North Central Region Soil Survey Conference

Lincoln, Nebraska

June 4 – 7, 2012

Field Tour

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North Central Region Cooperative Soil Survey Tour

General Information

North Central Region Soil Survey Conference

June 6, 2012 Field Tour Itinerary

8:00AM – Depart from Hardin Hall take US Highway 34 to Plattsmouth.

9:30AM – Field stop: Schilling Wildlife Management Area, near confluence of the Platte and Missouri Rivers to view Missouri River flooding aftermath.

10:30AM – Depart Schilling WMA travel on Highway 75 to Bellevue

11:00AM – Arrive at Camp Wakonda and Fontenelle Forest, Bellevue NE (off of Bellevue Blvd.) Speakers: Mick Szydlowski, Volunteer and Events Manager, Fontenelle Nature Association. Director of science and land stewardship for Fontenelle Forest, Gary Garabrandt, will lead a forest hike.

12:00 Noon – Lunch at Camp Wakonda

1:00 PM – Depart Fontenelle Forest

1:40PM – Arrive at Chalco Hills Recreation Area, 156th street Access (By Highway 370 exit off of I-80) to view Soil Profiles of Peorian Loess and Pre-Illinoian till.

2:45PM – Depart Chalco Hills

3:45PM – Arrive back at Hardin Hall.

Acknowledgements:

The NCRSSC Steering Committee wishes to extend our heartfelt thanks to:

Nebraska Game and Parks Commission

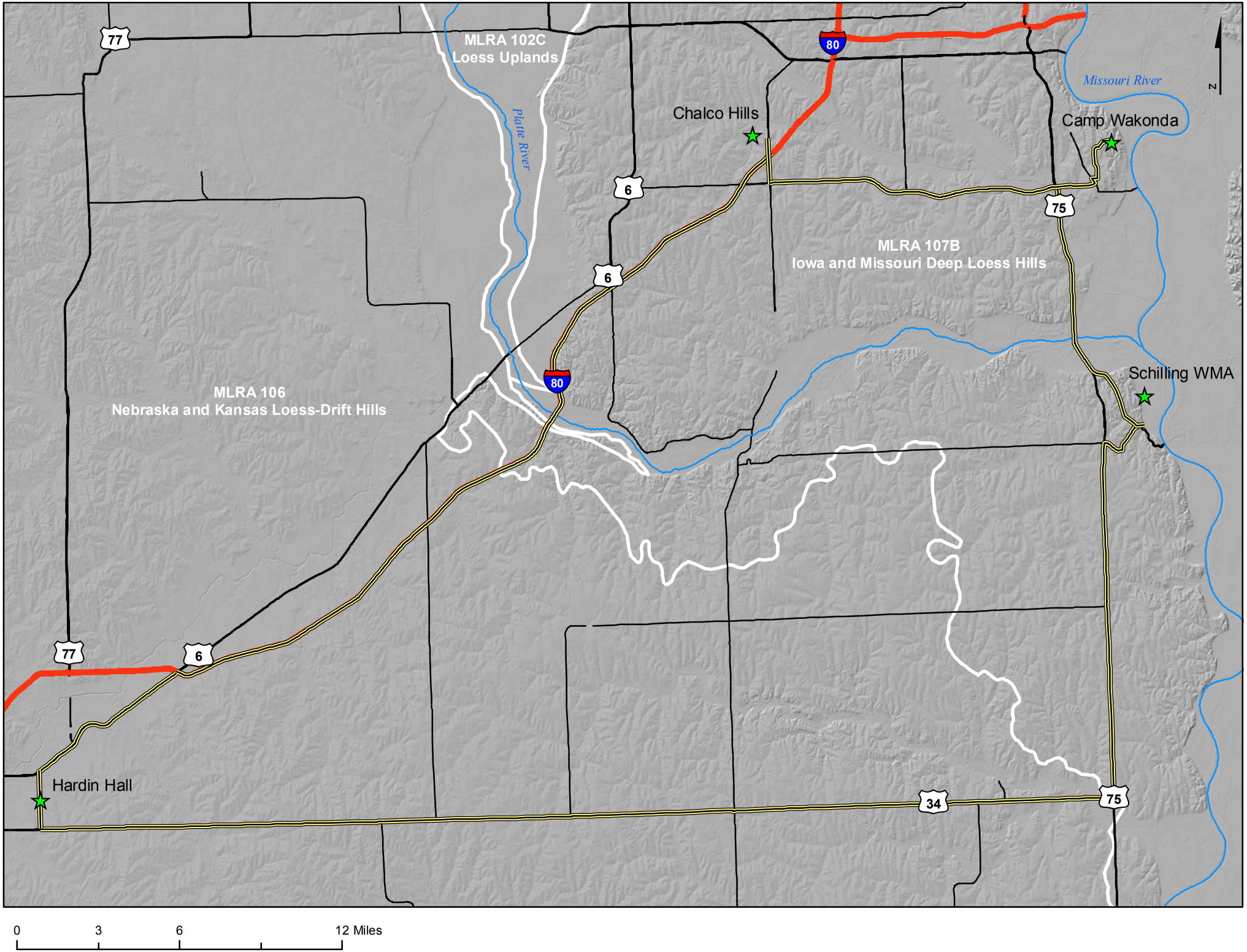
Mid America Council, Boy Scouts of America

Fontenelle Nature Association (Fontenelle Forest)

Papio-Missouri River Natural Resources District

Chalco Hills Recreation Area

For the generous use of their expertise, resources and facilities.


MLRA 102C
Loess Uplands
Platte River
Missouri River
Chalco Hills
Camp Wakonda
MLRA 107B
Iowa and Missouri Deep Loess Hills
Schilling WMA
MLRA 106
Nebraska and Kansas Loess-Drift Hills
Hardin Hall
77
80
6
75
34
N
0
3
6
12 Miles

MLRA 106 - Nebraska and Kansas Loess-Drift Hills

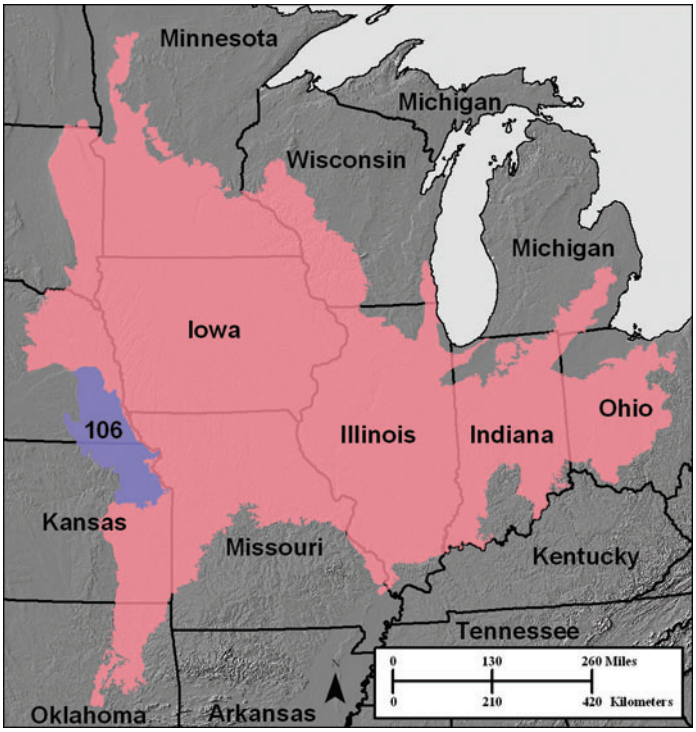


Figure 106-1: Location of MLRA 106 in Land Resource Region M

Introduction

This area (shown in fig. 106-1) is in Nebraska (52 percent) and Kansas (48 percent). It makes up about 10,920 square miles (28,295 square kilometers). It includes the town of Beatrice, Nebraska; the city of Lincoln, Nebraska; and the cities of Topeka and Lawrence, Kansas. Interstate 80 crosses the northern part this MLRA, passing through an area just north of Lincoln, and Interstates 70 and 470 pass through Topeka and Lawrence, Kansas, in the southern part of the MLRA. The Iowa Sac and Fox, Kickapoo, and Potawatomi Indian Reservations are in the part of this area in Kansas. Part of the Iowa Sac and Fox Reservation is in Nebraska. The Homestead National Monument, commemorating pioneer life on the prairie, is just west of Beatrice, Nebraska.

Physiography

This area is almost entirely in the Dissected Till Plains Section of the Central Lowland Province of the Interior Plains. The southern tip is in the Osage Plains Section of the same province and division. Interstate 70 is close to the boundary between these two sections in this MLRA. This area is a dissected glacial drift plain. Ridgetops are broad and smooth, and slopes are nearly level to strongly sloping. Stream valleys are bordered by relatively narrow bands of hilly and steep slopes. Valley floors are typically narrow, except along the larger rivers and their primary tributaries. Elevation ranges from 980 to 1,650 feet (300 to 505 meters), increasing from east to west. Local relief is mainly 10 to 20 feet (3 to 6 meters), but some of the larger valley floors are 80 to 160 feet (25 to 50 meters) or more below the level of the adjacent uplands.

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Kansas (1027), 51 percent; Missouri-Nishnabotna (1024), 32 percent; and Platte (1020), 17 percent. The Little Nemaha River and the North Fork of the Big Nemaha

River flow into the Missouri River, which is just east of the part of this area in Nebraska. The Big Blue River flows through Beatrice, Nebraska, and on into the part of this area in Kansas. Salt-Wahoo Creeks flow through Lincoln and Wahoo and on into the Platte River in the northern part of the area. The Big Blue joins the Black Vermillion River at Tuttle Creek Lake in the southern end of the MLRA, in Kansas. The Soldier and Delaware Rivers also are in the part of the MLRA in Kansas.

Geology

Loess covers the surface of almost all of the uplands in this MLRA. Glacial drift underlies the loess. Alluvial clay, silt, sand, and gravel are deposited in all of the stream and river valleys. The alluvial deposits can be extensive in the major river valleys. Paleozoic sandstone, shale, and limestone units are exposed in a few road cuts and in the walls of valleys along the major streams on the east side of the area, near the bluffs along the Missouri River. Limestone and shale (clay) quarries are in this MLRA.

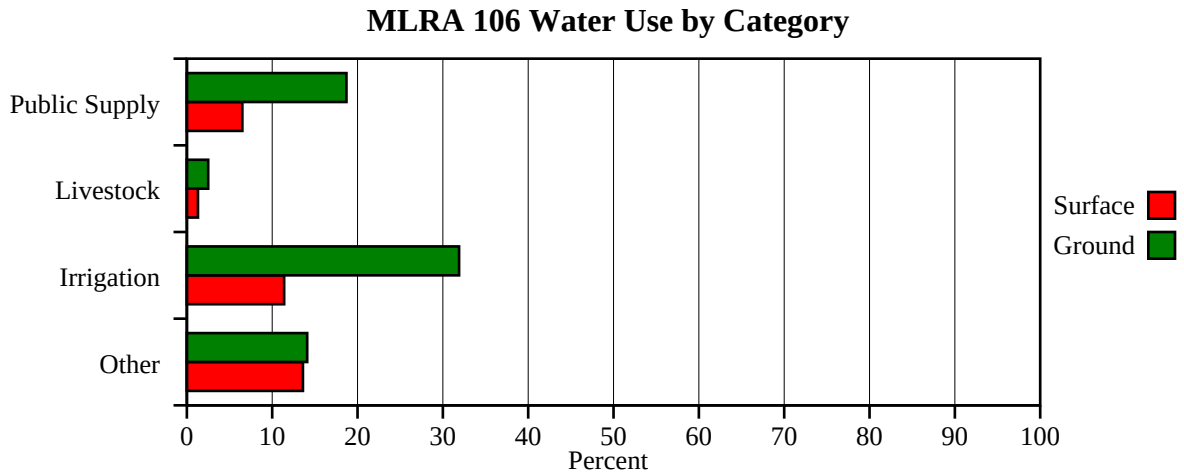
Climate

The average annual precipitation in most of this area is 28 to 40 inches (710 to 1,015 millimeters), increasing from northwest to southeast. About three-fourths of the precipitation falls as high-intensity, convective thunderstorms from late in spring through early in autumn. The scant precipitation in winter occurs mainly as snow. The average annual temperature is 50 to 55 degrees F (10 to 13 degrees C). The freeze-free period averages about 195 days and ranges from 175 to 215 days.

Water

The total withdrawals average 485 million gallons per day (1,835 million liters per day). About 67 percent is from ground water sources, and 33 percent is from surface water sources. Precipitation is generally adequate for crops, but in years of little or no precipitation, yields are reduced. The supply of both surface and ground water is limited in this area. Small areas along some of the perennial streams are irrigated. Small ponds and reservoirs are important sources of water for livestock. The surface water in this area is generally of good quality, but it typically is not used for drinking because of the variability of the supply. Many streams flow only in direct response to rainfall.

Shallow wells in glacial drift and in alluvium in stream valleys supply water for domestic and livestock needs on most farms. This water primarily contains calcium, magnesium, and bicarbonate and is very hard. The level of total dissolved solids varies considerably in the water in the glacial drift. The water in the alluvial deposits has a median level of 390 parts per million (milligrams per liter) total dissolved solids. In some areas deep wells in glacial drift provide very hard water that contains more than 700 parts per million (milligrams per liter) total dissolved solids. Many communities and households obtain water from the Dakota Formation. This water is very hard and has a median level of 840 parts per million (milligrams per liter) total dissolved solids. The public water supply for Lincoln, Nebraska, is pumped from alluvium along the Platte River, almost 30 miles east of the city.



Category (Surface,Ground): Public Supply (6.5, 18.7), LiveStock (1.3, 2.5), Irrigation (11.4, 31.9), Other (13.6, 14.1)

Soils

The dominant soil orders in this MLRA are Mollisols, Alfisols, and Entisols. The soils in the area dominantly have a mesic soil temperature regime, a udic soil moisture regime, and mixed or smectitic mineralogy. They generally are very deep, well drained or moderately well drained, and loamy or clayey. Hapludolls formed in alluvium on flood plains (Kennebec series), in colluvium on footslopes and alluvial fans (Judson series), and in loess on uplands (Marshall series). Argiudolls formed in loess (Aksarben and Wymore series), till (Burchard, Morrill, Pawnee, and Shelby series), and colluvium and/or residuum (Martin series) on uplands. Udifluvents (Nodaway series) formed in alluvium on flood plains. Udorthents (Steinauer series) formed in till on uplands. Hapludalfs formed in loess on uplands and stream terraces (Yutan and Otoe series) and in till on uplands (Malmo series).

Biology

This area supports grassland vegetation characterized by mid and tall grasses. Big bluestem, little bluestem, switchgrass, Indiangrass, porcupinegrass, and sideoats grama are the dominant species on silty soils in the uplands. Clayey soils in the uplands support a similar plant community but have a higher percentage of switchgrass and have some wildrye. Green ash, hackberry, oak, boxelder, black walnut, and maple trees grow along streams and intermittent drainageways.

Some of the major wildlife species in this area are white-tailed deer, raccoon, opossum, tree squirrel, pheasant, bobwhite quail, and mourning dove.

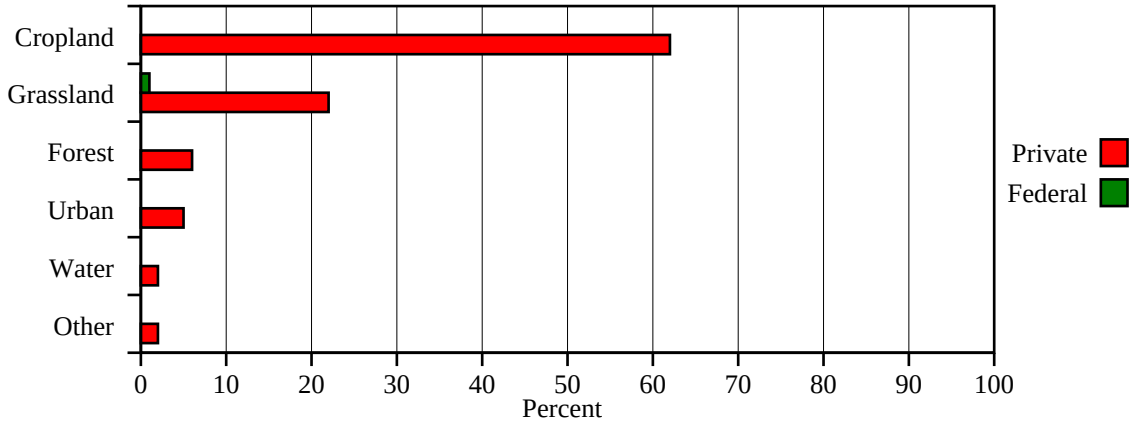
Land Use

Nearly all of this area is farmland, and about two-thirds is cropland. The cropland is more extensive on the less sloping soils that formed in loess than on other soils. Wheat and corn are important cash crops, but grain sorghum, soybeans, and alfalfa and other hay crops are grown on a large percentage of the area. Most of the grain and hay is fed to livestock on the farms where it is grown. About one-fourth of the area is used as pasture or range. Pastures of native grasses are more extensive on the strongly sloping to steep soils that formed in glacial till than on other soils. Pastures of introduced grasses and legumes are on the more productive soils, and native grasses are common on the more sloping, shallow soils. Native woodland is confined to narrow bands bordering drainageways and streams and to some nearly level, wet soils on bottom land.

The major soil resource concerns are water erosion and maintenance of the content of organic matter in the soils. The resource concerns on pasture and rangeland are plant productivity, health,

and vigor; noxious and invasive plants; and inadequate wildlife habitat. Conservation practices on cropland generally include high-residue crops in the cropping system, systems of crop residue management (such as no-till, strip-till, and mulch-till systems), gradient terraces and grassed waterways, underground outlets, contour farming, conservation crop rotations, and nutrient and pest management. Conservation practices on rangeland and pasture generally include prescribed grazing, brush management, management of upland wildlife habitat, and proper distribution of watering facilities.

MLRA 106 Land Use by Category



Category (Private,Federal): Cropland (62.0, 0.0), Grassland (22.0, 1.0), Forest (6.0, 0.0), Urban (5.0, 0.0), Water (2.0, 0.0), Other (2.0, 0.0)

MLRA 107B - Iowa and Missouri Deep Loess Hills

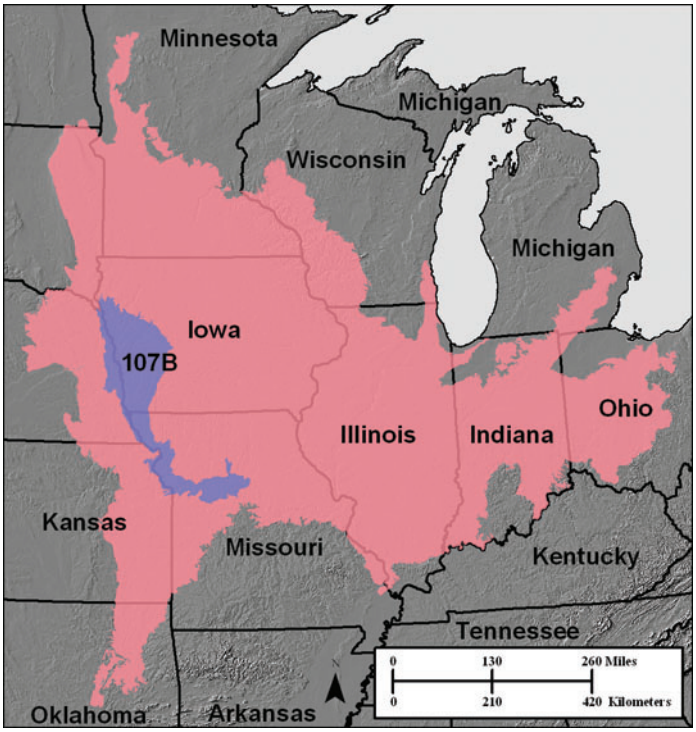


Figure 107B-1: Location of MLRA 107B in Land Resource Region M

Introduction

This area (shown in fig. 107B-1) is in Iowa (53 percent), Missouri (32 percent), Nebraska (12 percent), and Kansas (3 percent). It makes up about 14,410 square miles (37,335 square kilometers). It includes the cities or towns of Atlantic, Council Bluffs, and Sioux City, Iowa; St. Joseph, Kansas City, Independence, and Marshall, Missouri; Atchison, Leavenworth, and Kansas City, Kansas; and Omaha, Nebraska. Interstates 29, 35, 70, and 80 cross different parts of this area. Fort Leavenworth Military Reservation and parts of the Winnebago and Omaha Indian Reservations are in this MLRA. A number of State parks are throughout the area, and a number of national wildlife refuges are in the area, especially along the Missouri River.

Physiography

This area is almost entirely in the Dissected Till Plains Section of the Central Lowland Province of the Interior Plains. The farthest southern part of the area in Missouri is in the Osage Plains Section of the same province and division. Slopes are mostly rolling to hilly, but some broad ridgetops are nearly level to undulating. Slopes bordering the major stream valleys are steep. Nearly level, broad valley floors are along a few large rivers. Elevation ranges from 600 feet (185 meters) where the Missouri River exits the area to 1,565 feet (475 meters) on the highest ridges. Local relief is mainly 10 to 100 feet (3 to 30 meters), but valley floors can be 80 to 300 feet (25 to 90 meters) below the adjacent uplands. Also, some upland flats and valley floors have local relief of only 3 to 6 feet (1 to 2 meters).

The extent of the major Hydrologic Unit Areas (identified by four-digit numbers) that make up this MLRA is as follows: Missouri-Nishnabotna (1024), 45 percent; Missouri-Little Sioux (1023), 33 percent; Lower Missouri (1030), 15 percent; Des Moines (0710), 2 percent; Platte (1020), 2

percent; Chariton-Grand (1028), 2 percent; and Missouri-Big Sioux (1017), 1 percent. A small part of the Kansas (1027) and Elkhorn (1022) Hydrologic Unit Areas also occur in this MLRA. The Missouri River forms the “centerline” of this MLRA. The major tributaries that join the Missouri River in this area include, from north to south, the Floyd, Little Sioux, Soldier, Boyer, Platte (Nebraska), Nishnabotna, Little Nemaha, Tarkio, Big Nemaha, Nodaway, Platte and Little Platte (Missouri), Kansas, Grand, and Thompson Rivers.

Geology

This area includes the Missouri Alluvial Plain, the Loess Hills, and part of the Southern Iowa Drift Plain landform regions of Iowa. Most of the area is overlain by loess deposits that reach a thickness of 65 to 200 feet (20 to 60 meters) in the Loess Hills and thin to about 20 feet (6 meters) in the eastern part of the area. The loess is underlain by pre-Illinoian till, which was deposited more than 500,000 years ago and has since undergone extensive erosion and dissection. In the Loess Hills, Holocene cycles of erosion and deposition, or “cut and fill,” have produced deeply incised gullies and fine grained alluvial deposits. The Quaternary overburden ranges from 150 to 450 feet (45 to 135 meters) in thickness throughout most of the area, but it is generally less than 150 feet (45 meters) thick in the southeastern part of the area. The glacial materials are underlain by Pennsylvanian and Cretaceous bedrock, which consists of shale, mudstones, and sandstones.

Climate

The average annual precipitation in this area is 26 to 41 inches (660 to 1,040 millimeters). Most of the rainfall occurs as convective thunderstorms during the growing season. About 10 percent of the precipitation occurs as snow in the winter. The average annual temperature is 46 to 56 degrees F (8 to 13 degrees C). The freeze-free period averages about 190 days and ranges from 155 to 220 days.

