected.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability ratings will be 6. This site typically has an O-horizon consisting of roots and partially decomposed vegetation that is up to 3 inches (7.5 cm) thick. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon is typically 9 inches (23 cm) thick. The soil color is typically dark gray (values of 3) when moist. Soil structure is weak fine and medium granular. There is an O horizon that is typically 2 inches thick and consists of mucky peat.

   Tryon, Loup, and Almeria are the major soil series correlated to this ecological site. Other soil series that have been correlated to this site include Barney, Crowther, Cullison, Cutcomb, Gannett, Guss, and Hoffland.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. Compaction layers should not be present.

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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: Phase 1.1
    1. Native, perennial and annual forbs: broadleaf cattail, swamp smartweed.

    Phase 1.2
    1.Grass-likes: Bulrushes, sedges, rushes.

    Sub-dominant: Phase 1.1
    1.Grass-likes: Bulrushes.

    Phase 1.2
    1. Native, perennial and annual forbs: broadleaf cattail, swamp smartweed.

    Other: Minor - Phase 1.1
    1. Native, perennial, cool-season tallgrass: bluejoint, northern reedgrass, northern reedgrass, slimstem reedgrass.
    1. Native, perennial, warm-season tallgrass: prairie cordgrass.

    Minor - Phase 1.2
    1. Native, perennial, cool-season tallgrass: bluejoint, northern reedgrass, northern reedgrass, slimstem reedgrass.
    1. Native, perennial, warm-season tallgrass: prairie cordgrass.

    Additional: The Reference Community (1.1) includes four functional/structural groups which are in order of relative abundance native, perennial and annual forbs; grass-likes; native, perennial, cool-season tall- and midgrass; native, perennial, warm-season tall-grass.

The Shallow Water Community (1.2) includes four four functional/structural groups which are in order of relative abundance grass-likes; native, perennial and annual forbs; native, perennial, cool-season tall- and midgrass; native, perennial, warm-season tall-grass.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Very little evidence of decadence or mortality. Bunch grasses have strong, healthy centers and shrubs have few dead stem

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 80 to 90 percent and at a depth of 0.50 to 1.5 inch (1.3-4 cm).

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 5,800 pounds per acer on an air dry weight basis. Low and high production years should yield 4,700 and 6,300 pounds per acre respectively.

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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:** Canada thistle, reed canarygrass, creeping foxtail, common watercress, leafy spurge, quackgrass, redtop, and purple loosestrife are known invasives that have the potential to be dominant or co-dominant on the site. Consult the state noxious weed and state watch lists for potential invasive species on each ecological site.

    NOTE: Invasive plants (for the purposes of the IIRH protocol) are plant species that are typically not found on the ecological site or should only be in trace or minor categories under the natural disturbance regime and have the potential to become a dominant or codominant species on the site if their establishment and growth are not actively controlled by natural disturbances or management interventions. Species listed characterize degraded states AND have the potential to become a dominant or co-dominant species

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17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to recent weather conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