Water

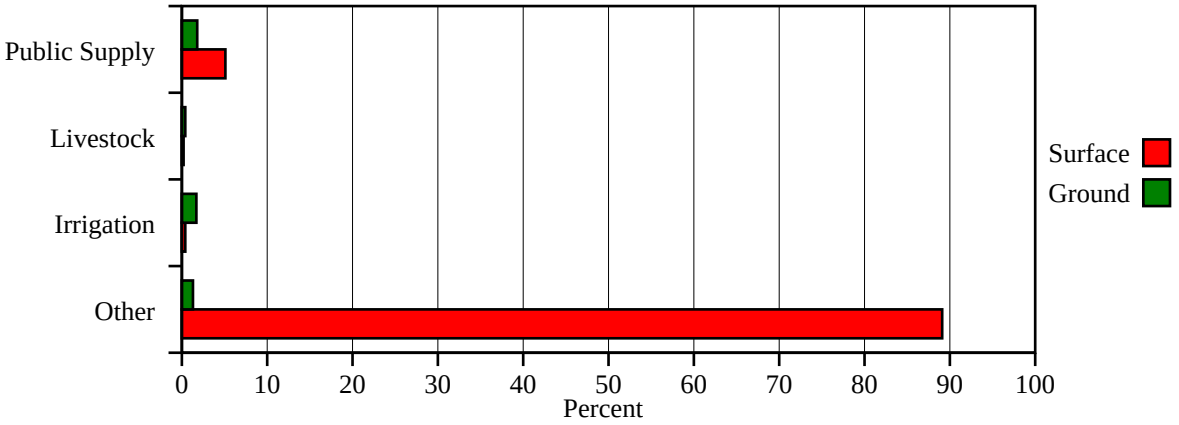
The total withdrawals average 4,210 million gallons per day (15,935 million liters per day). About 5 percent is from ground water sources, and 95 percent is from surface water sources. Sediment, nutrients, and pesticides from agricultural activities impair many of the major streams and rivers in this area (not including the Missouri River). The surface water is used mainly for cooling thermoelectric power plants along the Missouri River. The Missouri River also provides most of the municipal and industrial water for the major cities in the area. Other streams and rivers provide some surface water for livestock, irrigation, and public supplies in parts of the area.

The principal sources of ground water in the area are glacial drift, alluvial aquifers along the major streams, buried valley aquifers, the Dakota Sandstone, and Paleozoic rocks. Glacial drift aquifers supply many rural homeowners with domestic water. The buried channels are sources of moderate or moderately large supplies of generally good-quality water. The mineral content of the water may be high if this aquifer is hydraulically connected to bedrock aquifers beneath it. Alluvial deposits are extensive across the broad flood plain along the Missouri River. This aquifer is used for public supplies in Missouri. It has very hard water that contains a median level of 467 parts per million (milligrams per liter) total dissolved solids. The other shallow aquifers in Iowa have water very similar in quality to that in the Missouri River alluvium. They provide water for domestic use, livestock, some irrigation, and public supply.

The Cretaceous-age Dakota Sandstone is at a shallow or moderate depth in the northern half of this area. It is tapped by many domestic and livestock wells. A few irrigation wells tap this aquifer. In areas where more shallow aquifers do not occur, a number of communities obtain their public supplies from this aquifer. Locally, the base of the Dakota Sandstone has beds of gravel from which moderately large yields can be obtained. The median level of total dissolved solids in the aquifer in Iowa and Nebraska is 824 and 840 parts per million (milligrams per liter), respectively, and the water is very hard.

The Jordan aquifer is the most extensively used aquifer in Iowa. It consists of Ordovician-Cambrian sandstone and dolomite beds. Its water has a median level of total dissolved solids that exceeds 800 parts per million (milligrams per liter) and may contain levels of radium that exceed the national standards for drinking water. Some communities in the part of this area in Iowa depend on this aquifer for public supplies, even though the wells are very deep. Paleozoic units serve as aquifers in the parts of this area in southeastern Nebraska and northwestern Missouri. Water from these aquifers has a median level of total dissolved solids of 1,300 parts per million (milligrams per liter) in Nebraska. Many farmers and communities in Missouri have abandoned wells in these units because of high levels of dissolved salts.

MLRA 107B Water Use by Category



Category (Surface,Ground): Public Supply (5.1, 1.8), LiveStock (0.2, 0.4), Irrigation (0.4, 1.7), Other (89.1, 1.3)

Soils

The dominant soil orders in this MLRA are Mollisols and, to a lesser extent, Alfisols and Entisols. The soils in the area dominantly have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. They generally are very deep, well drained or moderately well drained, and silty or loamy. Well drained and moderately well drained, gently sloping to strongly sloping Hapludolls (Marshall and Monona series) formed on loess-mantled uplands. Well drained, strongly sloping Alfisols (Knox series) formed in loess. Well drained, strongly sloping Udorthents on side slopes (Steinauer series) and Argiudolls (Shelby series) formed in clay loam glacial till. Somewhat excessively drained and well drained, strongly sloping to very steep Udorthents (Hamburg and Ida series) on uplands formed in thick layers of loess bordering the Missouri River. Well drained and moderately well drained Udifluvents (Haynie and McPaul series) and Hapludolls (Keg, Kennebec, Napier, and Salix series), somewhat poorly drained or poorly drained Fluvaquents (Onawa and Albaton series), and poorly drained or very poorly drained Haplaquolls (Colo, Luton, and Wabash series) formed in alluvium on bottom land.

Biology

Prairies in this area support tall grasses on moist soils and xeric short grasses on uplands. Within the prairies, grama, muhly, lovegrass, and wheatgrass commonly grow beside the more familiar little bluestem, big bluestem, Indiangrass, and wildrye. The most common forbs are eared milkweed, Missouri milkvetch, prairie tea, western prairie fringed orchid, yucca, Baldwin ironweed, painted cup, pale gentian, silky aster, and skeletonweed (in the loess hills).

The wooded areas on uplands commonly support red oak, white oak, hackberry, shagbark hickory, and bitternut hickory. The wooded areas on bottom land commonly support mulberry, sycamore, cottonwood, willow, elms, green ash, silver maple, and American elder.

The wildlife species in the prairies include barn and long-eared owls; broad-winged hawk; Leonard's, Pawnee, Ottoe, and dusted skippers; wild indigo and sleepy dusky wings; and zebra swallowtail, Great Plains toad, plains leopard frog, plains spadefoot, massasauga rattlesnake, prairie skink, ornate box turtle, six lined racerunner, bobcat, black-tailed jackrabbit, plains pocket mouse, and least shrew. The wildlife species in the wooded areas include blue grosbeak, great crested flycatcher, western meadowlark, western fox snake, western worm snake, and Woodhouse's toad. This area has 47 threatened or endangered species or species of special concern, including piping plover, blacknose and Topeka shiners, pallid sturgeon, least tern, small white lady's slipper, bog buckbean, yellow monkey flower, and spring ladies-tresses.

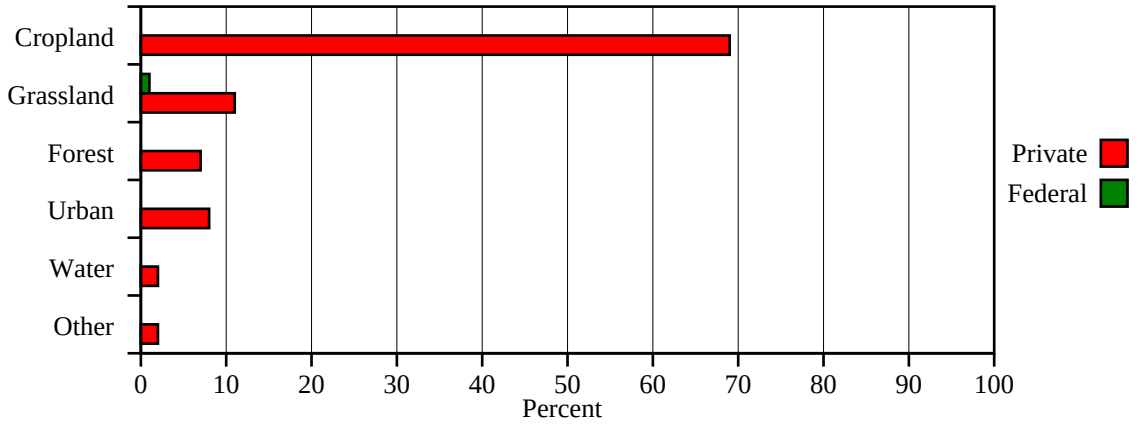
Land Use

Historically, 92 percent of this MLRA was prairie. Forests made up 4 percent of the area; savannas, 2 percent; rivers and streams, 1 percent; wetlands, 1 percent; ponds and lakes, 0.2 percent; and shrub land, 0.2 percent. The increase in the forested acreage from 4 percent of the historic landscape to 7 percent of the current landscape occurred mainly on the loess hills, where the forested acreage increased significantly because of fire suppression.

Farms currently make up nearly all of this area. They produce cash and grain crops and livestock.

The major resource concerns are water erosion, depletion of organic matter in the soils, and poor water quality. Conservation practices on cropland generally include systems of crop residue management (especially no-till, strip-till, and mulch-till systems), cover crops, pest and nutrient management, grassed waterways, terraces, manure management, pasture and hayland planting, and grade-stabilization structures.

MLRA 107B Land Use by Category



Category (Private,Federal): Cropland (69.0, 0.0), Grassland (11.0, 1.0), Forest (7.0, 0.0), Urban (8.0, 0.0), Water (2.0, 0.0), Other (2.0, 0.0)

Soil and Landscape Development of the Soils of the Missouri River Floodplain

The Missouri River Valley in Eastern Nebraska and Western Iowa consists of three distinct geomorphic regions; the three are not always present at specific locations. The geomorphic regions are: the **channel belt** which consists of bar and channel topography and braided stream remnants, the **meander belt** which is a floodplain step that consists of meander scrolls and splays and abandon oxbows, and the **flood basin** which consists of a natural levee and backswamp area which has upland steam channels snaking across it (fig. 1).

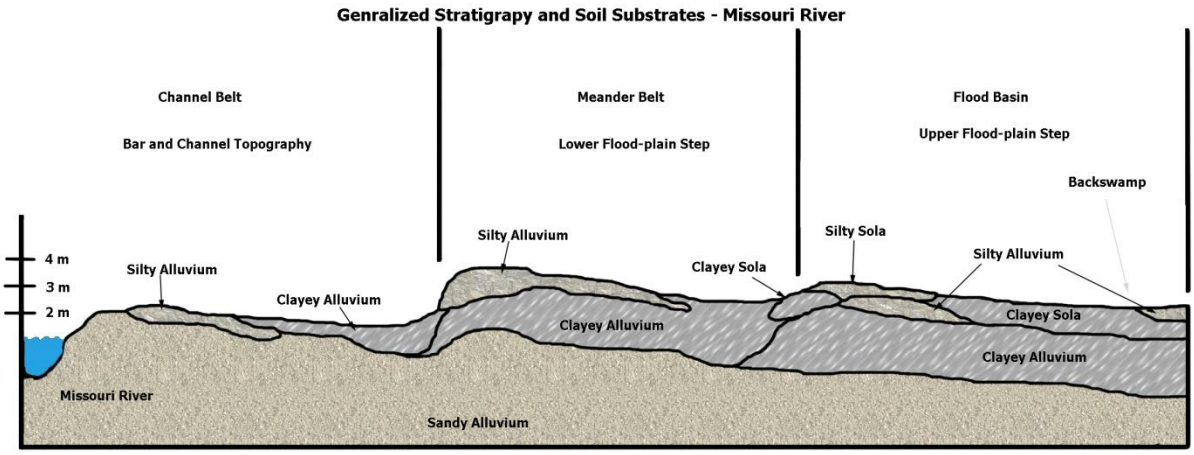


Figure 1.—Overview of the relationship between parent materials and position on the Missouri River flood plain.

The ***channel belt*** is the area adjacent to the Missouri River (fig. 2). It is nearly continuous from north to south. It includes the area thought to have been occupied by the Missouri River within about the last 100 years. This area was frequently flooded with 2 to 3 meters of water before the construction of dams on the Missouri River.

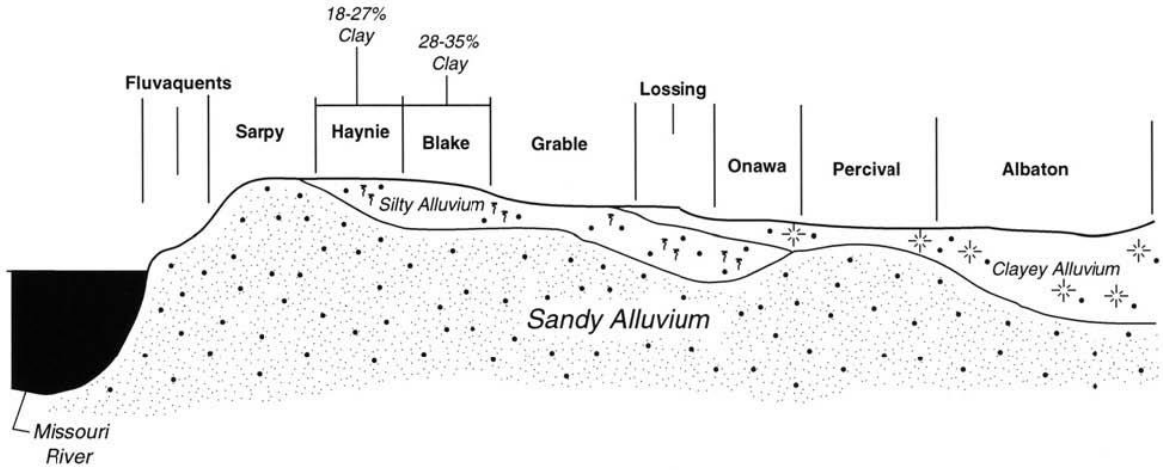


Figure 2.—The relationship of the major soils to parent material and position in the bar area of the Missouri River flood plain

The Army Corps of Engineers built dams upstream on the Missouri River in South Dakota and North Dakota to control downstream flooding. These dams were completed in 1955. Since that time the only remaining frequently flooded areas are chutes, low swales, and other low areas adjacent to the Missouri River. Because of the dams, the flooding frequency of the soils in the bar area is now rated as *occasional.*

There are no farmsteads in the bar area, but a few vacation cabins have been built in recent years. This area was flooded during the 2011 season. Some of the soils in this area are the occasionally flooded phases of Albaton and Percival soils.

Taxonomically the soils in this area consist of Entisols that range in particle-size class from sandy to fine and from excessively well drained to poorly drained.

Sarpy	Mixed, mesic typic Udipsamments
Kenmoor	Sandy over clayey, mixed, superactive, calcareous, mesic, Oxyaqic Usdipsamments
Morconick	Sandy, mixed, mesic Mollic Udifluvents
Wathena	Sandy, mixed, mesic Mollic Udifluvents
Carr	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Udifluvient
Waubounsie	Coarse-loamy over clayey, mixed, superactive, mesic Fluventic Hapludolls
Haynie,	Coarse-silty, mixed, superactive, calcareous, mesic Mollic Udifluvents
Grable	Coarse-silty over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Mollic Udifluvents
Modale	Coarse-silty over clayey, mixed, superactive, calcareous, mesic Aquic Udifluvents
Rodney	Fine-silty over clayey, mixed, superactive, calcareous, mesic Mollic Fluvaquents
Blake	Fine-silty, mixed, superactive, calcareous, mesic Aquic Udifluvents
Lossing	Fine-silty, mixed, superactive, calcareous, mesic Aquic Udifluvents
Scroll	Fine-silty over sandy or sandy-skeletal, mixed, active, calcareous, mesic Aquic Udifluvents
Vore	Fine-silty over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Aquic Udifluvents
Onawa	Clayey over loamy, smectitic over mixed, superactive, calcareous, mesic Aquertic Udifluvents
Percival	Clayey over sandy or sandy-skeletal, smectitic over mixed, calcareous, mesic Aquic Udifluvents
Albaton	Fine, smectitic, calcareous, mesic Vertic Fluvaquents

The ***meander belt*** is the area between the *channel belt* and the *flood basin* (fig. 3). The Missouri River occupied channels in this area during the past 100 to 300 years. As the river meandered, meander loops and channels were abandoned. Some of the loops and channels were partly filled by deposition during later flooding. Most of the area in the meander belt was covered with floodwater during the flood of 1952. Some areas of Haynie, Blake, and Modale soils were not flooded because they are at the higher elevations. Because of the dams on the Missouri River, the flooding frequency of the some soils on the young bottom land is now rated *rare*. Part of this area flooded during the flood of 2011 within the confines of some natural levees.

Many of the same soils are mapped both in the bar area and on the young bottom land. These soils are identified on the soil maps with different map unit symbols because of the difference in flooding frequency. Also, the soils on the young bottom land tend to be somewhat less stratified than the corresponding soils in the channel belt (fig 4).

Taxonomically the soils in this area consist of Entisols familiar to the channel belt and a few Fluventic Mollisols ranging from coarse-silty to fine particle-size class and well drained to poorly drained.

Haynie,	Coarse-silty, mixed, superactive, calcareous, mesic Mollic Udifluvents
Waubounsie	Coarse-loamy over clayey, mixed, superactive, mesic Fluventic Hapludolls
Grable	Coarse-silty over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Mollic Udifluvents
Modale	Coarse-silty over clayey, mixed, superactive, calcareous, mesic Aquic Udifluvents

Rodney	Fine-silty over clayey, mixed, superactive, calcareous, mesic Mollic Fluvaquents
Blake	Fine-silty, mixed, superactive, calcareous, mesic Aquic Udifluvents
Lossing	Fine-silty, mixed, superactive, calcareous, mesic Aquic Udifluvents
Vore	Fine-silty over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Aquic Udifluvents
Onawa	Clayey over loamy, smectitic over mixed, superactive, calcareous, mesic Aquertic Udifluvents
Percival	Clayey over sandy or sandy-skeletal, smectitic over mixed, calcareous, mesic Aquic Udifluvents
Owego	Fine, smectitic, nonacid, mesic Vertic Endoaquepts
Forney	Fine, smectitic, nonacid, mesic Vertic Fluvaquents
Albaton	Fine, smectitic, calcareous, mesic Vertic Fluvaquents

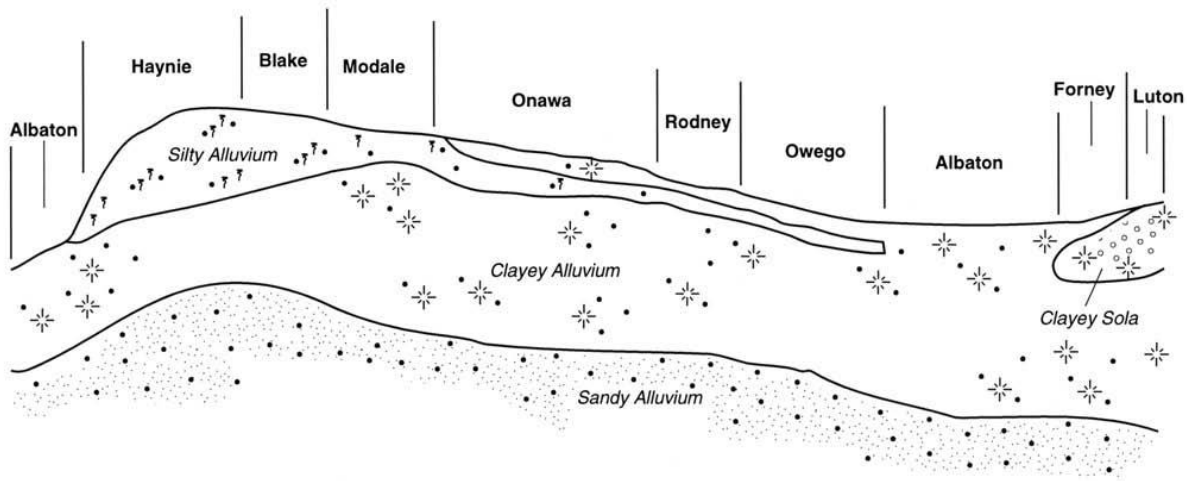


Figure 3.—Major soil to parent material and position relationships on the meander belt of the Missouri River flood plain.

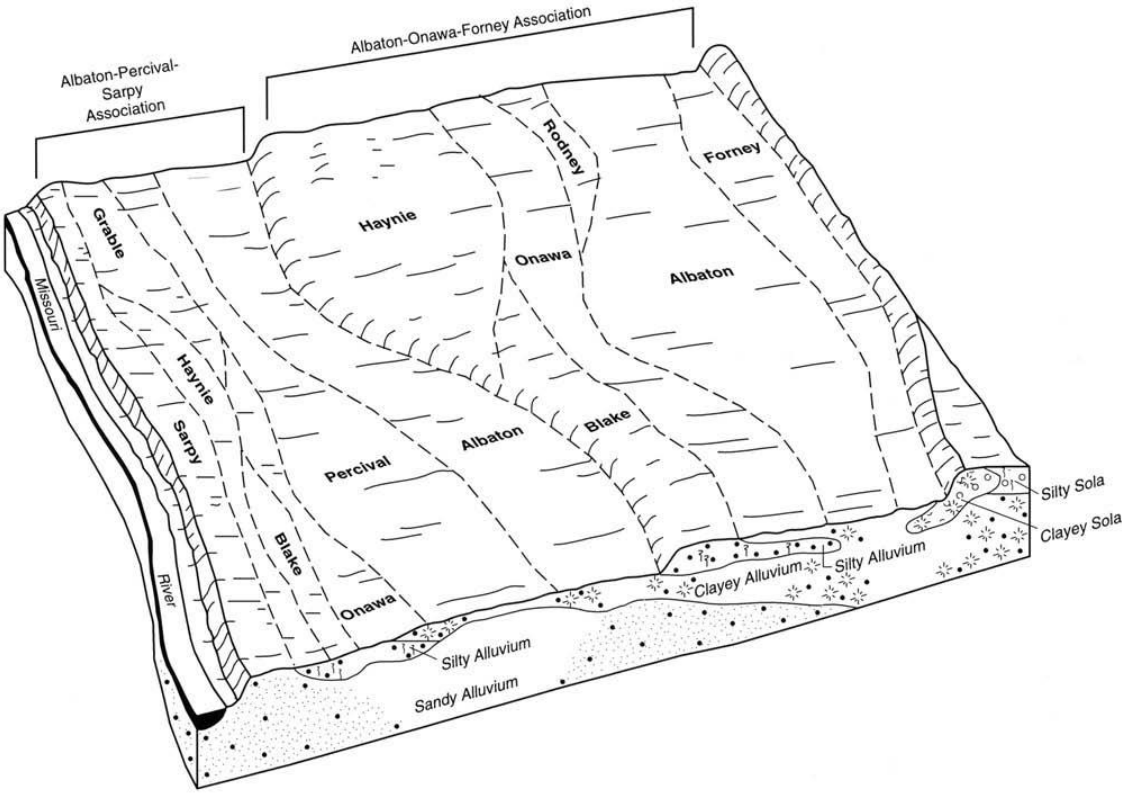


Figure 4.—Typical pattern of soils and parent material in the Albaton-Percival-Sarpy and Albaton-Onawa-Forney associations on the channel belt and meander belt areas of the Missouri River floodplain.

The ***flood basin*** consists of a natural levee and backswamp area and is the area between the meander belt and the loess hills in the uplands (fig. 5). Near the loess hills alluvial fans of upland drainageways overlay the flood basin. The flood basin is a low relief that generally lacks distinct meander scars and obows. The backswamp of the flood basin may be lower than the adjacent meander belt. Low areas of the flood basin often display a pattern left by a branch of a river that flows away from the main stream and does not rejoin it. The tributary rivers have all been diked or channelized in order to reduce the occurrence of flooding. Because it does not have meander scars and oxbows left behind from the meandering Missouri River, the flood basin has fewer surface features than the channel belt or the meander belt. At the conjunction of the meander belt and the flood basin, the meander belt is cut deeper into the Missouri River Valley and leaves behind an area that acts as a natural levee that is higher in elevation than the remaining bottom-land areas of the Missouri River valley.

The rarely flooded Keg and Salix soils are typical of the soils on this natural levee (fig 6). Because floodwaters have not crested this natural levee for hundreds of years, the soils are more developed than those on the channel belt or meander belt areas of the floodplain. The soils on the natural levee tend to be Fluventic, Typic, and Aquertic Hapludolls. The flood basin area is characterized by Endoaquolls and Aquertic Hapludolls.

Taxonomically the soils in this area consist of Mollisols which range from well drained to poorly drained.

Blyburg	Coarse-silty, mixed, superactive, mesic Fluventic Hapludolls
Keg	Fine-silty, mixed, superactive, mesic Typic Hapludolls
Salix	Fine-silty, mixed, superactive, mesic Typic Hapludolls
Lakeport	Fine, smectitic, mesic Aquertic Hapludolls
Cooper	Fine-silty over clayey, mixed, superactive, mesic Fluvaquentic Hapludolls
Blencoe	Clayey over loamy, smectitic over mixed, superactive, mesic Aquertic Hapludolls
Woodbury	Fine, smectitic, mesic Vertic Endoaquolls

Luton	Fine, smectitic, mesic Typic Endoaquerts
Tieville	Fine, smectitic, calcareous, mesic Vertic Endoaquolls
Moville	Coarse-silty over clayey, mixed, superactive, calcareous, mesic Aquic Udifluvents

_____.

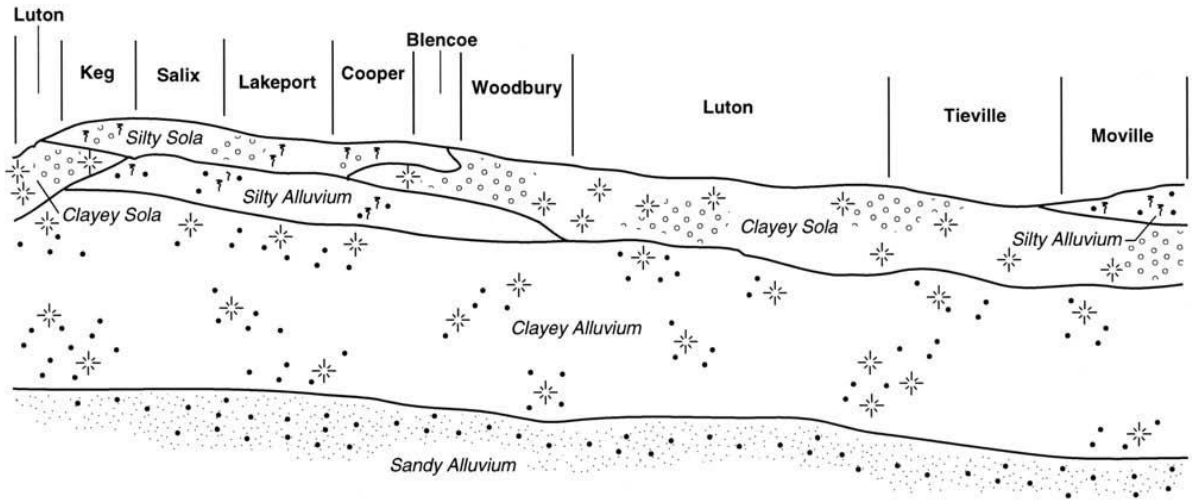


Figure 5.—Major soil to parent material and position relationships of the Flood Basin of the Missouri River flood plain.

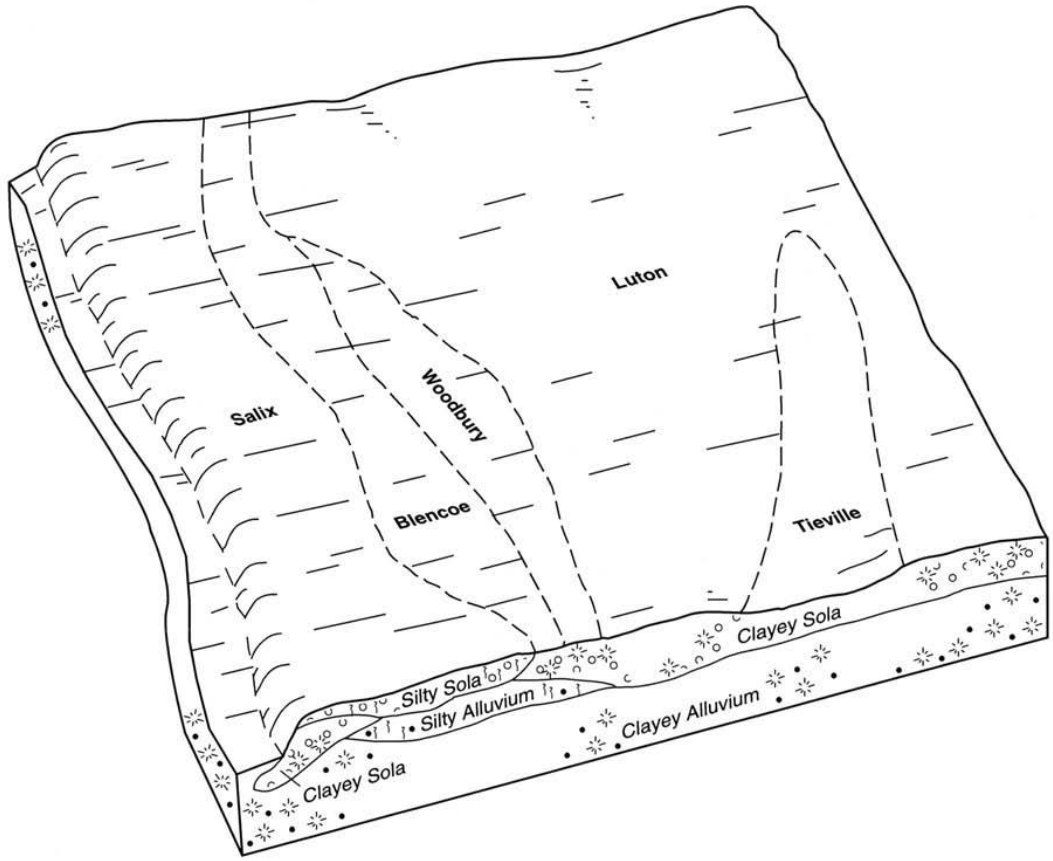


Figure 6.—Typical pattern of soils and parent material in the Luton-Salix association in the flood basin area of the Missouri River floodplain.

Adapted from material published in *Clark, B. J. 2003. Soil Survey of Monona County, Iowa. U.S. Department of Agriculture, Natural Resources Conservation Service. By Patrick Cowsert, Soil Scientist,USDA NRCS, Nebraska.*

North Central Region Cooperative Soil Survey Tour

Stop 1 – Schilling Wildlife Management Area

NEBRASKA GAME AND PARKS COMMISSION
WILDLIFE DIVISION

WILDLIFE MANAGEMENT AREA SUMMARY

W.M.A. **Randall W. Schilling**

LOCATION: **The wildlife area is situated at the confluence of the Platte and Missouri Rivers in Cass County. The area lies just northeast of Plattsmouth, Nebraska. The field headquarters is located 1 mile north of Main Street on Refuge Road. The area is in sections 31, 5, 6, 7 and 8; T12N, R14E.**

AREA DESCRIPTION:

SIZE: **approximately 1789 acres**

OWNERSHIP & AQUISITION: **The Nebraska Game and Parks Commission owns all of the wildlife area. The north part (1164 ac.) was purchased in 1947 for $22,000.00 from the federal government with federal aid funds (PRW18L1). In 1962, a trade involving 145.6 acres was made with Allied Chemical. No money was exchanged. The south part was purchased for $712,368.97 in 1997 from Rodney Rhoden with federal aid funds (W78L26).**

PUBLIC USE CONSIDERATIONS: **The area headquarters is primarily used for office and shop/maintenance space but also serves as a check station during the November firearm deer season. The area headquarter is handicapped accessible and has a handicapped accessible restroom. Approximately 4 miles of roads are maintained for vehicle traffic. Rifles, handguns and target shooting are not permitted on the area for public safety purposes. Non-toxic shot is required on the entire area. The north part of the area is closed September 1-4 each year for a youth mourning dove hunt.**

Primary Wildlife: **White-tailed deer, wild turkey, ring-necked pheasant, bobwhite quail, mourning dove, cottontail rabbit, fox squirrel, raccoon, beaver, muskrat, mink, opossum, Canada geese, several species of raptors, and many species of song birds are common visitors to the area throughout the year. Lesser snow geese, shorebirds and several species of ducks can be observed during spring and fall migration.**

WATERSHED: **Platte River - .5 mile, Missouri River - 2 miles, River chute -1.5 mi., Backwater - 40 acres**

FISHERY ASPECTS: **Common fish species in the rivers are channel catfish, flathead catfish, common carp, buffalo, bullhead, fresh water drum, several sucker species, big mouth carp, goldeye, shovel nose sturgeon, pallid sturgeon, and several minnow species. Asian and bighead carp are prevalent in both the Platte and Missouri Rivers in the area.**

A chute restoration project was constructed in 2005 by the Nebraska Game and Parks Commission and the U.S. Army Corps of Engineers. The chute is approximately 1.5 miles long and transects the area.

A backwater project was constructed in 2006 on the south part of the area with mitigation funds from the Omaha Municipal Utilities District. An addition to the backwater was put in 2009 with funds from the U.S Army Corps. Of Engineers.

HISTORICAL CONSIDERATIONS: **Two concrete ammunition bunkers are still present on the area from the U.S. Army rifle range. The confluence of the Platte and Missouri Rivers is a significant point of the Louis and Clark Expedition.**

AREA MANAGEMENT:

HABITAT TYPES:

woodland - approximately 235 acres, primarily riparian timber.

converted - approximately 700 acres planted to warm/cool season mix, approximately 550 in agricultural production (corn, soybean, milo and sunflowers).

wetlands - approximately 60 acres in backwater and 20 acres flowthrough in goose lake

Special Habitat Management Considerations: **The entire area is subject to periodic flooding and frequent re-establishing of perennial grass stands may be needed. Cottonwood and willow invasion is a continual problem that also results from flooding.**

SPECIAL PROBLEMS: **Minor problems with trash dumping along roads and parking areas. Mud dragging or driving though standing water along roads is becoming a major problem.**

NOXIOUS WEEDS: **Purple loosestrife is a concern on the area as widespread infestations are occurring along the Platte River. Some Purple loosestrife is present on the area but currently is controlled by chemical or mechanical means. Musk thistles is present but is controlled by mechanical means. Garlic mustard in woodland areas is becoming more predominate and poses a threat to native habitats.**

PREPARED BY: **Neal Van Winkle, Wildlife Biologist**

DATE: **December 2010**

Schilling Wildlife Management Area – Plattsmouth, Nebraska

Schilling Wildlife Management Area – September, 2011

IMPACTS

Of the 2011 Flood on the Missouri River Channel

By Tim Cowman
Missouri River Institute

Impacts of the Missouri River Flood of 2011 will be felt for a long time. The flood was far reaching in extent and great in magnitude. Although the peak flows were tempered by the mainstem dams, it was still the highest flow on record since the construction of the dams authorized by the Pick-Sloan Plan. Impacts of these flows in the "free flowing" and channelized sections of the river are extensive. This article will discuss some of the changes that are evident and some that will be revealed over the next few years.

It is important to realize that the 2011 flood altered the Missouri River, its channel, and its ecosystem greatly. The river will respond to these changes over the next few years as it moves back toward a state of equilibrium. Some impacts will take months or even years to become apparent. Other impacts have already been observed in the aftermath of the high flows. Some of the impacts to the river and its ecosystem will be detrimental, others will be beneficial. It is important that these impacts are observed, measured, and documented by the scientific community. Proper post-flood assessment will yield information that can be very useful in managing the river over the next several decades.

This article will mainly talk about changes in the free flowing segments of the Missouri River below Fort Randall and Gavins Point Dams. However, significant changes of a different sort have occurred in the channelized section of river beginning below Ponca State Park. The channelized river responds differently to a flood than the unchannelized section. This is mainly due to the narrow, confined nature of the channelized section. The wider nature of the unchannelized river is better equipped to dissipate the energy of the flood without inundating larger areas of floodplain. Figure 1 shows an example of the differences in width between the unchannelized and channelized river sections. Figure 2 shows the theoretical impact of this difference based on U.S. Army Corps of Engineers estimated inundation maps for the flood of 2011.

Figure 1. Example of difference in width between the unchannelized (left) and channelized (right) river segments.

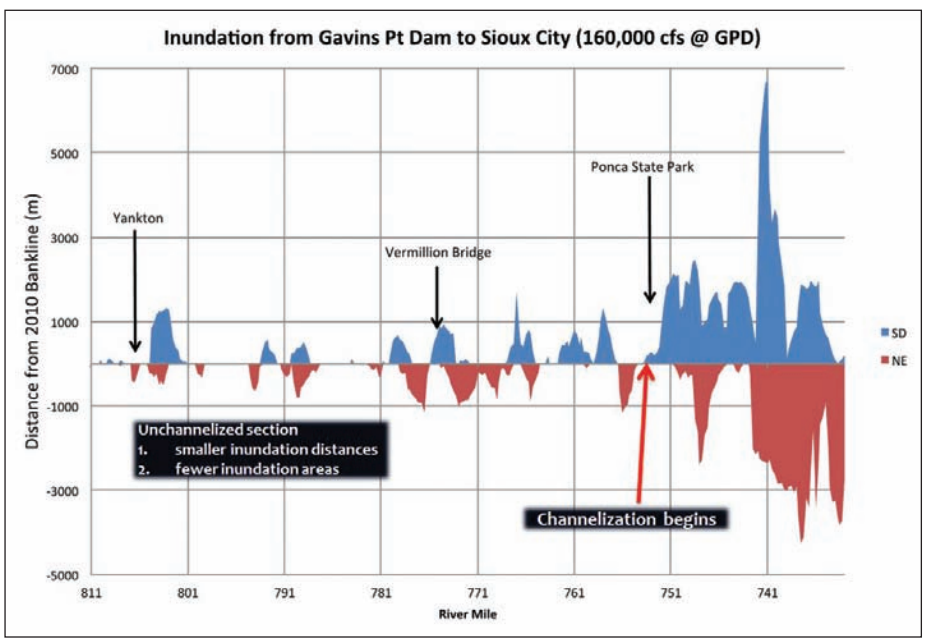


Figure 2. Difference in extent of flood inundation on unchannelized versus channelized sections (based on USACE inundation maps).

Changes to the channel

One of the most obvious areas where there has been change is in the channel itself. The river bed is composed of unconsolidated sand, silt, and clay. These sediments are moved around a lot in a normal flow year. Flood conditions like 2011 drastically rearranged the bed sediments. In the free flowing sections from Fort Randall Dam to about Niobrara, NE and from Gavins Point Dam to Ponca, NE, the river bed has been significantly altered in many areas. Large deposits of sand have been left behind by the high waters. Some of these deposits are now sandbars that are 8 to 10 feet above normal water levels. To understand why these sandbars are so large, consider how the river creates them. A flowing river with unconsolidated bed sediments, such as the Missouri River, will move the sediments into the shape of dunes on the river bed. Many of these dunes build up to within two or three feet of the river level. The Missouri River is continuously carrying out this process and is the reason why most of it is so shallow. Before flows were controlled by the dams, the Missouri River routinely built sandbars during its annual rises. That process has been greatly reduced since the dams were put in place. During the flood, river levels were close to 10 feet above normal. The sand dunes on the river bed built up to within a few feet of the flood level the river was at. When the water levels dropped with the decrease in discharges from the dams, they left behind sandbars that protruded great distances out of the water. These sandbars will still persist until slowly eroded away by wind, water, and ice over the years. Figure 3 shows the difference in typical pre-flood and post-flood sandbars. Figure 4 is a comparison of the channel before and after the flood, highlighting the drastic increase in post-flood channel deposits.

The source of large sand deposits created in the channel and in some overbank areas had to come from somewhere, and it wasn't from behind the dams. The source of these deposits was mostly from the riverbed, and to a lesser extent from bank erosion. Evidence has already been shown that areas of the free flowing channel have been scoured and are significantly deeper than

before the flood. Bed degradation values of ten feet or more have been detected in some areas. Other areas have seen bed degradation to a lesser degree. Features have been observed protruding along the river banks at flows of about 20,000 cubic feet per second (cfs) that in past years would have still been submerged. This is a result of the bed degradation and will likely have an impact on docks, boat ramps, and other objects that were built to a specific river level. Also, as the river cuts deeper into its channel, it reduces its connection with the floodplain, negatively affecting the riparian ecosystem.

The main channel (thalweg) has been moved significantly in several areas. In some cases it has moved from the Nebraska side of the river to the South Dakota side and vice-versa. The main channel location impacts river navigation as well as energy distribution in the river. Not only will navigation by boats and other vessels be impacted, but points of erosion and deposition will likely change as well. Fast moving water areas and slow moving water areas have also likely changed. This can have an effect on fisheries and wildlife patterns.

In the channelized reach of the river, deposition has greatly affected the surrounding landscape. This is particularly evident in some of the agricultural fields surrounding the river. In some cases sand and silt were deposited over productive topsoil, making it difficult to recover for crop production. Areas where flowing water moved out of the main channel and into surrounding agricultural fields had an even greater negative impact on agriculture. In many of these areas, the moving water eroded away the topsoil and cut channels into the underlying sandy sediments (which were probably former river beds from decades or centuries ago). Figure 5 shows typical results from this type of impact.

Figure 3. Typical Missouri River sandbars before (left) and after (right) the flood.

Wetlands and Backwaters

Bed degradation in the river channel below Gavins Point Dam has resulted in a loss of natural wetlands and other backwaters along the river. When the riverbed downcuts, it lowers the surrounding water table and wetlands and backwaters dry up. The flood has impacted two of the restored backwaters near Yankton and Ponca State Park. Originally designed and constructed to be connected to the river on their downstream end, both of these backwaters have been eroded on the upstream end by the flood to the extent that they are now connected to the river on both ends. This results in a flow-through backwater and significantly changes the dynamic of the backwater. The most significant change is the threat of erosion that comes with the flow through channel. Time will tell what the impact will be, with the worst case being complete loss of the backwaters to erosion.

Wetland areas along the river have also been altered. Sand and silt deposits left by the flood have covered these wetland areas, in essence changing their ability to function as a wetland. Other wetlands escaped without significant deposition, but were inundated by flood waters which may have transported contaminants into the environment. These potential water quality impacts will need to be evaluated during the post-flood assessments.

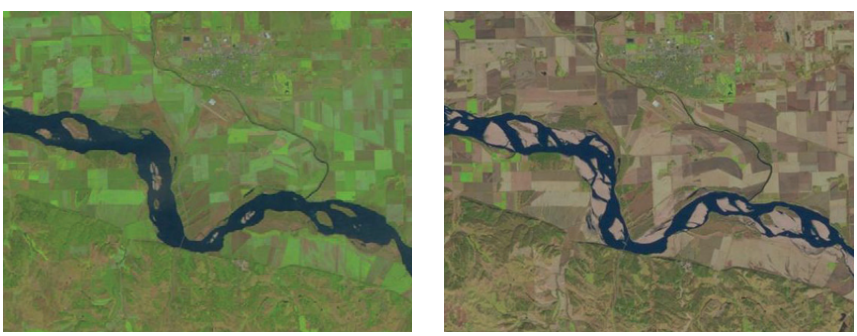


Figure 4. Pre-flood 2009 (left) and post-flood 2011 (right) Landsat imagery showing new sand deposits.

Riparian Forest Impacts

One of the most ecologically important trees along the river is the cottonwood. These trees have adapted to shallow water tables and short periods of inundation, but the unusually long inundation period created by this flood was enough to damage the root systems of some trees. Such root damage may make trees more susceptible to blow down by strong winds, as has been observed

at various locations along the river. In addition, some trees have been toppled as the flood has undercut the riverbank, while others have been lost due to an apparent increase in beaver activity. Loss of these trees may represent a negative impact on the forest, but an ecologically positive impact on the aquatic environment, as snags increase the variety of habitats for aquatic insects and fish. Some areas of forest along the river have already experienced significant cottonwood tree loss. Other areas that may have been impacted won't show the damage immediately, but tree loss could occur over the next few years. At this point it is unknown how extensive the cottonwood tree damage will be.

Significant benefits may also come to the forests as a result of the flood. Eastern red cedar and Russian olive trees are undesirable species that have colonized the floodplain during the regulated flows of the last sixty years. These trees are sensitive to inundation and the flood may have reduced some occurrences of them while rejuvenating native floodplain forest plant species. For instance, it is possible that the flood generated new cottonwood areas on sandbars and floodplain deposits. The extent of new cottonwood generation is unknown at this time, but will need to be documented over the next few years.

Figure 5: Field erosion after flooding. Note collapsed center pivot into eroded area and absence of topsoil.

Invasive Plant Species

Purple loosestrife is an invasive plant species that can take over riparian habitats and create a monoculture (figure 6). It has the ability to regenerate rapidly and its seed is distributed by flowing water. Significant efforts are in place by various government agencies to control the purple loosestrife population on the river. The flood has created a potential challenge for these agencies. Knowledge about the location of purple loosestrife colonies is no longer accurate. The flood has destroyed many of the existing areas where the plant was established. Unfortunately, the flood waters will have redistributed the seed and plant fragments from colonies that existed prior to the flood. The result will be many new colonies appearing over the next few years in areas that are unknown at this time. Close monitoring will have to occur along the river to identify these colonies before they become too established. Efforts will need to be carried out to eradicate the colonies before they grow out of control. This will be an expensive and time-consuming effort for all organizations involved.

Summary

The flood of 2011 has and will have significant impacts on the Missouri River channel and its riparian ecosystem. We have become used to the river behaving in a similar manner for several decades. The flood has likely significantly altered the river system, with impacts that may be both positive and negative for the ecosystem. This provides both a challenge and an opportunity to learn more about how the river and its ecosystem function and respond in the years to come.

Figure 6: Purple loosestrife colony.

Missouri River Institute

The University of South Dakota established the Missouri River Institute (MRI) to develop and promote research, education, and public awareness related to the natural and cultural resources of the Missouri River Basin.

Components of the Missouri River Institute

Research

The MRI promotes interdisciplinary research on the Missouri River. To enhance this research, the MRI contributes faculty, student, equipment, and funding resources toward research projects that address issues related to the Missouri River system.

Education

The MRI is developing new curricula and academic programs for introductory and advanced river studies at USD. This includes undergraduate courses and graduate programs centered on riverine and environmental studies.

Outreach

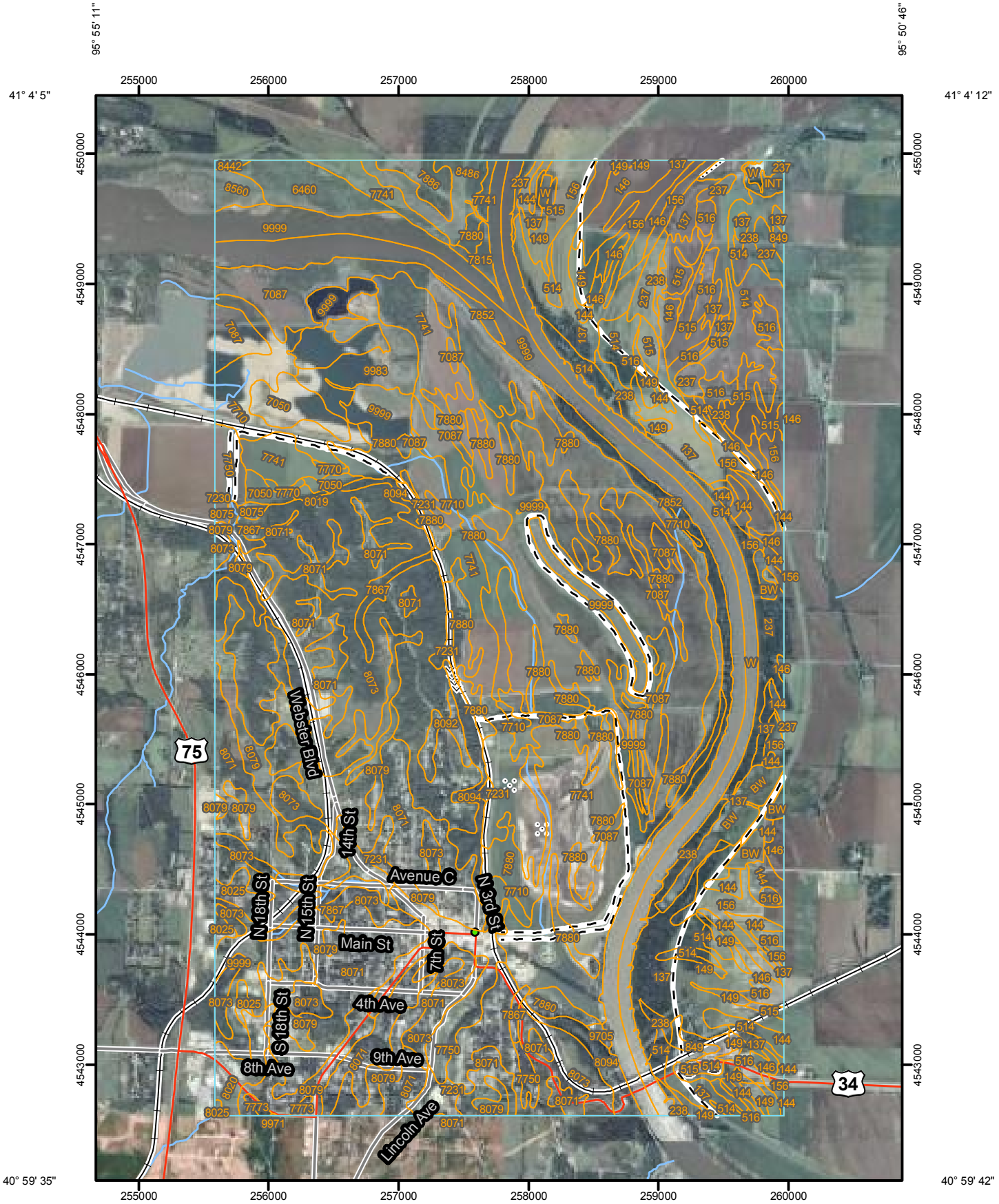
The MRI is active in projects to promote understanding of and interaction with the river.

Please feel free to contact us for more information.

Tim Cowman
Director
Tim.Cowman@usd.edu

Website: http://www.usd.edu/missouri-river-institute/

Soil Map—Cass County, Nebraska, Mills County, Iowa, and Sarpy County, Nebraska
(Schilling Wildlife Management Area and Vicinity)



Map Scale: 1:39,800 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 350 700 1,400 2,100

Feet: 0 1,500 3,000 6,000 9,000

Map Unit Legend

Cass County, Nebraska (NE025)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
7050	Kennebec silt loam, occasionally flooded	72.7	0.9%
7087	Sarpy-Haynie complex, occasionally flooded	510.8	6.4%
7230	Judson silt loam, 0 to 2 percent slopes	1.2	0.0%
7231	Judson silt loam, 2 to 6 percent slopes	64.1	0.8%
7710	Albaton silty clay, occasionally flooded	136.1	1.7%
7741	Haynie silt loam, occasionally flooded	1,217.6	15.3%
7750	Nodaway silt loam, occasionally flooded	138.4	1.7%
7770	Colo silty clay loam, occasionally flooded	8.0	0.1%
7773	Colo-Nodaway complex, frequently flooded	7.3	0.1%
7852	Sarpy loamy fine sand, frequently flooded	87.7	1.1%
7867	Nodaway silt loam, channeled, frequently flooded	74.3	0.9%
7880	Onawa silty clay, occasionally flooded	377.8	4.8%
8019	Marshall silty clay loam, 2 to 6 percent slopes	4.3	0.1%
8020	Marshall silty clay loam, 2 to 6 percent slopes, eroded	45.5	0.6%
8025	Marshall silty clay loam, 6 to 11 percent slopes, eroded	33.7	0.4%
8071	Monona silt loam, 11 to 17 percent slopes, eroded	865.1	10.9%
8073	Monona silt loam, 17 to 30 percent slopes	907.7	11.4%
8075	Monona silt loam, 2 to 6 percent slopes	9.7	0.1%
8079	Monona silt loam, 6 to 11 percent slopes, eroded	310.8	3.9%
8092	Monona-Ida silt loams, 11 to 17 percent slopes, eroded	22.4	0.3%
8094	Monona-Ida silt loams, 30 to 60 percent slopes	99.2	1.2%
9705	Udorthents, silty	4.2	0.1%
9971	Arents, earthen dam	0.1	0.0%
9983	Gravel pit	94.7	1.2%
9999	Water	460.0	5.8%
Subtotals for Soil Survey Area		**5,553.3**	**69.9%**
Totals for Area of Interest		**7,947.7**	**100.0%**

Mills County, Iowa (IA129)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
137	Haynie silt loam, 0 to 2 percent slopes	433.1	5.4%
144	Blake silty clay loam, 0 to 2 percent slopes	102.0	1.3%
146	Onawa silty clay, 0 to 2 percent slopes	161.2	2.0%

Mills County, Iowa (IA129)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
149	Modale silt loam, 0 to 2 percent slopes	73.5	0.9%
156	Albaton silty clay, 0 to 2 percent slopes	214.9	2.7%
237	Sarpy loamy fine sand, 1 to 3 percent slopes	136.2	1.7%
238	Sarpy fine sandy loam, 0 to 2 percent slopes	101.5	1.3%
514	Grable silt loam, 0 to 2 percent slopes	269.6	3.4%
515	Percival silty clay, 0 to 2 percent slopes	109.6	1.4%
516	Vore silty clay loam, 0 to 2 percent slopes	93.3	1.2%
849	Kenmoor loamy fine sand, 0 to 2 percent slopes	13.1	0.2%
BW	Built wetland	79.4	1.0%
INT	Intermittent water	10.6	0.1%
W	Water	210.3	2.6%
Subtotals for Soil Survey Area		**2,008.4**	**25.3%**
Totals for Area of Interest		**7,947.7**	**100.0%**

Sarpy County, Nebraska (NE153)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
6460	Inglewood-Novina complex, occasionally flooded	73.6	0.9%
7741	Haynie silt loam, occasionally flooded	41.5	0.5%
7815	Ticonic-Sarpy-Carr complex, occasionally flooded	14.1	0.2%
7880	Onawa silty clay, occasionally flooded	8.7	0.1%
7886	Onawa-Lossing silty clays, occasionally flooded	29.7	0.4%
8442	Cass-Novina complex, occasionally flooded	3.5	0.0%
8486	Gilliam-Onawa complex, occasionally flooded	54.6	0.7%
8560	Platte and Alda soils, frequently flooded	22.5	0.3%
9999	Water	137.8	1.7%
Subtotals for Soil Survey Area		**386.0**	**4.9%**
Totals for Area of Interest		**7,947.7**	**100.0%**

LOCATION HAYNIE IA+IL KS MO NE SD
Established Series
Rev. DBO-RAL-TWN-JFH
07/2004

HAYNIE SERIES

The Haynie series consists of very deep, moderately well drained soils on flood plains. These soils formed in calcareous alluvium. Slopes range from 0 to 5 percent. Mean annual air temperature is about 11 degrees C (51 degrees F). Mean annual precipitation is about 710 millimeters (28 inches).

TAXONOMIC CLASS: Coarse-silty, mixed, superactive, calcareous, mesic Mollic Udifluvents

TYPICAL PEDON: Haynie silt loam, on a nearly level slope, in a cultivated field, at an elevation of 325 meters (1,065 feet) above sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 18 centimeters (0 to 7 inches); very dark grayish brown (10YR 3/2) silt loam, grayish brown (2.5Y 5/2) dry; small clods parting to weak fine subangular blocky and weak fine granular structure; some stratification of lighter colors in the lower part; very friable; few dark brown (10YR 3/3) organic stains on faces of peds; slightly effervescent; slightly alkaline; clear smooth boundary. [15 to 23 centimeters (6 to 9 inches) thick]

C--18 to 152 centimeters (7 to 60 inches); alternating layers of dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; massive with weak thin alluvial stratification; common 3 to 5 millimeter (1/8 to 1/4 inch) lenses of very fine sandy loam; a lens of very fine sandy loam at 25 to 33 centimeters (10 to 13 inches); very friable; common fine distinct gray (5Y 5/1) redoximorphic depletions; few fine distinct dark yellowish brown (10YR 4/4) and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; not all strata have redoximorphic features; strongly effervescent; slightly alkaline.

TYPE LOCATION: Major Land Resource Area (MLRA) 107B (Iowa and Missouri Deep Loess Hills, South Part); Monona County, Iowa subset; about 2.4 kilometers (1 1/2 miles) west and 1.6 kilometer (1 mile) north of Whiting; about 240 meters (790 feet) west and 433 meters (1,420 feet) north of the center of sec. 34, T. 85 N., R. 46 W.; USGS Sloan quadrangle; lat. 42 degrees 8 minutes 20 seconds N. and long. 96 degrees 11 minutes 15 seconds W., NAD 27.

RANGE IN CHARACTERISTICS:
Depth to carbonates--0 to 25 centimeters (0 to 10 inches)
Depth to redoximorphic concentrations--15 to 25 centimeters (6 to 10 inches)
Thickness of the ochric epipedon--less than 25 centimeters (10 inches)
Content of clay in the particle-size control section (weighted average)--15 to 18 percent

Content of sand in the particle-size control section (weighted average)--18 to 80 percent, mostly very fine sand, less than 15 percent fine sand and sand coarser than fine sand

Ap horizon:
Hue--10YR or 2.5Y
Value--3
Chroma--2
Texture--silt loam, very fine sandy loam, or silty clay loam
Clay content--15 to 30 percent
Sand content--18 to 55 percent
Calcium carbonate equivalent--0 to 25 percent
Reaction--neutral or slightly alkaline

C horizon:
Hue--10YR or 2.5Y
Value--4 or 5
Chroma--2 to 4
Texture: silt loam or very fine sandy loam, but some pedons contain strata, less than 5 inches thick, of fine sandy loam and loamy fine sand
Clay content--15 to 18 percent
Sand content--18 to 80 percent, mostly very fine sand
Calcium carbonate equivalent--3 to 30 percent
Reaction--slightly alkaline or moderately alkaline

The redoximorphic features in this profile are believed to be relict features

Some pedons have silty clay loam and silty clay strata below a depth of 127 centimeters (50 inches)

Some pedons have sandy materials below a depth of 152 centimeters (60 inches)

Some pedons have thin silty clay layers below a depth of 102 centimeters (40 inches)

COMPETING SERIES: These are the Ion and McPaul series.
Ion--have a buried soil within a depth of 51 to 102 centimeters (20 to 40 inches)
McPaul--do not have a hue of 2.5Y in the series control section

GEOGRAPHIC SETTING:
Parent material--calcareous alluvium
Landform--flood plains
Slopes--0 to 5 percent
Elevation--213 to 503 meters (700 to 1,650 feet) above sea level
Mean annual air temperature--8 to 13 degrees C (47 to 56 degrees F)
Mean annual precipitation--510 to 910 millimeters (20 to 36 inches)
Frost-free period--135 to 190 days

Note: The alluvium is 0.9 to many meters (3 to many feet) thick and typically grades to sandy alluvium as depth increases.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Albaton, Grable, Modale, Onawa, and Sarpy soils.
Albaton--are in the lower elevations and have a clay content of more than 50 percent in the particle-size control section
Grable--are in landscape positions similar to those of the Haynie soils and have 65 to 95 percent fine sand within a depth of 46 to 76 centimeters (18 to 30 inches)
Modale--are in landscape positions similar to those of the Haynie soils and have a clay content of 40 to 60 percent within a depth of 46 to 76 centimeters (18 to 30 inches)
Onawa--are in the lower elevations and have a clay content of 50 to 60 percent in the upper third of the particle-size control section
Sarpy--are at the higher elevations and have a clay content of 2 to 5 percent in the particle-size control section

DRAINAGE AND PERMEABILITY:
Drainage: a saturated zone occurs within depths of 122 to 183 centimeters (4 to 6 feet) during April to June in most years and is considered apparent
Saturated hydraulic conductivity--moderate
Surface runoff potential--low
Flooding--none to frequent for brief to long periods during the months of February to November in most years resulting from precipitation events and snowmelt

USE AND VEGETATION:
Most areas are cultivated. The principal crops are corn, soybeans, small grain, and hay. Some areas are land-leveled and irrigated. The native vegetation is big bluestem, indiangrass, switchgrass, and other grasses of the tall grass prairie.

DISTRIBUTION AND EXTENT:
MLRA 63B (Southern Rolling Pierre Shale Plains) within the Western Great Plains Range and Irrigated Region (Land Resource Region G);

MLRAs 74 (Central Kansas Sandstone Hills) and 76 (Bluestem Hills) within the Central Great Plains Winter Wheat and Range Region (Land Resource Region H);

MLRAs 102C (Loess Uplands), 106 (Nebraska and Kansas Loess-Drift Hills), 107B (Iowa and Missouri Deep Loess Hills, South Part), and 115B (Central Mississippi Valley Wooded Slopes) within the Central Feed Grains and Livestock Region (Land Resource Region M).

This series is of large extent; the total extent is over 170,000 hectares (400,000 acres).

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Clay County, South Dakota, 1953.

REMARKS:
Particle-size control section--the zone from a depth of 25 to 100 centimeters (10 to 40 inches - C horizon);
series control section--the zone from the surface to a depth of 152 centimeters (60 inches - Ap and C horizons).

Diagnostic horizons and features recognized in this pedon:
ochric epipedon--the zone from the surface to a depth of 18 centimeters (7 inches - Ap horizon);
udic moisture regime.
Cation-exchange class is inferred from lab data for similar soils in the surrounding area.
Taxonomy version--second edition, 1999.

The redoximorphic features in this profile are believed to be related to the moisture status of the materials at the time of deposition and not related to present day moisture status. The redoximorphic features in this profile were not considered in the current classification of the soil.

National Cooperative Soil Survey
U.S.A.

LOCATION ONAWA IA+KS MO NE SD
Established Series
Rev. PTC-RAL-TWN
09/2003

ONAWA SERIES

The Onawa series consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in 18 to 30 inches of clayey alluvium and the underlying loamy alluvium. Slopes range from 0 to 2 percent. Mean annual air temperature is about 51 degrees F. Mean annual precipitation is about 27 inches.

TAXONOMIC CLASS: Clayey over loamy, smectitic over mixed, superactive, calcareous, mesic Aquertic Udifluvents

TYPICAL PEDON: Onawa silty clay, on a nearly level flood plain, in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 7 inches; very dark grayish brown (2.5Y 3/2) silty clay; moderate fine subangular blocky structure; firm; slightly alkaline; abrupt smooth boundary. (6 to 10 inches thick)

Cg1--7 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay; massive with weak, thin alluvial stratification; firm; 1 inch layer of silty clay loam at 18 to 19 inches; few fine prominent red (2.5YR 5/8) and strong brown (7.5YR 5/8) redoximorphic concentrations; slightly effervescent; slightly alkaline; clear smooth boundary. (12 to 20 inches thick)

2Cg2--22 to 60 inches; dark grayish brown (10YR 4/2) and very dark gray (10YR 3/1) silt loam; massive; firm; few fine prominent strong brown (7.5YR 5/6) and few fine distinct reddish brown (5YR 4/3) redoximorphic concentrations; strongly effervescent; slightly alkaline.

TYPE LOCATION: Monona County, Iowa; about 50 feet west and 1,980 feet north of the southeast corner of sec. 1, T. 84 N., R. 47 W.; USGS Macy quadrangle; lat. 42 degrees 7 minutes 26 seconds N. and long. 96 degrees 15 minutes 8 seconds W., NAD 27

RANGE IN CHARACTERISTICS:
Depth to carbonates--0 to 10 inches
Depth to loamy alluvium--18 to 30 inches
Content of clay in the upper third to upper half of the particle-size control section (weighted average)--50 to 70 percent
Content of clay in the lower half to lower two thirds of the particle-size control section (weighted average)--10 to 18 percent
Content of sand in the upper third to upper half of the particle-size control section (weighted average)--1 to 5 percent fine sand and sand coarser than fine sand
Content of sand in the lower half to lower two thirds of the particle-size control section (weighted average)--10 to 75 percent fine sand and sand coarser than fine sand

A or Ap horizon:
Hue--10YR or 2.5Y
Value--2 or 3
Chroma--1 or 2
Texture--silty clay, clay, silty clay loam, loam, or silt loam
Clay content--15 to 50 percent
Sand--1 to 50 percent
Calcium carbonate equivalent--5 to 30 percent
Reaction--slightly alkaline or moderately alkaline

Overwash phase:
Texture--fine sandy loam or loamy fine sand
Clay content--2 to 20 percent
Sand content--50 to 90 percent
Thickness--10 to 20 inches

Cg horizon:
Hue--10YR, 2.5Y, 5Y, or is neutral
Value--3 to 5
Chroma--0 to 2
Texture--clay or silty clay
Clay content--50 to 70 percent
Sand--1 to 5 percent
Calcium carbonate equivalent--5 to 30 percent
Reaction--slightly alkaline or moderately alkaline

Many pedons have strata of silty or clayey materials with individual strata up to 1 to 2 inches thick

Some pedons have a transitional layer, less than 5 inches thick, between the Cg1 and 2Cg2 horizons of silty clay loam, with sand content up to 15 percent fine sand and sand coarser than fine sand

2Cg horizon:
Hue--10YR, 2.5Y, 5Y, or is neutral
Value--3 to 5
Chroma--0 to 2
Texture--silt loam, very fine sandy loam, loam with a high amount of very fine sand, or loamy very fine sand
Clay content--10 to 18 percent
Sand content--10 to 75 percent
Calcium carbonate equivalent--5 to 30 percent
Reaction--slightly alkaline or moderately alkaline

Some pedons have strata of loamy fine sand or fine sand below a depth of 40 inches

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING:
Parent material--18 to 30 inches of clayey alluvium and the underlying loamy alluvium
Landform--flood plains
Slopes--0 to 2 percent
Elevation--700 to 1,260 feet above sea level
Mean annual air temperature--46 to 56 degrees F.
Mean annual precipitation--19 to 36 inches
Frost-free period--135 to 185 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Albaton, Blake, Percival, Grable, Haynie, and Modale soils.
Albaton--are in the slightly lower landscape positions, have a saturated zone within a depth of 1 foot during March to June in most years, and have a clay content of 50 to 60 percent throughout the particle-size control section
Blake--are in landscape positions similar to those of the Onawa soils and have a clay content of 22 to 35 percent throughout the particle-size control section
Percival--are in the slightly higher landscape positions, have a clay content of less than 10 percent in the lower half of the particle-size control section
Grable--are in the higher landscape positions, have a clay content of 12 to 16 percent in the upper half of the particle-size control section, and do not have a saturated zone within a depth of 6 feet during April to June in most years
Haynie--are in the slightly higher landscape positions, have a clay content of 15 to 18 percent throughout the particle-size control section, and have a saturated zone between depths of 4 to 6 feet during April to June in most years
Modale--are in the slightly higher landscape positions, have a clay content of 10 to 18 percent in the upper third to upper half of the particle-size control section, and have a saturated zone between depths of 1 to 3 feet during April to June in most years

DRAINAGE AND PERMEABILITY:
Drainage class--somewhat poorly drained--a saturated zone occurs within depths of 1 to 3 feet during March to June in most years and is considered apparent
Permeability--slow in the clayey alluvium and moderate or moderately rapid in the underlying loamy alluvium
Surface runoff potentiallow or medium
Flooding--rare to occasional flooding with very brief or brief duration during the months of February to November from precipitation events and snowmelt and flooding from streambank overflow is limited where dams and levees protect areas

USE AND VEGETATION:
Most areas are cultivated. The principal crops are corn, soybeans, and small grains. Some areas are land-leveled and irrigated. The native vegetation is big bluestem, little bluestem, western wheatgrass, indiangrass, switchgrass, and other grasses of the tall grass prairie.

DISTRIBUTION AND EXTENT:
LRR M, MLRAs 102B, 107A and 107B, LRR G, MLRA 63B; along the Missouri River in Iowa, Kansas, Missouri, Nebraska, and South Dakota. This series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Boone County, Missouri, 1952.

REMARKS:
Particle-size control section--the zone from a depth of 10 to 40 inches (Cg1 and 2Cg2 horizons); series control section--the zone from the surface to a depth of 60 inches (Ap, Cg1, and 2Cg2 horizons).

Diagnostic horizons and features recognized in this pedon:
ochric epipedon--the zone from the surface to a depth of 7 inches (Ap horizon);
udic moisture regime.

Cation-exchange activity class is supported by lab sample numbers S94NE-177-015 and S96IA-193-028, National Soil Survey Laboratory.
Taxonomy version--second edition, 1999.

ADDITIONAL DATA:
Laboratory data--Iowa State University Agricultural Experiment Station, Ames, Iowa file No. 55907-55909
Laboratory data--National Soil Survey Laboratory, Lincoln, Nebraska pedons S94NE-177-015 and S96IA-193-028 (http://ssldata.sc.egov.usda.gov/).

LOCATION SARPY MO+IA IL KS NE SD
Established Series
Rev. BJM-RAL-TWN
10/2004

SARPY SERIES

The Sarpy series consists of very deep, excessively drained soils on flood plains. These soils formed in sandy alluvium. Slopes range from 0 to 9 percent. Mean annual precipitation is about 86 centimeters (34 inches). Mean annual air temperature is about 12 degrees C (54 degrees F).

TAXONOMIC CLASS: Mixed, mesic Typic Udipsamments

TYPICAL PEDON: Sarpy loamy fine sand, on a 3 percent slope, in a cultivated field, at an elevation of 213 meters (700 feet) above sea level. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 15 centimeters (0 to 6 inches); very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common fine roots; neutral; abrupt smooth boundary. [5 to 23 centimeters (2 to 9 inches) thick]

C--15 to 152 centimeters (6 to 60 inches); grayish brown (10YR 5/2) fine sand; single grain; loose; few fine roots in upper part; strongly effervescent; slightly alkaline.

TYPE LOCATION: Major Land Resource Area (MLRA) 107; Ray County, Missouri; about 4 miles southwest of Hardin; about 302 meters (990 feet) south and 442 meters (1,450 feet) west of the northeast corner of section 19, T. 51 N., R. 26 W.; USGS Lexington East quadrangle; lat. 39 degrees 13 minutes 8 seconds N. and long. 93 degrees 51 minutes 45 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:
Depth to carbonates--0 to 152 centimeters (0 to 60 inches)
Content of clay in the particle-size control section (weighted average)--2 to 5 percent
Content of sand in the particle-size control section (weighted average)--87 to 95 percent, dominantly fine sand

The particle-size control section contains less than 10 percent silt plus clay, and less than 40 percent silt plus clay plus very fine sand

Ap or A horizon:
Hue--10YR or 2.5Y
Value--3 to 5, 4 to 6 dry
Chroma--1 to 3
Texture--sand, fine sand, loamy sand, loamy fine sand, sandy loam, fine sandy loam, very fine sandy loam, or loam

Clay content--2 to 15 percent
Sand content--35 to 95 percent
Calcium carbonate equivalent--0 to 15 percent
Reaction--neutral to moderately alkaline

Some pedons have a surface texture of gravelly loamy sand with more than 15 percent gravel by volume

Overwash phase:
Hue--10YR or 2.5Y
Value--3 to 5, 4 to 6 dry
Chroma--1 to 3
Texture--silt loam, silty clay, or clay
Clay content--25 to 60 percent
Sand content--5 to 35 percent
Calcium carbonate equivalent--0 to 15 percent
Reaction--neutral to moderately alkaline
Thickness--2 to 10 inches

C horizon:
Hue--10YR or 2.5Y
Value--4 to 6
Chroma--2 to 4
Texture--loamy sand, loamy fine sand, fine sand or sand
Clay content--2 to 5 percent
Sand content--75 to 98 percent
Calcium carbonate equivalent--0 to 15 percent
Reaction--neutral to strongly alkaline

Some pedons have textures of silt loam or fine sandy loam below a depth of 152 centimeters (60 inches)

Alluvial stratification is evident throughout the C horizon

COMPETING SERIES: These are the Acquango, Aldo, Bigapple, Biltmore, Boplain, Breeze, Caesar, Chute, Dabney, Hodge, Oakville, Osolo, Pahuk, Penwood, Perks, Pinegrove, Plainfield, Sardak, Scotah, Spessard, Suncook, Tyner, and Windsor seies.
Acquango--are very slightly to moderately saline within the series control section
Aldo--have a saturated zone between depths of 1.1 to 1.8 meters (3.5 to 6 feet) for as much as 1 month per year in normal years
Bigapple--have anthrotransported materials over 102 centimeters (40 inches) thick
Biltmore, Dabney, Oakville, Penwood, Perks, Plainfield, Suncook, Tyner, and Windsor--are more acid in the series control section and do not have carbonates within a depth of 152 centimeters (60 inches)
Boplain--have a paralithic contact within the series control section
Breeze--contain more than 10 percent (by volume) construction debris coarse fragments within

the particle-size control section
Caesar and Spessard--have cambic horizons and are more acid in the series control section
Chute--do not have stratification within the series control section
Hodge--contain more than 40 percent silt plus clay plus very fine sand in the particle-size control section
Osolo--have a cambic horizon, silt content plus clay content averages more than 10 percent and fine sand content averages less than 50 percent in the particle-size control section, and have redoximorphic features within depths of 152 to 183 centimeters (40 to 72 inches)
Pahuk--have relict redoximorphic features in the lower third of the series control section
Pinegrove--contain coarse fragments of sandstone and shale throughout the series control section
Sardak--are in areas that have mean annual precipitation of less than 66 centimeters (26 inches), are more acid in the series control section, and do not have free carbonates within a depth of 152 centimeters (60 inches)
Scotah--have a cambic horizon, have redoximorphic features at depths of 102 to 152 centimeters (40 to 60 inches) and are frequently saturated for 1 month or less per year in 6 or more out of 10 years, and have an irregular decrease in organic carbon with depth

GEOGRAPHIC SETTING:
Parent material--sandy alluvium
Landform--flood plains
Slopes--0 to 9 percent
Elevation--122 to 595 meters (400 to 1,950 feet) above sea level
Mean annual air temperature--11 to 14 degrees C (52 to 57 degrees F)
Mean annual precipitation--66 to 107 centimeters (26 to 42 inches)
Frost-free period--150 to 190 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Albaton, Carr, Grable, Haynie, Landes, Modale, Onawa, Percival, and Waubonsie soils.
Albaton--are in the lower landscape positions, have a frequently saturated zone within a depth of 0.3 meter (1 foot) in normal years, and have a clay content of 50 to 60 percent in the particle-size control section
Carr--are in landform positions similar to those of the Sarpy soils and have a clay content of more than 5 percent in the particle-size control section
Grable--are in landform positions similar to those of the Sarpy soils and have a clay content of 12 to 16 percent in the upper half of the particle-size control section
Haynie--are in landform positions similar to those of the Sarpy soils, have a clay content of 15 to 18 percent throughout the particle-size control section, and have a frequently saturated zone between depths of 1.2 to 1.8 meters (4 to 6 feet) in normal years
Landes--are in landform positions similar to those of the Sarpy soils, have a clay content of 5 and 18 percent and a sand content of 50 and 90 percent in the particle-size control section, and have a mollic epipedon 25 to 51 centimeters (10 to 20 inches) thick
Modale--are in the slightly lower landscape positions, have a clay content of 10 to 18 percent in the upper third to upper half of the particle-size control section, and have a frequently saturated zone between depths of 0.3 to 0.9 meters (1 to 3 feet) in normal years
Onawa--are in the lower landscape positions, have a clay content of 50 to 70 percent in the upper third to upper half of the particle-size control section

Percival--are in the lower landscape positions, have a clay content of 40 to 60 percent in the upper half of the particle-size control section, and have a clay content of less than 10 percent in the lower half of the particle-size control section
Waubonsie--are in the lower landscape positions, have a mollic epipedon 25 to 30 centimeters (10 to 12 inches) thick, and have a frequently saturated zone perched between depths of 0.5 to 0.8 meters (1.5 to 2.5 feet) in normal years

DRAINAGE AND PERMEABILITY:
Drainage class--excessively drained--saturation does not occur with 1.8 meters (6 feet) in normal years
Saturated hydraulic conductivity--high or very high
Surface runoff potential--negligible or low
Flooding--rarely to frequently flooded for brief to long periods during the months of November to June and flooding from streambank overflow is limited where dams and levees protect areas

USE AND VEGETATION:
The native vegetation commonly is a thin stand of native grasses and sandburrs or cottonwood and willow trees. Cleared areas are in pasture or cultivated. Common crops include alfalfa, oats, soybeans, and wheat.

DISTRIBUTION AND EXTENT:
Physiographic Division--Interior Plains
Physiographic Province--Central Lowland
Physiographic section(s)--Osage plain, Western lake section, Till plains Dissected till plains
MLRA(s)--Central Kansas Sandstone Hills (74), Central Loess Plains (75), Bluestem Hills (76), Till Plains (102B), Nebraska and Kansas Loess-Drift Hills (106), Iowa and Missouri Deep Loess Hills (107), Southern Illinois and Indiana Thin Loess and Till Plain (114), and Central Mississippi Valley Wooded Slopes (115)
Physiographic Province--Great Plains
Physiographic section--High plains
MLRA--Southern Rolling Pierre Shale Plains (63B)
LRR M, LRR G, and LRR H; mainly along the Missouri River and other major streams in Missouri, Iowa, Kansas, Nebraska, South Dakota, and Illinois
Extent--large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Sarpy County, Nebraska, 1905.

REMARKS:
Particle-size control section--the zone from a depth of 25 to 100 centimeters (10 to 40 inches) (C horizon);
series control section--the zone from the surface to a depth of 150 centimeters (0 to 60 inches) (Ap and C horizons).

Diagnostic horizons and features recognized in this pedon:
ochric epipedon--the zone from the surface to a depth of 15 centimeters (0 to 6 inches) (Ap horizon);
udic moisture regime.

Taxonomy version--second edition, 1999.

These soils are not prime farmland due to low available water capacity.

Refer to DMUid 260,350 in NASIS for property data.

Missouri River Valley Near Tekamah, Burt Co. Nebraska – May 2012

Missouri River Valley Near Fort Calhoun, Washington Co. Nebraska – May 2012

Missouri River Valley at Schilling Wildlife Management Area, Cass Co. NE April 2012

North Central Region Cooperative Soil Survey Tour

Stop 2 – Camp Wakonda/Fontenelle Forest

About Fontenelle Nature Association

Founded in 1913, Fontenelle Nature Association is one of Nebraska's oldest conservation organizations and one of the largest private nature centers in the nation. This federally designated 501(c)(3) non-profit public charity is a National Natural Landmark and is listed on the National Register of Historic Sites.

FNA owns and manages two nature centers: Fontenelle Forest Nature Center in Bellevue and Neale Woods in Omaha. The properties encompass nearly 2,000 acres of forest, prairie and wetlands along the Missouri River in the geographically significant Loess Hills.

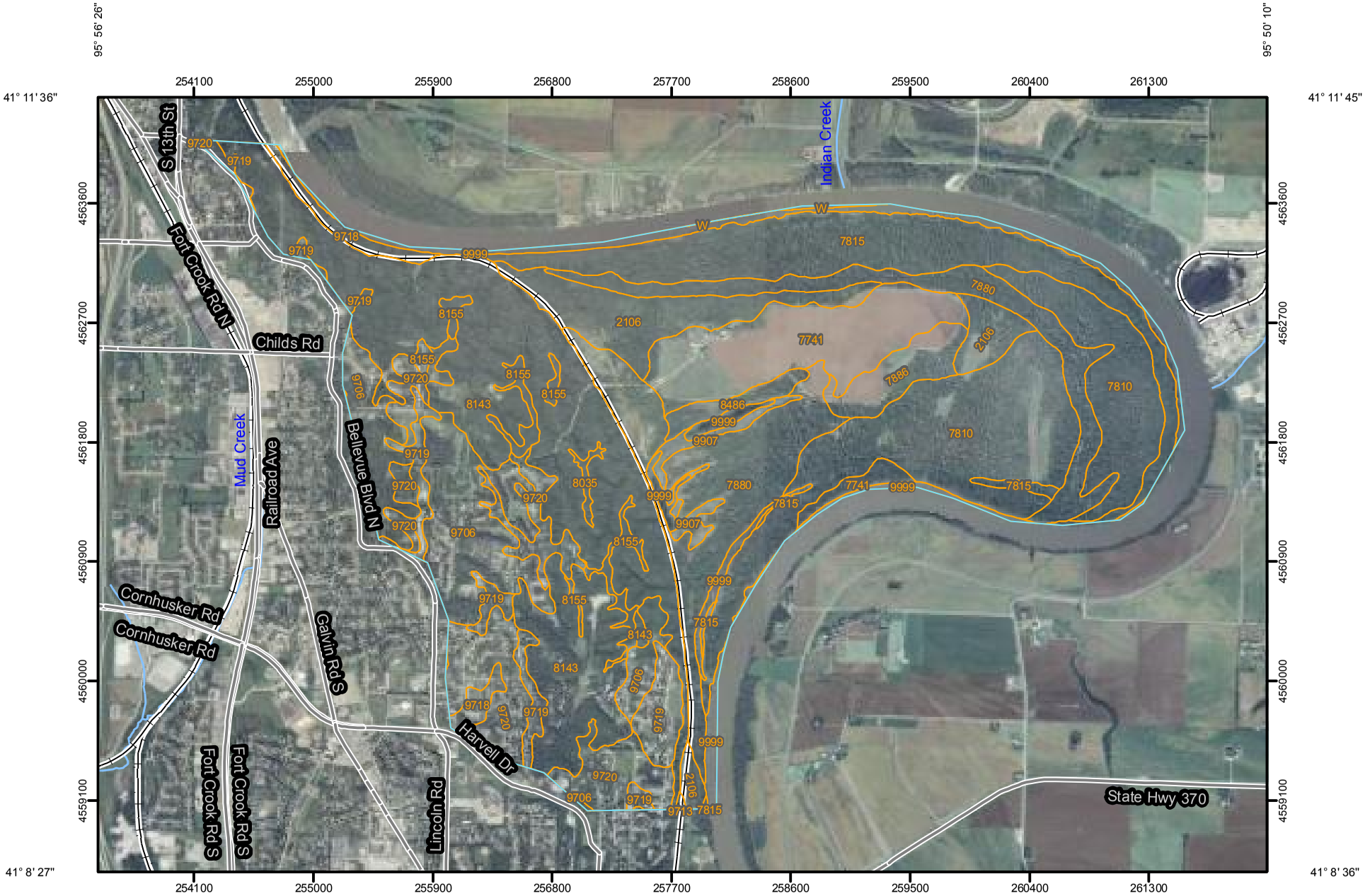
The mission of Fontenelle Nature Association is to provide a place where people can experience and enjoy the quiet wild of nature. We want to inspire current and future generations to care for the natural world.

Leadership

Fontenelle Nature Association employs a staff of nearly 30 part-time and full-time people within five primary departments: Development, Education, Facility Management, Land Stewardship and Visitor Services & Finance. FNA is overseen by a volunteer Board of Directors, representing over 30 local businesses.

http://www.fontenelleforest.org/

Soil Map—Pottawattamie County, Iowa, and Sarpy County, Nebraska
(Fontenelle Forest and Vacinity)



Map Scale: 1:41,800 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 500 1,000 2,000 3,000

Feet: 0 2,000 4,000 8,000 12,000

Map Unit Legend

Pottawattamie County, Iowa (IA155)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
W	Water	3.0	0.1%
Subtotals for Soil Survey Area		**3.0**	**0.1%**
Totals for Area of Interest		**4,466.8**	**100.0%**

Sarpy County, Nebraska (NE153)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
2106	Carr-Ticonic-Scroll complex, occasionally flooded	243.7	5.5%
7741	Haynie silt loam, occasionally flooded	313.3	7.0%
7810	Scroll-Percival complex, occasionally flooded	685.9	15.4%
7815	Ticonic-Sarpy-Carr complex, occasionally flooded	435.6	9.8%
7880	Onawa silty clay, occasionally flooded	537.2	12.0%
7886	Onawa-Lossing silty clays, occasionally flooded	83.1	1.9%
8035	Marshall-Contrary silty clay loams, 2 to 7 percent slopes	9.4	0.2%
8143	Pohocco-Monona silt loams, 11 to 54 percent slopes	984.1	22.0%
8155	Contrary-Monona silty clay loams, 6 to 11 percent slopes	66.9	1.5%
8486	Gilliam-Onawa complex, occasionally flooded	36.8	0.8%
9706	Udorthents-Urban land-Pohocco complex, 0 to 39 percent slopes	359.7	8.1%
9713	Urban land-Udorthents complex, 0 to 10 percent slopes, occasionally flooded	1.6	0.0%
9718	Urban land-Udorthents-Judson complex, 0 to 11 percent slopes	55.1	1.2%
9719	Urban land-Udorthents-Marshall complex, 0 to 9 percent slopes	147.2	3.3%
9720	Urban land-Udorthents-Pohocco complex, 0 to 16 percent slopes	303.5	6.8%
9907	Fluvaquents, silty, frequently flooded and Tieville soils, rarely flooded	42.2	0.9%
9999	Water	158.6	3.6%
Subtotals for Soil Survey Area		**4,463.8**	**99.9%**
Totals for Area of Interest		**4,466.8**	**100.0%**

TRAIL DESCRIPTIONS

A – Riverview Boardwalk: 1.0 mile boardwalk in three connected loops, allowing shorter and longer routes. Accessible to wheelchairs and strollers. Twenty-four rest areas with exhibits describing natural features. Our most popular trail; recommended for all first-time visitors.

B – Hickory: 0.2 miles; descends from third loop of boardwalk down steep slope to Childs Hollow and across the railroad tracks to the Missouri River.

C – Linden: 0.3 mile; follows gently sloping ridge then descends to Childs Hollow.

D – Childs Hollow: 0.3 miles; level path in hollow named for Charles Childs, an early pioneer who owned much of the land that is now Fontenelle Forest.

E – Hawthorn: 0.9 miles; passes unmarked earth lodge sites dating from 1200 A.D.; leads to Mill Hollow.

F – Hackberry: 0.4 miles; winds its way on moderate slopes to connect with Linden Trail.

G – Wren: 0.1 miles; level connector trail.

H – Chickadee: 0.4 miles; moderate climb from Childs Hollow to Hawthorn trial on ridgetop.

I – Oak: 1.3 miles; parallels Mill Hollow stream, then climbs steeply to a broad ridge with 250-year-old bur oaks. Steep descent to Gifford Road on south end.

J – Missouri: 1.0 miles; level floodplain trail along banks of Missouri River.

K – Walking Club: 0.7 miles; level trail follows former channel of Missouri River past giant cottonwood trees.

L – Cottonwood: 0.9 miles; level path through mature floodplain forest. Beaver activity sometimes floods south end of trail.

M – Handsome Hollow: 0.5 miles; gentle, scenic route up a deep, steep-sided ravine, from floodplain to ridgetop.

N – Indian: 0.3 miles; level ridgetop trail; passes several unmarked earth lodge sites.

O – Bladdernut: 0.4 miles; short loop trail from Camp Logan Fontenelle building and back.

P – Stream: 0.8 miles; flat floodplain trail; heads north from road through beaver activity area, or south to Great Marsh.

Q – Marsh: 0.4 miles; follows shoreline of Great Marsh; excellent views of aquatic life, especially waterfowl in spring and fall. Great Marsh is a "river scar" marking a former channel of the Missouri River. The Fontenelle Trading Post (ca. 1822) was located just west of the present-day marsh, on a site which was then on the riverside.

R – Hidden Lake: 1.3 miles; level; trail skirts the east end of the Great Marsh to reach Hidden Lake. Southern portion prone to flooding. Connects with Gifford Memorial Boardwalk.

S – Gifford Memorial Boardwalk: 0.4 miles; equal access, flat boardwalk; leads from the Wetlands Learning Center through the Missouri River floodplain to Great Marsh, ending at two-story wildlife observation tower.

T – Pond Trail: 0.3 miles; floodplain trail leading from the Wetlands Learning Center to a small teaching pond. Connects with Stream Trail.

U – Signal Ridge: 0.9 miles; access from Gifford Road or from Camp Wakonda; mostly level ridgetop trail; steep at north end.

V – Mormon Hollow: 0.6 miles; traces the path of Mormon pioneers; traverses length of deep ravine: gentle to moderate grade.

W – Prairie: 0.5 miles; ridgetop path through young oak woodland; steep to moderate grade.

X – History: 1.3 miles; moderate to steep loop from Prairie Trail. A self-guided history trail brochure, available at the visitor's center, describes the historic sites along this trail and Prairie Trail.

Y – Red Bud: 0.5 miles; passes through a large stand of native redbud trees and provides an alternative route between the Great Marsh and Hidden Lake.

AA – Ridge: 0.5 miles; traverses either side of a narrow ridge leading to a bluff overlooking the Missouri River.

CC – Habitat Hollow: 0.1 miles; primarily used for teaching.

RULES OF THE FOREST

- Leave all plants and animals undisturbed for others to enjoy; no collecting or picking of any sort is allowed.
- Stay on the trails.
- Use caution when crossing the railroad tracks, which remains in active use. Do not walk on the tracks.
- Camping, jogging, and bicycling are not permitted. No motorized vehicles are permitted beyond the parking lots except for disabled persons' access.
- Pets and horses are not permitted.
- No smoking or fires are allowed.
- Picnic only in the areas designated for that purpose.
- Carry your trash out with you.
- Hunting, fishing and musical equipment are not allowed, except with prior permission.

Fontenelle Forest Nature Center Trail Map

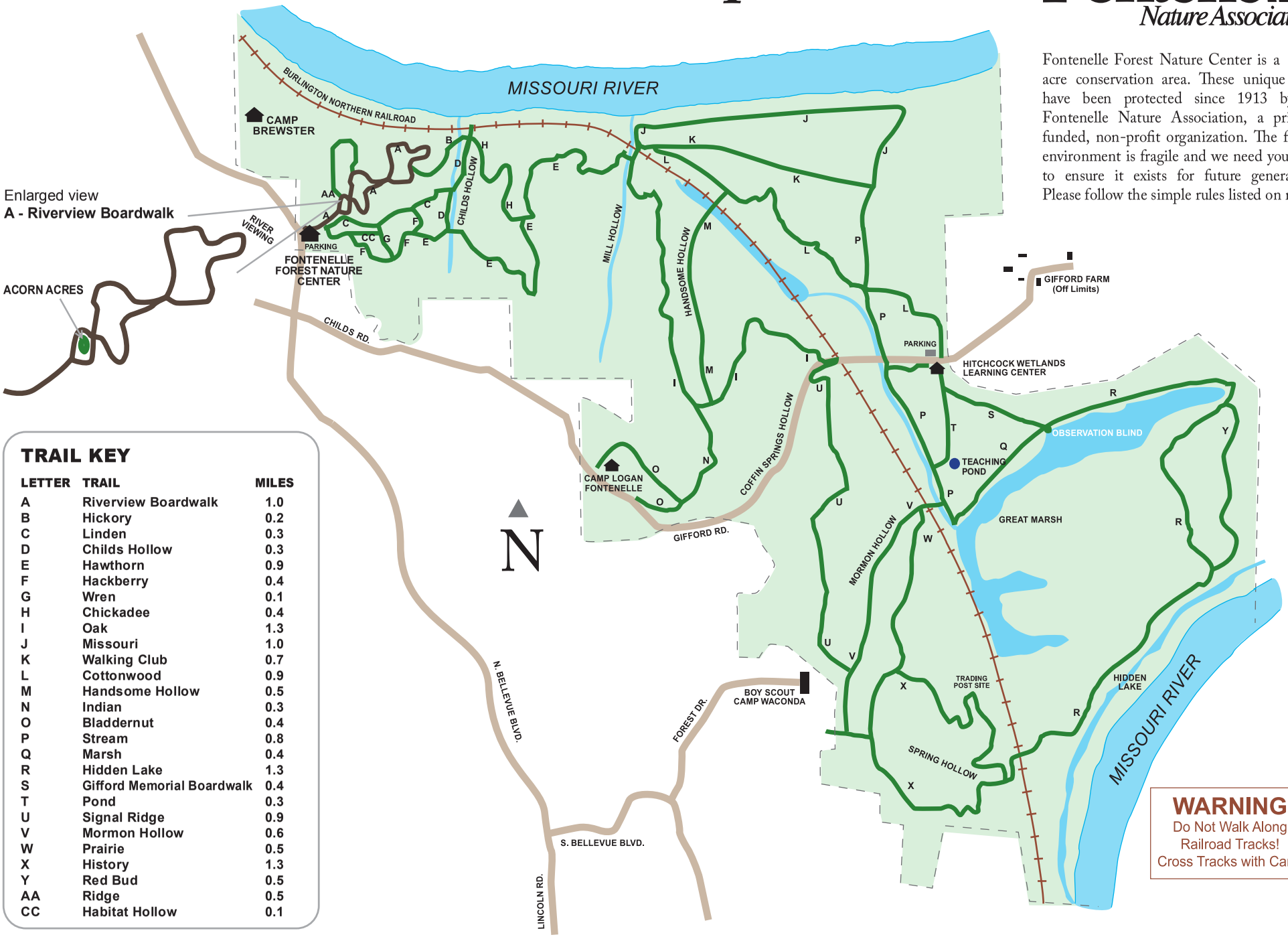
Fontenelle
Nature Association

1111 Bellevue Blvd. N., Bellevue, NE 68005
402.731.3140

Trail Map

Fontenelle Nature Association

Fontenelle Forest Nature Center is a 1,400 acre conservation area. These unique lands have been protected since 1913 by the Fontenelle Nature Association, a privately funded, non-profit organization. The forest's environment is fragile and we need your help to ensure it exists for future generations. Please follow the simple rules listed on reverse.



TRAIL KEY

LETTER	TRAIL	MILES
A	Riverview Boardwalk	1.0
B	Hickory	0.2
C	Linden	0.3
D	Childs Hollow	0.3
E	Hawthorn	0.9
F	Hackberry	0.4
G	Wren	0.1
H	Chickadee	0.4
I	Oak	1.3
J	Missouri	1.0
K	Walking Club	0.7
L	Cottonwood	0.9
M	Handsome Hollow	0.5
N	Indian	0.3
O	Bladdernut	0.4
P	Stream	0.8
Q	Marsh	0.4
R	Hidden Lake	1.3
S	Gifford Memorial Boardwalk	0.4
T	Pond	0.3
U	Signal Ridge	0.9
V	Mormon Hollow	0.6
W	Prairie	0.5
X	History	1.3
Y	Red Bud	0.5
AA	Ridge	0.5
CC	Habitat Hollow	0.1

WARNING
Do Not Walk Along Railroad Tracks!
Cross Tracks with Care!

Camp Wa-kon-da

Camp Wa-kon-da is in Bellevue, Nebraska and covers 40 acres of wooded bluffs, adjacent to Fontenelle Forest. The camp has 6 Adirondack style shelters. There are conveniently located latrines, with water, in addition to frost-free spigots that are running year-round. Our centerpiece, the Paxton Program Building, has a furnace, fireplace, kitchen, restroom and shower.

Wa-kon-da is the home of the Logan Fontenelle Trail, one of the BSA's historic trails. The Mid-America Council has an agreement with Fontenelle Forest that allows our campers access to 10 miles of trails, included in your camp reservation fee.

Wa-kon-da is home to Cub Scout day camps, Fun with Son camping, Troop and Pack outings and hosts many out-of-council units.

Wa-kon-da is a convenient place to stay while taking in the our local attractions.

Wa-kon-da is available year-round. For more information, see Camp Facilities Reservation Form.

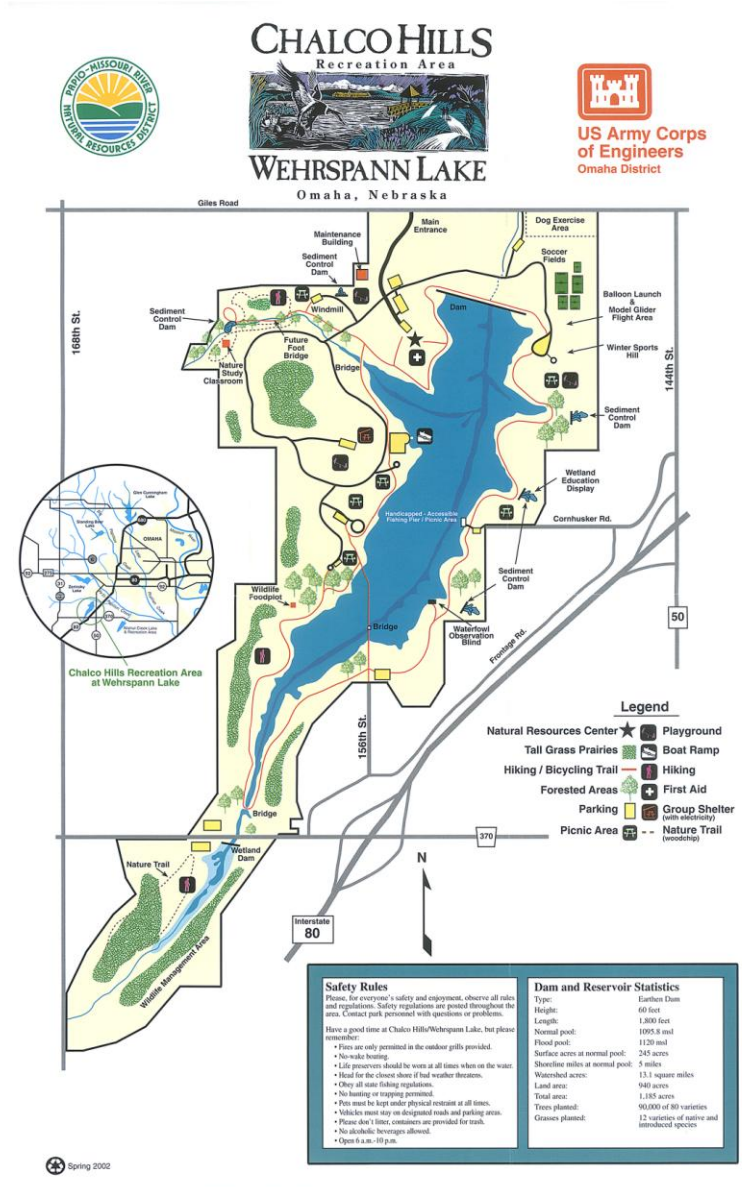
http://www.mac-bsa.org/camp_home.aspx

North Central Region Cooperative Soil Survey Tour

Site 3 – Chalco Hills Recreation Area

Chalco Hill Recreation Area

Chalco Hills Recreation Area is located in northwestern Sarpy County, Nebraska, and approximately 12 miles (19 km) west of downtown Omaha. Chalco Hills consists of 1,186 acres (4.80 km^2) of which 246 acres (1.00 km^2) is covered by Wehrspann Lake, an artificial reservoir. The recreation area was opened in 1988 as part of Papio-Missouri River Natural Resources District efforts to provide flood control and improve recreation opportunities. The Dam was built by the Corps of Engineers and the recreation area is managed by the Natural Resources District.[1]



Featured at this recreation area is the Natural Resources Center, the NRD's headquarters. Also located at the Recreation Area are two US Department of Agriculture Agencies: The Natural Resources Conservation Service and the Farm Services Agency, as well as a field office for the US Army Corps of Engineers, NE Department of Environmental Quality and the Civil Air Patrol. The District works closely with these agencies for effective management of natural resources, and are nationally known for this co-location of resource management offices convenient for all interested in our environment.

There are seven picnic areas and several have covered pavilions, the largest of which can accommodate up to 100 people. Seven miles (11 km) of walking trails encircle Wehrspann Lake. Soccer fields, baseball fields, and playgrounds adjacent to picnic areas are easily reached from nearby parking areas. The soccer fields are also used as launch sites for hot-air balloons and radio controlled airplanes. The area is used for cross-country running events during the fall, and cross-country skiing and ice fishing are popular in the winter. Fishing is more popular in the warmer seasons, and there is parking for 30 trailers. Motorized boats must comply with the no-wake regulation by maintaining speeds under 5 miles (8 km) per hour.

Glacial till derived soils in MLRA 107B

by: Patrick Cowsert, RSS, Stanton Nebraska

The landscape in MLRA 107B is dominated by a thick deposits of Wisconsin age loess which overlays pre-Illinoisan glacial till. The pre-Illinoisan glacial period was between 500,000 and 2.5 million years ago during the early to middle Pleistocene Era. The pre-Illinoisan period was once thought to consist of two distinct glacial events, however it has had 11 distinct glacial stages identified during that time. During the post glacial period, a till paleosol developed which was later exposed in some places. The landscape that developed in the glacial till dictated the larger 1st order stream valleys prior to, and after, loess deposition. As the loess landscape developed and the loess blanket was eroded and the secondary drainage systems developed, the glacial till was re-exposed. In some locations the till is exposed in isolated areas in the upland sideslopes and in others the drainageways are so entrenched and the degree of erosion on the side slopes is so great that little or no loess can be found over the till. The exposed till in some areas has been truncated and the paleo-surface eroded away.

The exposed till is characterized by generally little sorting with a variety of rock fragment sizes throughout the soil profile. Many hillsides of glacial derived soils are scattered with glacial erratics . The till is well drained, but relict redoximorphic concentrations and depletions from a previous climatic period are common with coarse to extremely coarse features visible. Manganese is associated with the iron in the concentrations. Calcium carbonate is common and ranges from free calcium carbonate to soft masses and nodules to concretions which can be quite large. Many stones have a rind of calcium carbonate on the lower side. Some pedogenic development has begun on these till exposures and soil structure and clay films are present in some soils.

Pre-Illinoian glacial till is calcareous and it has an average clay content of 24 to 35% clay and an average sand content of 20-40% with some pedons as high as 52%. The typical soil texture is clay loam or loam with loam, silt loam or silty clay loam at the surface. Rock fragments are generally less than 10% of mixed origin. Mean annual temperature ranges from 10 to 13 degrees C, and mean annual precipitation ranges from 71 to 86 centimeters with some areas as high as 94 centimeters. Average frost-free period ranges between 130 to 180 days with some areas 200 days.

The glacial derived soils of this area, in order from least to most developed are: Steinauer, Liston, Burchard, and Shelby. The Steinauer and Liston soils are usually found on more eroded landscape positions on steeper side slopes and exposed nose slopes (see figure 4). The slope range here is from 5 to 75% slope. Steinauer soils are an AC profile with non-pedogenic free calcium carbonate to the surface. Liston soils have a B horizon. Next are the Burchard and Shelby soils (see figure 2 and 4). The slope range is 2 to 40 % slope. Burchard soils have a mollic epipedon and are leached of carbonates in the upper part. Shelby soils have a thicker mollic epipedon and are leached to a greater depth.

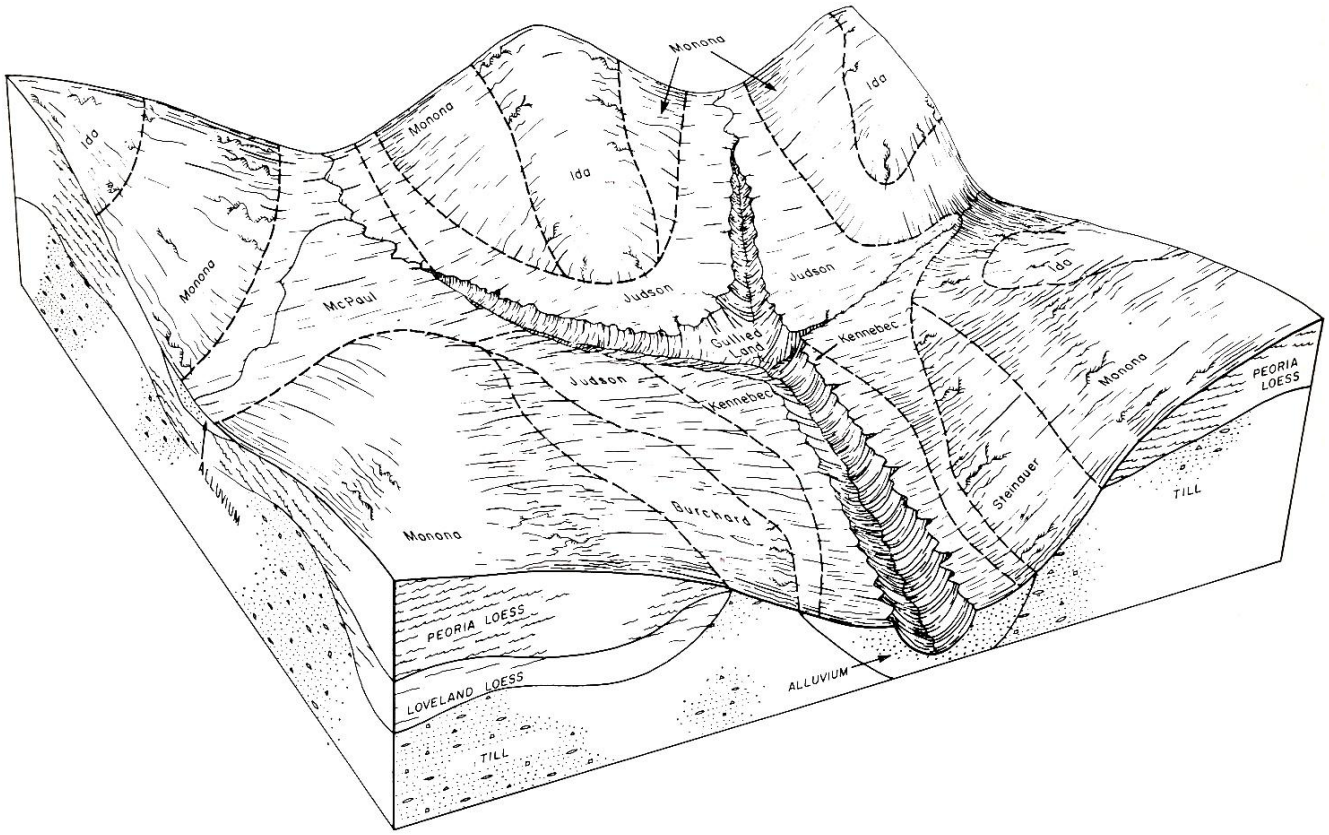


Figure 4.—**Soils of the Monona-Ida association.**

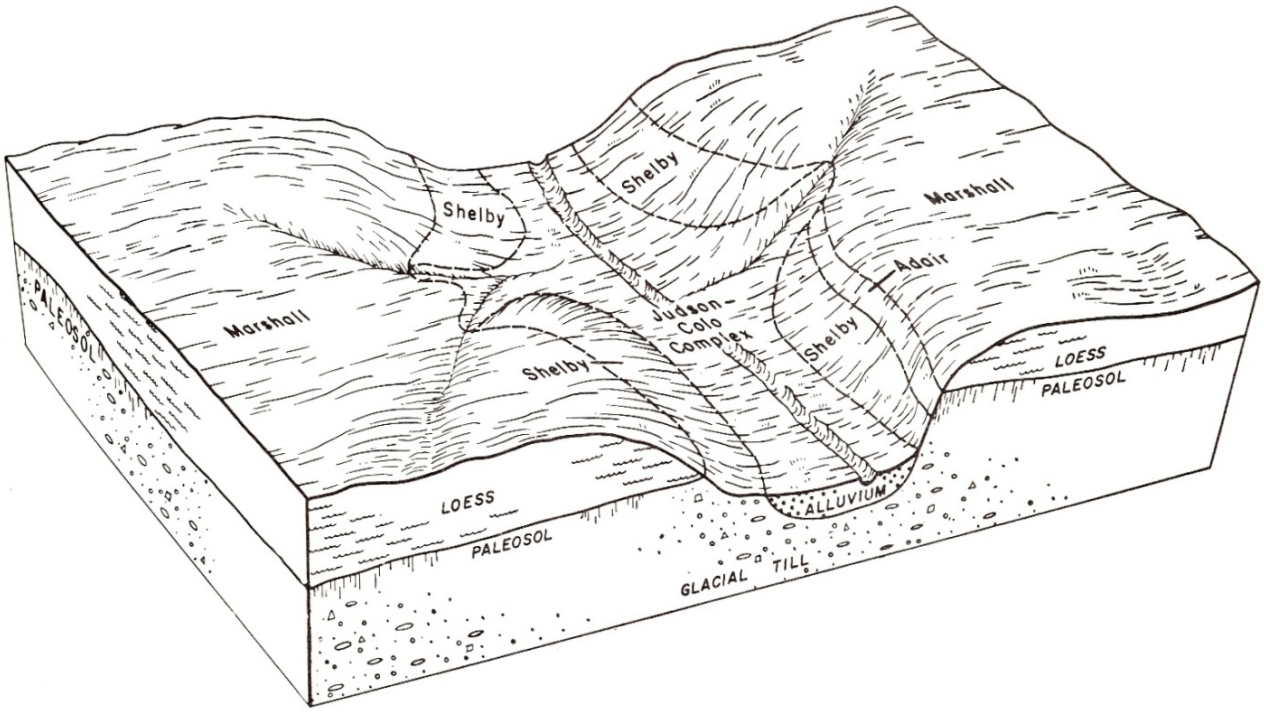


Figure 2.—Relationship of the soils in association 2 to the landscape and to the parent material.

Steinauer Fine-loamy, mixed, superactive, calcareous, mesic Typic Udorthents

RANGE IN CHARACTERISTICS:
Horizonation:
A: 10-18 cm thick
AC: 0-36 cm thick
C
Depth to secondary calcium carbonate: 0 to 25 centimeters (0 to 10 inches)

158,813 total acres in MLRA 102C, 106, and 107B

Liston Fine-loamy, mixed, superactive, mesic Typic Eutrudepts

RANGE IN CHARACTERISTICS:
Horizonation:
A: 10 -18 cm thick
Bw: 0-41cm thick
Bk: 20-97cm thick
C
Depth to carbonates--0 to 25 centimeters (0 to 10 inches)

6,115 total acres in MLRA 107B

Burchard Fine-loamy, mixed, superactive, mesic Typic Argiudolls

RANGE IN CHARACTERISTICS:
Horizonation:
A: 20 -46 cm thick
Bt: 10-61 cm thick
Btk: 25-76cm thick
Bk: 0-38cm thick
C
Thickness of the mollic epipedon--20 to 46 centimeters
Depth to argillic horizon--20 to 46 centimeters
Depth to carbonates--30 to 76 centimeters
Depth to redox concentrations (if they occur)--56 to 203 centimeters

211,592 total acres in MLRA 106 and 107B

Shelby Fine-loamy, mixed, superactive, mesic Typic Argiudolls

RANGE IN CHARACTERISTICS:
Horizonation:
A: 15 -25 cm thick
AB: 10-20cm thick
Bt: 50-145cm thick
Btk: 0-38cm thick
C
Thickness of the mollic epipedon--25 to 50 centimeters
Depth to argillic horizon--25 to 50 centimeters
Depth to carbonates--greater than 75 centimeters

1,266,023 total acres in MLRA 106, 107B, 108, 109

Loess Derived Soils at Chalco Hills Recreation Area

(provided by Dan Shurtliff)

Ida Fine-silty, mixed, superactive, calcareous, mesic Typic Udorthents

RANGE IN CHARACTERISTICS:
Horizonation:
A: 8-23 cm thick
AC: 0-15 cm thick
C
Depth to secondary calcium carbonate: 0 centimeters (carbonates at the surface)

679,142 total acres in MLRA 102C, 106, and 107B

Contrary Fine-silty, mixed, superactive, mesic Dystric Eutrudepts

RANGE IN CHARACTERISTICS:
Horizonation:
A: 10-23 cm thick
Bw: 51 –122 cm thick
BC: 0-25 cm thick
C
Depth to carbonates—Greater than 102 cm

103,902 total acres in MLRA 107B

Monona Fine-silty, mixed, superactive, mesic Typic Hapludolls

RANGE IN CHARACTERISTICS:
Horizonation:
A: 25-61 cm thick
Bw: 30-114 cm thick
C
Thickness of the mollic epipedon--25 to 61 centimeters
Depth to carbonates—Greater than 61 centimeters (typically absent)

873,344 total acres in MLRA 102C, 106 and 107B

Marshall Fine-silty, mixed, superactive, mesic Typic Hapludolls

RANGE IN CHARACTERISTICS:
Horizonation:
A: 25-60 cm thick
Bw: 50-125 cm thick
Bg: 0-30 cm thick
Cg
Thickness of the mollic epipedon--25 to 61 centimeters
Depth to Redoximorphic features – Greater than 75 centimeters
Depth to carbonates—Greater than 183 centimeters (typically absent)

1,410,276 total acres in MLRA 102C,106, 107B, 108, 109

*Judson Fine-silty, mixed, superactive, mesic Cumulic Hapludolls

RANGE IN CHARACTERISTICS:

Horizonation:

A: 50 -75 cm thick
AB: 10-25 cm thick
Bt or Bw: 15-100 cm thick
BC: 15-50 cm thick
C

Thickness of the mollic epipedon—80 to 150 centimeters
Depth to carbonates--greater than 150 centimeters
Note: If Bt horizon present, increase in clay content is too little to qualify as an argillic horizon
*Sampled for IUSS Tour

888,295 total acres in MLRA 102C,106, 107B, 108, 109

Map Scale: 1:3,390 if printed on A size (8.5" x 11") sheet.

N

Meters
0 45 90 180 270

Feet
0 150 300 600 900

Map Unit Legend

Sarpy County, Nebraska (NE153)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
7210	Burchard-Contrary-Steinauer complex, 7 to 16 percent slopes	5.6	10.3%
7234	Judson silty clay loam, 2 to 6 percent slopes	9.3	17.2%
8153	Contrary-Marshall silty clay loams, 6 to 11 percent slopes	9.3	17.2%
8157	Contrary-Monona-Ida complex, 6 to 17 percent slopes	11.6	21.4%
9711	Urban land-Udarents complex, 0 to 16 percent slopes	0.8	1.4%
9986	Miscellaneous water, sewage lagoon	7.5	13.9%
9999	Water	10.1	18.6%
Totals for Area of Interest		**54.2**	**100.0%**

The Judson series formed in silty colluvium derived from non-calcareous loess on foot slopes, upland drainageways, and alluvial fans. Slope ranges from 0 to 12 percent and most areas are cultivated producing crops such as corn, small grain, and alfalfa. Areas of native vegetation consisting of big bluestem, little bluestem, Indiangrass, switchgrass, as well as other grasses of the tall grass prairie remain in isolated locations.

PEDON DESCRIPTION

Print Date: 03/29/2012
Description Date: 10/12/2011
Describer: S. McVey, P. Cowsert, V. Jaehrling, E. Benham, D. Shurtliff
Site ID: S11NE153003
Site Note:
Pedon ID: S11NE153003
Pedon Note:
Lab Source ID: SSL
Lab Pedon #: 12N0011
Soil Name as Described/Sampled: Judson
Soil Name as Correlated:
Classification: Fine-silty, mixed, superactive, mesic Cumulic Hapludolls
Pedon Type:
Pedon Purpose:
Taxon Kind:
Associated Soils:
Physiographic Division: Interior Plains
Physiographic Province: Central Lowland Province
Physiographic Section: Dissected till plains
State Physiographic Area:
Local Physiographic Area:
Geomorphic Setting: on footslope of base slope of upland
Upslope Shape: linear
Cross Slope Shape: concave
Particle Size Control Section: 25 to 100 cm.
Description origin: NASIS
Diagnostic Features: mollic epipedon 0 to 95 cm.
cambic horizon 95 to 170 cm.

Country: USA
State: Nebraska
County: Sarpy
MLRA: 107B -- Iowa and Missouri Deep Loess Hills
Soil Survey Area: NE153 – Sarpy County, Nebraska
Map Unit: 7234—Judson silty clay loam, 2 to 6 percent slopes
Quad Name:
Legal Description: SW 1/4 of NW 1/4 of Section 26, Township 14N , Range 11E
Latitude: 41 degrees 9 minutes 17.60 seconds north
Longitude: 96 degrees 9 minutes 22.60 seconds west
Datum:
UTM Zone:
UTM Easting:
UTM Northing:
Primary Earth Cover: Grass/herbaceous cover
Secondary Earth Cover: Grassland rangeland
Existing Vegetation: goldenrod, Indiangrass, Kentucky bluegrass, little bluestem, Maximilian sunflower, smooth brome
Parent Material: slope alluvium
Bedrock Kind:
Bedrock Depth:
Bedrock Hardness:
Bedrock Fracture Interval:
Surface Fragments:
Description database: NSSL

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Upslope Length (meters)
4.0		0						well		

Judson silty clay loam at Chalco Hills Recreation Area

Profile Description:

Ap--0 to 14 centimeters; black (10YR 2/1) silty clay loam; 28 percent clay; moderate fine granular parts to weak fine subangular blocky structure; friable, slightly hard, slightly sticky, slightly plastic; very fine and fine roots throughout; very fine and fine interstitial pores; filled worm burrows; clear smooth boundary.

A1--14 to 36 centimeters; black (10YR 2/1) exterior and very dark brown (10YR 2/2) interior silty clay loam; 30 percent clay; moderate thin platy parts to moderate fine subangular blocky structure; friable, slightly hard, moderately sticky, moderately plastic; very fine and fine roots throughout and medium roots throughout; very fine and fine tubular pores; abrupt smooth boundary.

A2--36 to 56 centimeters; black (10YR 2/1) exterior and very dark brown (10YR 2/2) interior silty clay loam; 30 percent clay; moderate medium subangular blocky structure; friable, slightly hard, moderately sticky, moderately plastic; fine roots throughout and very fine roots throughout; fine tubular pores; gradual wavy boundary.

AB--56 to 95 centimeters; very dark brown (10YR 2/2) exterior and very dark grayish brown (10YR 3/2) interior silty clay loam; 32 percent clay; moderate medium subangular blocky structure; friable, slightly hard, moderately sticky, moderately plastic; very fine roots throughout; fine tubular pores; clear smooth boundary.

Bw1--95 to 119 centimeters; very dark grayish brown (10YR 3/2) exterior and dark grayish brown (10YR 4/2) interior silty clay loam; 32 percent clay; moderate fine subangular blocky structure; friable, slightly hard, moderately sticky, moderately plastic; very fine roots throughout; very fine tubular pores; 6 percent prominent clay films on vertical faces of peds; clear smooth boundary.

Bw2--119 to 170 centimeters; dark grayish brown (10YR 4/2) exterior and brown (10YR 4/3) interior silty clay loam; 30 percent clay; moderate medium subangular blocky structure; firm, moderately hard, moderately sticky, moderately plastic; very fine roots throughout; very fine tubular pores; 30 percent distinct very dark grayish brown (10YR 3/2) organic stains on vertical faces of peds.

Seq. #	Horizon depth (cm)	Horizon designation		Diagnostic horizon		Diagnostic characteristics or properties		Diagnostic materials	
		Tour Book	Tour	Soil Taxonomy	World Reference Base	Diagnostic characteristics of Soil Taxonomy	Diagnostic properties of World Reference Base	Soil Taxonomy	World Reference Base
1	0 14	Ap	~	mollic epipedon	mollic horizon			mineral soil material	mineral material
2	14 36	A1	~	mollic epipedon	mollic horizon	lithologic discontinuity at 36 cm	lithological discontinuity at 36 cm	mineral soil material	mineral material
3	36 56	A2	~	mollic epipedon	mollic horizon			mineral soil material	mineral material
4	56 95	AB	~	mollic epipedon	mollic horizon			mineral soil material	mineral material
5	95 119	Bw1	~	cambic horizon	cambic horizon			mineral soil material	mineral material
6	119 170	Bw2	~	cambic horizon	cambic horizon			mineral soil material	mineral material

Taxonomic Classifications of Judson (12N0011)

Soil Taxonomy Fine-silty, mixed, superactive, mesic Cumulic Hapludolls

WRB Haplic Phaeozems (Pachic, Siltic)

1.) Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436

Soil Survey Staff. 2010. Keys to Soil Taxonomy, 11th ed. USDA-Natural Resources Conservation Service, Washington, DC.

IUSS Working Group WRB. 2007. World Reference Base for Soil Resources 2006, first update 2007. World Soil Resources Reports No.103. FAO, Rome.

*** Primary Characterization Data ***

Pedon ID: S11NE153003 (Sarpy, Nebraska) Print Date: May 18 2012 3:30PM
Sampled as on Oct 12, 2011: Judson ; Fine-silty, mixed, superactive, mesic Cumulic Hapludoll
Revised to :

SSL - Project C2012USNE004 IUSS Tour
- Site ID S11NE153003 Lat: 41° 9' 17.60" north Long: 96° 9' 22.60" west NAD83 MLRA: 107B
- Pedon No. 12N0011
- General Methods 1B1A, 2A1, 2B

United States Department of Agriculture
Natural Resources Conservation Service
National Soil Survey Center
Soil Survey Laboratory
Lincoln, Nebraska 68508-3866

Layer	Horizon	Orig Hzn	Depth (cm)	Field Label 1	Field Label 2	Field Label 3	Field Texture	Lab Texture
12N00039	Ap		0.0-14.0	S11NE153003-1			SICL	SIL
12N00040	A2		14.0-36.0	S11NE153003-2			SICL	SIL
12N00041	A3		36.0-56.0	S11NE153003-3			SICL	SICL
12N00042	AB		56.0-95.0	S11NE153003-4			SICL	SICL
12N00043	Bw1		95.0-119.0	S11NE153003-5			SICL	SICL
12N00044	Bw2		119.0-170.0	S11NE153003-6			SICL	SICL

Pedon Calculations

Calculation Name	Result	Units of Measure
Weighted Particles, 0.1-75mm, 75 mm Base	1.67	% wt
Volume, >2mm, Weighted Average	0.009	% vol
Clay, total, Weighted Average	28.349	% wt
Clay, carbonate free, Weighted Average	28.349	% wt
CEC Activity, CEC7/Clay, Weighted Average, CECd, Set 4	0.677	(NA)
LE, Whole Soil, Summed to 1m	3.8	cm/m

Weighted averages based on control section: 25-100 cm

PSDA & Rock Fragments

Layer	Depth (cm)	Horz	Prep	-1- Clay < .002	-2- Total Silt .002-.05	-3- Total Sand .05-2	-4- Clay Fine < .0002	-5- Clay CO_3 < .002	-6- Silt Fine .002-.02	-7- Silt Coarse .02-.05	-8- Sand VF .05-.10	-9- Sand F .10-.25	-10- Sand M .25-.50	-11- Sand C .5-1	-12- Sand VC 1-2	-13- Rock Fragments (mm) Weight 2-5	-14- 5-20	-15- 20-75	-16- .1-75	-17- >2 mm wt % whole soil
				% of <2mm Mineral Soil												% of <75mm				
				3A1a1a			3A1a1a		3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
12N00039	0-14	Ap	S	21.6	56.2	22.2	15.7		19.3	36.9	7.3	6.5	6.2	1.9	0.3	--	--	--	15	--
12N00040	14-36	A2	S	24.6	57.7	17.7	17.1		21.1	36.6	7.4	6.3	2.5	1.3	0.2	tr	--	--	10	tr
12N00041	36-56	A3	S	28.7	66.5	4.8	20.1		24.7	41.8	4.5	0.2	0.1	tr	--	--	--	--	tr	--
12N00042	56-95	AB	S	29.0	65.7	5.3	19.3		25.6	40.1	5.2	0.1	tr	--	--	--	--	--	tr	--
12N00043	95-119	Bw1	S	29.9	64.5	5.6	18.5		25.9	38.6	5.2	0.2	0.1	0.1	--	--	--	--	tr	--
12N00044	119-170	Bw2	S	30.3	62.5	7.2	17.2		25.6	36.9	6.6	0.5	0.1	tr	tr	--	--	--	1	--

Bulk Density & Moisture

Layer	Depth (cm)	Horz	Prep	-1- (Bulk Density) 33 kPa Oven Dry	-2-	-3- Cole Whole Soil	-4- Water Content 6 kPa	-5- 10 kPa	-6- 33 kPa	-7- 1500 kPa	-8- 1500 kPa Moist	-9- Ratio AD/OD	-10- WRD Whole Soil	-11- Aggst Stabl 2-0.5mm	-12- Ratio/Clay CEC7	-13- Ratio/Clay 1500 kPa
				g cm^{-3}			pct of < 2mm						cm^3 cm^{-3}	%		
				DbWR1	DbWR1				DbWR1	3C2a1a		3D1				
12N00039	0-14	Ap	S	1.47	1.63	0.035			21.9	11.5		1.017	0.15		0.81	0.53
12N00040	14-36	A2	S	1.53	1.65	0.025			20.6	11.5		1.019	0.14		0.71	0.47
12N00041	36-56	A3	S	1.35	1.48	0.031			26.3	13.0		1.022	0.18		0.69	0.45
12N00042	56-95	AB	S	1.35	1.56	0.049			28.0	13.0		1.023	0.20		0.66	0.45
12N00043	95-119	Bw1	S	1.37	1.54	0.040			23.4	14.2		1.025	0.13		0.69	0.47
12N00044	119-170	Bw2	S	1.46	1.63	0.037			22.3	13.8		1.027	0.12		0.71	0.46

Water Content

Layer	Depth (cm)	Horz	Prep	-1- Atterberg Limits LL	-2- Atterberg Limits PI	-3- Bulk Density Field	-4- Bulk Density Recon 33 kPa	-5- Bulk Density Recon Oven Dry	-6- Bulk Density Field	-7- Water Content Recon 33 kPa	-8- Sieved Samples 6 kPa	-9- Sieved Samples 10 kPa	-10- Sieved Samples 33 kPa	-11- Sieved Samples 100 kPa	-12- Sieved Samples 200 kPa	-13- Sieved Samples 500 kPa
				pct <0.4mm		g cm^{-3}				% of < 2mm						
															3C1e1a	
12N00039	0-14	Ap	S												17.5	
12N00040	14-36	A2	S												16.6	
12N00041	36-56	A3	S												19.4	
12N00042	56-95	AB	S												19.6	
12N00043	95-119	Bw1	S												22.8	
12N00044	119-170	Bw2	S												21.4	

*** Primary Characterization Data ***

Pedon ID: S11NE153003 (Sarpy County, Nebraska) Print Date: May 18 2012 3:30PM

Sampled As : Judson Fine-silty, mixed, superactive, mesic Cumulic Hapludoll

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 12N0011

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1- C	-2- N	-3- S	-4- OC	-5- OC (WB)	-6- C/N Ratio	-7- Fe	-8- Al	-9- Mn	-10- Al+½FeO	-11- DOEFe	-12- Al	-13- Si	-14- Mn	-15- C	-16- Fe	-17- Al	-18- Mn
				(- - -- - Total - - - -)				Est		(- - Dith-Cit Ext - -)			(-- - Ammonium Oxalate Extraction -- - -)					(- Na Pyro-Phosphate -)			
				(- - - - - - - -of <2 mm- - - - - - -)						(- - - - - - - - - - - - - - - - % of < 2mm - - - - - - - - - - -)							mg kg^{-1}	(- -- - - % of < 2mm - - -)			
				4H2a	4H2a	4H2a				4G1	4G1	4G1		4G2a	4G2a	4G2a	4G2a	4G2a		4G3	4G3	4G3
12N00039	0-14	Ap	S	1.69	0.19	0.01	1.7		9	0.6	0.1	0.1	0.19	0.06	0.15	0.11	0.03	594.7		0.4	0.6	0.01
12N00040	14-36	A2	S	1.29	0.13	--	1.3		10	0.7	0.1	0.1	0.20	0.06	0.14	0.13	0.02	595.4		0.5	0.8	tr
12N00041	36-56	A3	S	1.39	0.15	--	1.4		9	0.7	0.1	0.1	0.24	0.05	0.17	0.16	0.03	483.7		0.5	0.8	--
12N00042	56-95	AB	S	0.89	0.09	--	0.9		10	0.8	0.1	0.1	0.24	0.05	0.18	0.15	0.03	539.1		0.5	0.8	--
12N00043	95-119	Bw1	S	0.46	0.09	--	0.5		5	0.9	0.1	0.1	0.25	0.04	0.23	0.13	0.04	688.0		0.6	0.9	--
12N00044	119-170	Bw2	S	0.30	0.11	--	0.3		3	0.9	0.1	0.1	0.23	0.03	0.25	0.11	0.05	781.3		0.6	0.8	--

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- Sum Bases	-6- Acid-ity	-7- Extr Al	-8- KCl Mn	-9- CEC8 Sum Cats	-10- CEC7 NH_4 OAC	-11- ECEC Bases +Al	-12- Al Sat	-13- (- Saturation -) Sum	-14- NH_4OAC
				(- - - - - NH_4OAC Extractable Bases - - - -)												(- - - Base - - - -)	
				(- - - - - - - - - - - - - - - - cmol(+) kg^{-1} - - - - - - - - - - - - - - - - -)							mg kg^{-1}	(- - - - cmol(+) kg^{-1} - - -)					
				4B1a1a	4B1a1a	4B1a1a	4B1a1a		4B2b1a1				4B1a1a				
12N00039	0-14	Ap	S	12.4	2.6	--	1.5	16.5	15.9			32.4	17.4			51	95
12N00040	14-36	A2	S	11.3	2.6	--	1.1	15.0	9.6			24.6	17.5			61	86
12N00041	36-56	A3	S	13.4	4.2	--	0.7	18.3	8.1			26.4	19.7			69	93
12N00042	56-95	AB	S	13.2	5.1	--	0.7	19.0	6.4			25.4	19.2			75	99
12N00043	95-119	Bw1	S	14.0*	6.1	--	0.9	21.0	5.9			26.9	20.6			78	100
12N00044	119-170	Bw2	S	14.6*	6.7	--	0.9	22.2	4.2			26.4	21.6			84	100

*Extractable Ca may contain Ca from calcium carbonate or gypsum. CEC7 base saturation set to 100.

Salt

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- CO_3	-6- HCO_3F	-7- Cl	-8- PO_4	-9- Br	-10- OAC	-11- SO_4	-12- NO_2	-13- NO_3	-14- H_2O	-15- Total Salts	-16- Elec Cond	-17- Pred Elec Cond	-18- Exch Na	-19- SAR
				(- - - - - - - - - - - - - - - - Water Extracted From Saturated Paste - - - - - - - - - - - - - - - - - -)																		
				(- - - mmol(+) L^{-1} - - - -)				(- mmol(-) L^{-1} - - - - - - - - - - - - - - - - - -)								(- - - % - - -)	(- - dS m^{-1} - -)			
				4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2		4F2	4F1a1a1		
12N00039	0-14	Ap	S	2.2	0.6	0.1	0.9	--	1.7	0.2	0.6	--	tr	--	0.5	0.1	tr	64.2	0.36	0.15	--	
12N00040	14-36	A2	S	1.1	0.3	0.1	0.5	--	0.8	0.2	0.3	--	--	--	0.2	0.1	tr	62.3	0.17	0.07	--	
12N00041	36-56	A3	S	1.2	0.3	0.2	0.3	--	0.4	0.2	0.6	--	--	--	0.2	tr	tr	69.9	0.20	0.08	--	
12N00042	56-95	AB	S	0.8	0.2	0.1	0.3	--	0.4	0.1	0.3	--	--	--	0.2	tr	tr	67.7	0.13	0.05	--	
12N00043	95-119	Bw1	S	0.8	0.2	0.1	0.3	--	0.3	--	0.3	--	--	--	0.4	--	tr	62.0	0.15	0.07	--	
12N00044	119-170	Bw2	S	0.9	0.2	tr	0.3	--	0.2	--	0.2	--	tr	--	0.5	--	0.1	62.5	0.15	0.07	--	

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1- KCl	-2- $CaCl_2$ 0.01M 1:2	-3- H_2O 1:1	-4- Sat Paste	-5- Oxid	-6- NaF	-7- (- Carbonate - -) As $CaCO_3$ <2mm	-8- <20mm	-9- (- Gypsum - - -) As $CaSO_4$*$2H_2O$ <2mm	-10- <20mm	-11- Resist ohms cm^{-1}
				(- - - - - - - - - - - - - - - - - - pH - - - - - - - - - - - - - - - - -)						(- - - - - - - - - - - - %		- - - - - - - - - - - -)		
					4C1a2a	4C1a2a	4F2		4C1a1a1					
12N00039	0-14	Ap	S		5.7	6.3	6.0		8.6					
12N00040	14-36	A2	S		5.2	6.0	5.7		8.7					
12N00041	36-56	A3	S		5.3	6.1	5.7		8.8					
12N00042	56-95	AB	S		5.6	6.4	6.0		9.2					
12N00043	95-119	Bw1	S		5.9	6.7	6.2		9.5					
12N00044	119-170	Bw2	S		6.2	6.8	6.4		9.4					

*** Primary Characterization Data ***

Pedon ID: S11NE153003 (Sarpy County, Nebraska) Print Date: May 18 2012 3:30PM

Sampled As : Judson Fine-silty, mixed, superactive, mesic Cumulic Hapludoll

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 12N0011

Phosphorous				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
					(- - - - - - - - - - - - - - - - - Phosphorous - - - - - - - - - - - - - - - -)										
Layer	Depth (cm)	Horz	Prep	Melanic Index	NZ %	Acid Oxal (- mg kg^{-1}	Anion Exch Available	Resin Capacity	Bray 1	Bray 2	Olsen - - - - - - - - - - - - - - - -)	H_2O	Citric Acid	Mehlich III	KCl Extr NO_3
						4G2a			4D3					4D6b	
12N00039	0-14	Ap	S			155.4			8.1					20.1	
12N00040	14-36	A2	S			166.2			5.8					18.7	
12N00041	36-56	A3	S			166.1			6.0					15.5	
12N00042	56-95	AB	S			161.5			8.9					14.8	
12N00043	95-119	Bw1	S			259.0			24.2					29.9	
12N00044	119-170	Bw2	S			328.9			34.0					43.4	

Phosphorous				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
					(- - - - - - - - - - - - - - - - - Phosphorous - - - - - - - - - - - - - - - -)										
Layer	Depth (cm)	Horz	Prep	Melanic Index	NZ %	Acid Oxal (- mg kg^{-1}	Anion Exch Available	Resin Capacity	Bray 1	Bray 2	Olsen - - - - - - - - - - - - - - - -)	H_2O	Citric Acid	Mehlich III	KCl Extr NO_3
														4D6a1	
12N00039	0-14	Ap	S											6.4	
12N00040	14-36	A2	S											5.0	
12N00041	36-56	A3	S											4.3	
12N00042	56-95	AB	S											7.2	
12N00043	95-119	Bw1	S											22.7	
12N00044	119-170	Bw2	S											34.0	

Trace Elements Tier 1				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
Layer	Depth (cm)	Horz	Prep	Ag mg/kg 4H1a	As mg/kg 4H1a	Ba mg/kg 4H1a	Be mg/kg 4H1a	Cd mg/kg 4H1a	Co mg/kg 4H1a	Cr mg/kg 4H1a	Cu mg/kg 4H1a	Mn mg/kg 4H1a	Mo mg/kg 4H1a		Hg ug/kg 4H1a
12N00039	0-14	Ap	HM	0.09	8.36	243.18	0.92	0.60	8.75	27.89	16.06	716.75	1.21		37
12N00040	14-36	A2	HM	0.10	8.70	249.10	0.93	0.55	8.78	28.25	16.28	655.53	0.90		32
12N00041	36-56	A3	HM	0.11	9.69	293.53	1.12	0.48	9.92	32.33	18.70	567.13	0.94		28
12N00042	56-95	AB	HM	0.10	9.22	285.70	1.18	0.46	9.91	31.59	18.68	563.85	0.85		24
12N00043	95-119	Bw1	HM	0.12	11.67	297.94	1.16	0.46	12.11	29.16	20.67	743.72	0.87		33
12N00044	119-170	Bw2	HM	0.12	10.95	351.21	1.20	0.77	13.35	34.20	22.83	795.69	12.44		34

Trace Elements Tier 2				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-
Layer	Depth (cm)	Horz	Prep	Ni mg/kg 4H1a	P mg/kg 4H1a	Pb mg/kg 4H1a	Sb mg/kg 4H1a	Se ug/kg 4H1a	Sn mg/kg 4H1a	Sr mg/kg 4H1a	Tl mg/kg	V mg/kg 4H1a	W mg/kg 4H1a	Zn mg/kg 4H1a
12N00039	0-14	Ap	HM	23.24	388.08	14.33	0.47	566.21	0.89	34.46		60.20	0.04	63.81
12N00040	14-36	A2	HM	22.49	319.02	13.83	0.44	468.63	0.91	35.02		61.30	0.03	65.23
12N00041	36-56	A3	HM	23.89	409.74	13.85	0.43	486.87	1.04	42.75		67.70	0.03	74.50
12N00042	56-95	AB	HM	24.35	387.04	13.51	0.41	272.72	1.00	44.71		65.96	0.02	72.20
12N00043	95-119	Bw1	HM	28.66	496.15	14.92	0.07	248.18	0.49	46.54		64.09	0.03	70.93
12N00044	119-170	Bw2	HM	31.97	540.62	16.69	0.53	159.96	1.06	54.26		73.66	0.04	78.90

*** Primary Characterization Data ***

Pedon ID: S11NE153003 (Sarpy County, Nebraska) Print Date: May 18 2012 3:30PM

Sampled As : Judson Fine-silty, mixed, superactive, mesic Cumulic Hapludoll

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 12N0011

Major Elements

Layer	Depth (cm)	Horz	Prep	-1- Al mg/kg 4H1b	-2- Ca mg/kg 4H1b	-3- Fe mg/kg 4H1b	-4- K mg/kg 4H1b	-5- Mg mg/kg 4H1b	-6- Mn mg/kg 4H1b	-7- Na mg/kg 4H1b	-8- P mg/kg 4H1b	-9- Si mg/kg 4H1b	-10- Sr mg/kg 4H1b	-11- Ti mg/kg 4H1b	-12- Zr mg/kg 4H1b
12N00039	0-14	Ap	HM	52708	6765	19920	19507	4356	851	9564	596	337242	156	3559	181
12N00040	14-36	A2	HM	56222	6478	21512	20122	4827	858	9507	606	331987	157	3658	183
12N00041	36-56	A3	HM	59382	5921	22328	19529	5181	660	9026	604	299741	142	3644	183
12N00042	56-95	AB	HM	61419	6355	24292	21045	5956	725	9365	650	314253	154	3772	169
12N00043	95-119	Bw1	HM	64548	7272	26806	21420	6918	971	9295	765	311620	165	3798	169
12N00044	119-170	Bw2	HM	66915	8250	28382	22359	7601	970	9649	911	320767	180	3944	177

Mehlich3 Elements

Layer	Depth (cm)	Horz.	Prep.	-1- Al	-2- As	-3- Ba	-4- Ca	-5- Cd	-6- Co	-7- Cr	-8- Cu	-9- Fe	-10- K	-11- Mg	-12- Mn	-13- Mo	-14- Na	-15- Ni	-16- P	-17- Pb	-18- Se	-19- Si	-20- Sr	-21- Zn
				(mg/kg)																				
				4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b		4D6b	4D6b	4D6b
12N00039	0-14	Ap	S	821.6	2.2	84.3	2149.6	0.2	0.9	0.1	2.3	175.4	516.3	310.3	116.3	0.4	14.8	2.1	20.1	2.9		450.2	14.7	2.7
12N00040	14-36	A2	S	996.0	2.4	90.0	2050.0	0.2	0.6	0.1	2.1	156.7	369.3	320.3	78.4	0.4	20.3	2.1	18.7	2.0		397.1	16.1	1.8
12N00041	36-56	A3	S	1050.8	1.1	102.7	2416.0	0.2	0.4	tr	2.3	117.1	257.1	425.7	38.1	0.2	40.4	2.3	15.5	2.0		385.9	20.6	1.4
12N00042	56-95	AB	S	1046.1	0.9	106.4	2456.3	0.2	0.3	0.1	2.5	85.4	258.1	526.2	26.0	0.4	38.1	1.6	14.8	1.6		428.1	23.0	1.2
12N00043	95-119	Bw1	S	977.6	1.5	93.2	2649.5	0.2	1.0	0.1	3.0	152.1	311.0	626.8	93.1	0.5	33.4	2.0	29.9	1.6		537.9	24.5	1.5
12N00044	119-170	Bw2	S	800.7	2.8	91.5	2988.4	0.2	1.5	0.1	3.2	136.1	313.0	695.6	132.8	0.4	31.4	2.5	43.4	2.4		549.6	25.9	1.6

Clay Mineralogy

Layer	Depth (cm)	Horz	Fraction	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
				X-Ray						Thermal			Elemental							EGME	Interpretation
													SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	Retn	
				7A1b1							7A4a										
				(peak size)							(%)					(%)				($mg\ g^{-1}$)	
12N00043	95-119	Bw1	tcly	MT 4	MI 3	KK 2					KK 32										SMEC
12N00044	119-170	Bw2	tcly	MT 4	MI 3	KK 2					KK 30										SMEC

FRACTION INTERPRETATION:

tcly - Total Clay,

MINERAL INTERPRETATION:

KK - Kaolinite MI - Mica MT - Montmorillonite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

LOCATION JUDSON IA+KS MN MO NE WI
Established Series
Rev. JCR-RAL-TWN
10/2008

JUDSON SERIES

The Judson series consists of very deep, well drained soils formed in silty colluvium derived from non-calcareous loess. These soils are on foot slopes, upland drainageways, and alluvial fans. Slope ranges from 0 to 12 percent. Mean annual air temperature is about 10 degrees C. Mean annual precipitation is about 810 millimeters.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Cumulic Hapludolls

TYPICAL PEDON: Judson silty clay loam, on a south-facing slope of 4 percent, in a cultivated field. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 23 centimeters; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry, very dark grayish brown (10YR 3/2) kneaded; weak medium granular structure, friable; slightly acid; abrupt smooth boundary.

A1--23 to 38 centimeters; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak fine granular and weak very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

A2--38 to 56 centimeters; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry, very dark grayish brown (10YR 3/2) kneaded; weak very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary. (Combined thickness of the A horizon is 50 to 75 centimeters.)

AB--56 to 71 centimeters; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry, dark brown (10YR 3/3) kneaded; moderate fine subangular blocky structure; friable; many tubular pores; moderately acid; gradual smooth boundary. (10 to 25 centimeters thick)

Bt--71 to 89 centimeters; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry, dark brown (10YR 3/3) kneaded; moderate medium subangular blocky structure; friable; many tubular pores; common very dark grayish brown (10YR 3/2) organoargillans on faces of peds; very few clay films; slightly acid; gradual smooth boundary. (15 to 100 centimeters thick)

BC--89 to 132 centimeters; brown (10YR 4/3) silty clay loam; yellowish brown (10YR 5/4) kneaded; weak coarse subangular blocky structure; friable; many tubular pores; few very dark gray (10YR 3/1) stains on root channels; few fine faint grayish brown (10YR 5/2) redoximorphic

depletions; few fine distinct yellowish brown (10YR 5/6) redoximorphic concentrations; slightly acid; gradual smooth boundary. (15 to 50 centimeters thick)

C--132 to 152 centimeters; brown (10YR 4/3) silty clay loam; massive; friable; few fine dark oxides; few fine faint grayish brown (10YR 5/2) redoximorphic depletions; common fine distinct yellowish brown (10YR 5/6) redoximorphic concentrations; slightly acid.

TYPE LOCATION: Major Land Resource Area (MLRA) 108D-Illinois and Iowa Deep Loess and Drift, Western Part, Madison County, Iowa subset; about 7 miles north and 3 miles east of Winterset; located about 2,000 feet south and 300 feet west of the northeast corner of section 33, T. 77 N., R. 27 W.; USGS Saint Charles NW topographic quadrangle; lat. 41 degrees 25 minutes 34 seconds N. and long. 93 degrees 57 minutes 22 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:
Thickness of the mollic epipedon--80 to 150 centimeters
Depth to carbonates--more than 150 centimeters
Clay content in the particle-size control section (weighted average)--30 to 35 percent
Sand content in the particle-size control section (weighted average)--1 to 10 percent fine sand and sand coarser than fine sand

Ap or A horizon:
Hue--10YR
Value--2 or 3
Chroma--1 or 2
Texture--silty clay loam or silt loam
Clay content--24 to 32 percent
Sand content--1 to 10 percent
Reaction--very strongly acid to neutral

AB horizon:
Hue--10YR
Value--2 or 3
Chroma--2
Texture--silty clay loam
Clay content--27 to 32 percent
Sand content--1 to 10 percent
Reaction--moderately acid to neutral

Bt or Bw horizon:
Hue--10YR
Value--3 to 5
Chroma--3 to 5
Texture--silty clay loam
Clay content--30 to 35 percent
Sand content--1 to 10 percent
Reaction--moderately acid to neutral

Common dark-colored coats on faces of peds

Some pedons have redoximorphic features of low or high chroma within a depth of 75 centimeters

BC horizon:
Hue--10YR
Value--3 to 5
Chroma--3 or 4
Texture--silty clay loam or silt loam
Clay content--25 to 32 percent
Sand content--1 to 10 percent
Reaction--slightly acid to slightly alkaline

Some pedons have common redoximorphic features with chroma range of 1 to 6

C horizon:
Hue--10YR
Value--3 to 5
Chroma--3 or 4
Texture--silty clay loam or silt loam
Clay content--25 to 32 percent
Sand content--1 to 10 percent
Reaction--slightly acid to slightly alkaline

Some pedons have common redoximorphic features with chroma range of 1 to 6

COMPETING SERIES: These are the Allison, Anthon, Huntsville, Ivan, Kahola, Kennebec, Kenridge, Lindstrom, Napier, Rossville, Sturkie, and Worthen series.
Allison--have strata with a sand content of more than 10 percent below a depth of 75 centimeters
Anthon--have a sand content of more than 35 percent within a depth of 150 centimeters
Huntsville--have a clay content that averages 18 to 27 percent in the particle-size control section
Ivan--have carbonates within a depth of 25 centimeters
Kahola--have carbonates within a depth of 100 centimeters
Kennebec--have a clay content that averages 18 to 30 percent in the particle-size control section and have a matrix chroma of 1 or 2 in the throughout the series control section
Kenridge--have a matrix chroma of 2 immediately below the mollic epipedon
Lindstrom--have a clay content that averages 18 to 24 percent in the particle-size control section
Napier--have a clay content that averages 20 to 27 percent in the particle-size control section
Rossville--are in areas with a mean annual air temperature ranges from 11 to 13 degrees C and have a clay content of 12 to 26 percent in the lower third of the series control section
Sturkie--have a clay content that averages less than 30 percent in the particle-size control section
Worthen--have a clay content that averages 15 to 26 percent in the particle-size control section

GEOGRAPHIC SETTING:
Parent material--silty colluvium derived from non-calcareous loess

Landform--foot slopes, upland drainageways, and alluvial fans
Slope--0 to 12 percent
Elevation--155 to 610 meters above sea level
Mean annual air temperature--6 to 13 degrees C
Mean annual precipitation--585 to 1,040 millimeters
Frost-free period--155 to 220 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Marshall, Otley, Sharpsburg, and Tama soils.
Marshall--are on higher landscape positions and have mollic epipedons that are 25 to 60 centimeters thick
Otley--are on higher landscape positions and have a clay content that averages 36 to 42 percent in the particle-size control section
Sharpsburg--are on higher landscape positions and have a clay content that averages 36 to 42 percent in the particle-size control section
Tama--are on higher landscape positions and have mollic epipedons that are 25 to 50 centimeters thick

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Drainage class--well drained--a frequently saturated zone does not occur within a depth of 1.8 meters during the wettest periods of years when precipitation is within one standard deviation of the 30 year mean of annual precipitation
Saturated hydraulic conductivity--1.00 to 10.00 micrometers per second

USE AND VEGETATION:
Most areas are cultivated. The principal crops are corn, small grain, and alfalfa or clover. The native vegetation is big bluestem, little bluestem, indiangrass, switchgrass, and other grasses of the tall grass prairie.

DISTRIBUTION AND EXTENT:
Physiographic Division--Interior Plains
Physiographic Province--Central Lowlands
Physiographic sections--Western lake section, Wisconsin driftless section, and Dissected till plains
MLRAs--Till Plains (102B),
Central Iowa and Minnesota Till Prairies (103),
Eastern Iowa and Minnesota Till Prairies (104),
Northern Mississippi Valley Loess Hills (105),
Nebraska and Kansas Loess-Drift Hills (106),
Iowa and Minnesota Loess Hills (107A),
Iowa and Missouri Deep Loess Hills (107B),
Illinois and Iowa Deep Loess and Drift, West-Central Part (108C), and
Illinois and Iowa Deep Loess and Drift, Western Part (108D)
LRR M; Iowa, Nebraska, Kansas, Minnesota, and Wisconsin
Extent--large

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Blue Earth County, Minnesota, 1906.

REMARKS:
Particle-size control section--the zone from a depth of 25 to 100 centimeters (A1, A2, AB, Bt, and BC horizons);
series control section--the zone from the surface to a depth of 150 centimeters (Ap, A1, A2, AB, Bt, BC, and C horizons).

Diagnostic horizons and features recognized in this pedon include:
mollic epipedon--the zone from the surface to a depth of 89 centimeters (Ap, A1, A2, AB, and Bt horizons);
cambic horizon-the zone from a depth of 89 to 132 centimeters (BC horizon);
udic moisture regime.

The Bt horizon does not have the 1.2 percent clay increase to meet the requirements of an argillic horizon.

Cation-exchange class is supported by lab sample number S96IA-193-005, NSSL.

Taxonomy version--tenth edition, 2006.

A cherty silt loam phase is mapped in MLRA 105, this soil is considered a fine-loamy taxadjunct of the Judson series.

ADDITIONAL DATA:
Laboratory data--National Soil Survey Laboratory, Lincoln, Nebraska, user pedonid number S96IA-193-005, (http://ssldata.sc.egov.usda.gov/).

National Cooperative Soil Survey
U.S.A.

PEDON DESCRIPTION

Print Date: 03/29/2012
Description Date: 10/12/2011
Describer: P.T.C., V.M.J.
Site ID: S11NE153004
Site Note:

Pedon ID: S11NE153004

Pedon Note:
Lab Source ID: SSL
Lab Pedon #: 12N0012

Soil Name as Described/Sampled: Liston

Soil Name as Correlated:

Classification: Fine-loamy, mixed, active, mesic Typic Calciudolls

Pedon Type:
Pedon Purpose:
Taxon Kind:
Associated Soils:
Physiographic Division: Interior Plains
Physiographic Province: Central Lowland Province
Physiographic Section: Dissected till plains
State Physiographic Area:
Local Physiographic Area:
Geomorphic Setting: on footslope of upland on footslope of hillslope
Upslope Shape: linear
Cross Slope Shape: concave
Particle Size Control Section:

Description origin: NASIS

Country: USA
State: Nebraska
County: Sarpy
MLRA: 107B -- Iowa and Missouri Deep Loess Hills
Soil Survey Area: NE153 – Sarpy County, Nebraska
Map Unit: 7210—Burchard-Contrary-Steinauer complex, 7 to 16 percent slopes
Quad Name:

Legal Description:

Latitude: 41 degrees 9 minutes 18.70 seconds north
Longitude: 96 degrees 9 minutes 20.60 seconds west
Datum:
UTM Zone:
UTM Easting:
UTM Northing:

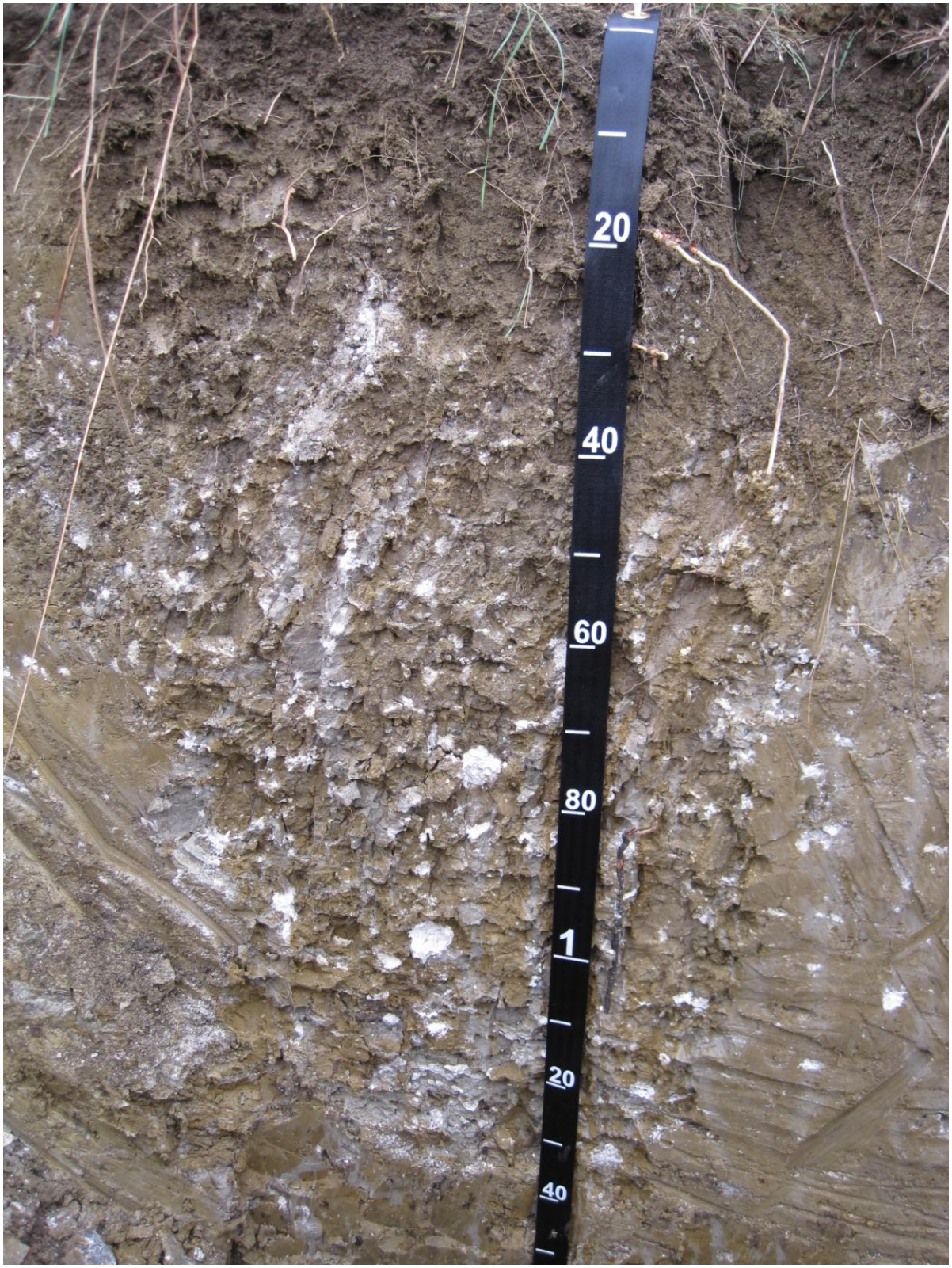
Primary Earth Cover: Grass/herbaceous cover
Secondary Earth Cover: Other grass/herbaceous cover
Existing Vegetation:
Parent Material: till
Bedrock Kind:
Bedrock Depth:
Bedrock Hardness:
Bedrock Fracture Interval:
Surface Fragments: 10.0 percent nonflat 2- to 75-millimeter

Description database: NSSL

Diagnostic Features: mollic epipedon 0 to 23 cm.
free carbonates 0 to 170 cm.
secondary carbonates 23 to 170 cm.
calcic horizon 23 to 50 cm.
cambic horizon 50 to 102 cm.

Cont. Site ID: S11NE153004 **Pedon ID:** S11NE153004

Slope (%)	Elevation (meters)	Aspect (deg)	MAAT (C)	MSAT (C)	MWAT (C)	MAP (mm)	Frost-Free Days	Drainage Class	Slope Length (meters)	Upslope Length (meters)
5.0		315						well		


20
40
60
80
1
20
40

Profile Description:

Ap1--0 to 9 centimeters; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2), dry; weak fine subangular blocky, and weak medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; common medium roots; few fine interstitial pores; 7 percent nonflat 2- to 75-millimeter unspecified fragments; slight effervescence, by HCl, 1 normal; clear wavy boundary.

Ap2--9 to 23 centimeters; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3), dry; weak fine subangular blocky, and weak medium granular structure; very friable, slightly hard, moderately sticky, moderately plastic; few very fine roots; few fine interstitial pores; 7 percent nonflat 2- to 75-millimeter unspecified fragments; slight effervescence, by HCl, 1 normal; clear wavy boundary.

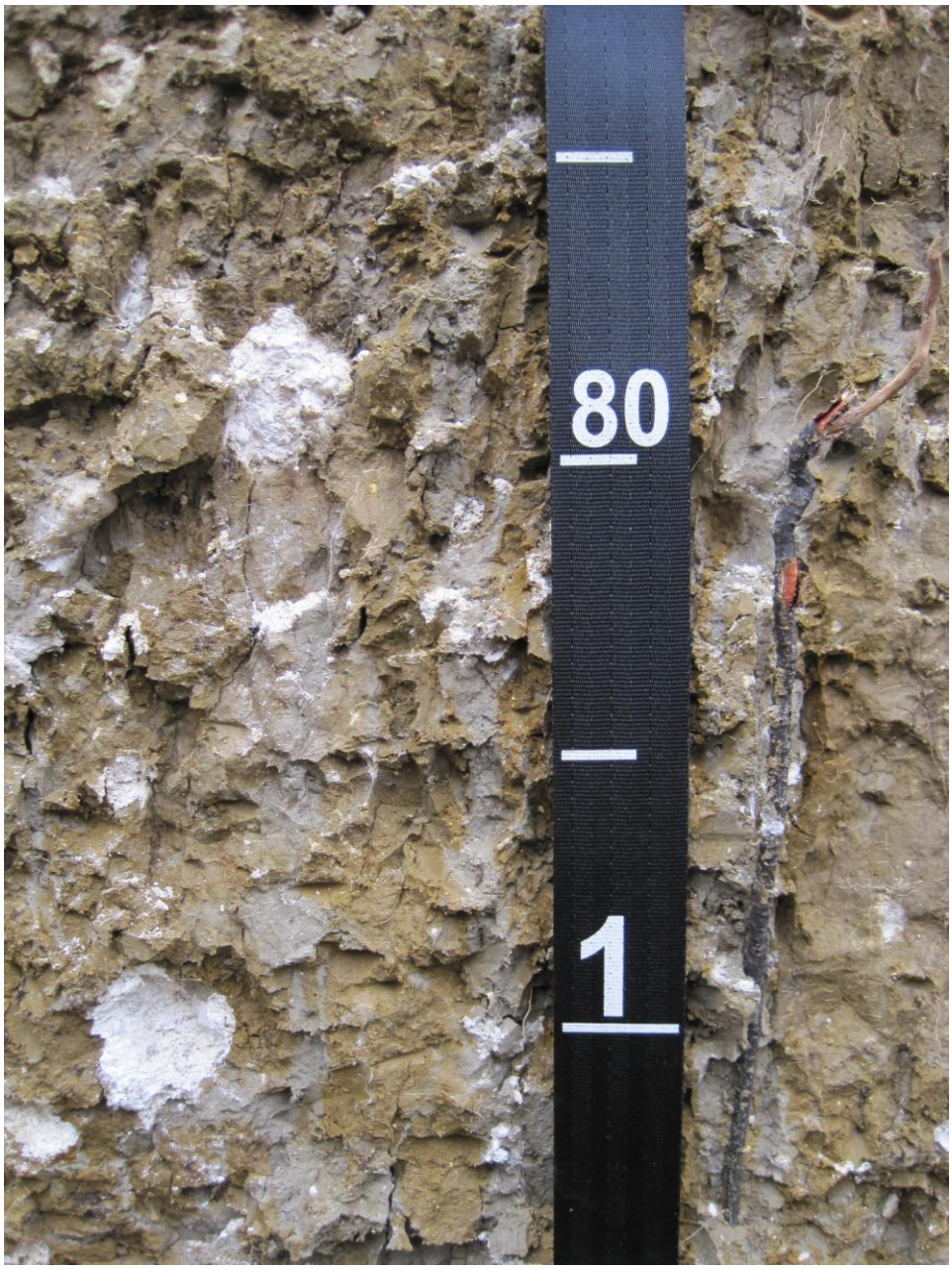
Bk--23 to 50 centimeters; brown (10YR 4/3) exterior and yellowish brown (10YR 5/4) interior with gray (10YR 5/1) silty clay loam; moderate coarse subangular blocky structure; firm, moderately hard, moderately sticky, moderately plastic; few very fine roots; few very fine interstitial pores; 15 percent medium carbonate masses; 7 percent nonflat 2- to 75-millimeter unspecified fragments; strong effervescence, by HCl, 1 normal; clear wavy boundary.

Btk1--50 to 79 centimeters; 75 percent brown (10YR 5/3) with 25 percent gray (10YR 5/1) silty clay loam; strong coarse angular blocky structure; firm, moderately sticky, moderately plastic; few very fine roots; few very fine interstitial pores; 1 percent clay films on all faces of peds; 2 percent manganese coatings; 5 percent medium carbonate concretions and 15 percent medium and coarse carbonate masses; 7 percent nonflat 2- to 75-millimeter unspecified fragments; strong effervescence, by HCl, 1 normal; clear wavy boundary.

Btk2--79 to 102 centimeters; 65 percent yellowish brown (10YR 5/4) with 35 percent gray (10YR 5/1) silty clay loam; strong coarse and very coarse prismatic, and strong coarse angular blocky structure; firm, moderately hard, moderately sticky, moderately plastic; few very fine roots; few very fine interstitial pores; 1 percent clay films on all faces of peds; 5 percent manganese coatings; 2 percent medium carbonate concretions and 7 percent medium carbonate masses; 7 percent nonflat 2- to 75-millimeter unspecified fragments; slight effervescence, by HCl, 1 normal; clear wavy boundary.

B'k--102 to 138 centimeters; 50 percent yellowish brown (10YR 5/4) and 50 percent gray (10YR 5/1) silty clay loam; strong coarse and very coarse prismatic, and strong coarse angular blocky structure; firm, moderately hard, moderately sticky, moderately plastic; few very fine roots; few very fine interstitial pores; 7 percent manganese coatings; 2 percent medium carbonate concretions and 15 percent medium carbonate masses; 7 percent nonflat 2- to 75-millimeter unspecified fragments; slight effervescence, by HCl, 1 normal; abrupt wavy boundary.

BCk--138 to 170 centimeters; 75 percent yellowish brown (10YR 5/4) with 25 percent gray (10YR 5/1) silty clay loam; massive; firm, moderately hard, moderately sticky, moderately plastic; few very fine roots; few very fine interstitial pores; 10 percent manganese coatings; 1 percent medium carbonate concretions and 5 percent medium carbonate masses; 7 percent nonflat 2- to 75-millimeter unspecified fragments; very slight effervescence, by HCl, 1 normal.



Calcium carbonate masses in the matrix and and gleying along prisms and polygons are visible in the Liston soil.

Seq. #	Horizon depth (cm)	Horizon designation		Diagnostic horizon		Diagnostic characteristics or properties		Diagnostic materials	
		Tour Book	Tour	Soil Taxonomy	World Reference Base	Diagnostic characteristics of Soil Taxonomy	Diagnostic properties of World Reference Base	Soil Taxonomy	World Reference Base
1	0 9	Ap1	~	mollic epipedon	anthric horizon, mollic horizon	free carbonates		mineral soil material	calcaric material, mineral material
2	9 23	Ap2	~	mollic epipedon	anthric horizon, mollic horizon	free carbonates		mineral soil material	calcaric material, mineral material
3	23 50	Bk	~	calcic horizon	calcic horizon	free carbonates, identifiable secondary carbonates	secondary carbonates	mineral soil material	calcaric material, mineral material
4	50 79	Btk1	~	cambic horizon	cambic horizon	free carbonates, identifiable secondary carbonates, relict redoximorphic features	relict gleyic colour pattern, secondary carbonates	mineral soil material	calcaric material, mineral material
5	79 102	Btk2	~	cambic horizon	cambic horizon	free carbonates, identifiable secondary carbonates, relict redoximorphic features	relict gleyic colour pattern, secondary carbonates	mineral soil material	calcaric material, mineral material
6	102 138	B'k	~			free carbonates, identifiable secondary carbonates, relict redoximorphic features	relict gleyic colour pattern, secondary carbonates	mineral soil material	calcaric material, mineral material
7	138 170	BCk	~			free carbonates, identifiable secondary carbonates, relict redoximorphic features	relict gleyic colour pattern, secondary carbonates	mineral soil material	calcaric material, mineral material

Taxonomic Classifications of Liston (12N0012)

Soil Taxonomy Fine-loamy, mixed, active, mesic Typic Calciudolls

WRB Calcic Kastanozems (Anthric)

1.) Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436

Soil Survey Staff. 2010. Keys to Soil Taxonomy, 11th ed. USDA-Natural Resources Conservation Service, Washington, DC.

IUSS Working Group WRB. 2007. World Reference Base for Soil Resources 2006, first update 2007. World Soil Resources Reports No.103. FAO, Rome.

*** Primary Characterization Data ***

Pedon ID: S11NE153004 (Sarpy, Nebraska) Print Date: May 18 2012 3:32PM
Sampled as on Oct 12, 2011: Liston ; Fine-loamy, mixed, superactive, mesic Typic Eutrudept
Revised to :

SSL - Project C2012USNE004 IUSS Tour
- Site ID S11NE153004 Lat: 41° 9' 18.50" north Long: 96° 9' 20.50" west NAD83 MLRA: 107B
- Pedon No. 12N0012
- General Methods 1B1A, 2A1, 2B

United States Department of Agriculture
Natural Resources Conservation Service
National Soil Survey Center
Soil Survey Laboratory
Lincoln, Nebraska 68508-3866

Layer	Horizon	Orig Hzn	Depth (cm)	Field Label 1	Field Label 2	Field Label 3	Field Texture	Lab Texture
12N00045	Ap1		0.0-9.0	S11NE153004-1			SICL	CL
12N00046	Ap2		9.0-23.0	S11NE153004-2			SICL	CL
12N00047	Bk		23.0-50.0	S11NE153004-3			SICL	CL
12N00048	Btk1		50.0-79.0	S11NE153004-4			SICL	CL
12N00049	Btk2		79.0-102.0	S11NE153004-5			SICL	CL
12N00050	B'k2		102.0-138.0	S11NE153004-6			SICL	CL
12N00051	C		138.0-170.0	S11NE153004-7			SICL	CL

Pedon Calculations

Calculation Name	Result	Units of Measure
Weighted Particles, 0.1-75mm, 75 mm Base	27.013	% wt
Volume, >2mm, Weighted Average	3.206	% vol
Clay, total, Weighted Average	33.618	% wt
Clay, carbonate free, Weighted Average	30.125	% wt
CEC Activity, CEC7/Clay, Weighted Average, CECd, Set 4	0.532	(NA)
LE, Whole Soil, Summed to 1m	5.2	cm/m

Weighted averages based on control section: 25-100 cm

PSDA & Rock Fragments				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				(- - - - Total - -- - - -)(- - Clay - - -)					(-- - - Silt -- - -)(- - - - - - - - - - - Sand - - - - - - - - - - - -)							(Rock Fragments (mm))				
				Clay	Silt	Sand	Fine	CO_3	Fine	Coarse	VF	F	M	C	VC	(- - - -- - - Weight - - - - - - -)				>2 mm
	Depth			< .002	.002 -.05	.05 -2	< .0002	< .002	.002 -.02	.02 -.05	.05 -.10	.10 -.25	.25 -.50	.5 -1	1 -2	2 -5	5 -20	20 -75	.1- 75	wt % whole
Layer	(cm)	Horz	Prep	(- -- - -- % of <2mm Mineral Soil - - - - - - - - - - - - - - - - - -- - - - - - - - - -)												(- - - - - % of <75mm - - - -)				soil
				3A1a1a			3A1a1a	3A1a1a	3A1a1a		3A1a1a	3A1a1a	3A1a1a	3A1a1a	3A1a1a					
12N00045	0-9	Ap1	S	29.6	32.2	38.2	14.7	1.9	17.5	14.7	7.9	11.8	11.3	4.8	2.4	2	3	1	34	6
12N00046	9-23	Ap2	S	32.9	34.5	32.6	12.2	3.8	20.2	14.3	7.9	10.8	8.4	3.6	1.9	3	1	3	30	7
12N00047	23-50	Bk	S	32.4	36.1	31.5	11.8	3.8	21.0	15.1	8.0	11.0	7.6	3.6	1.3	4	2	--	28	6
12N00048	50-79	Btk1	S	34.1	34.9	31.0	12.4	3.5	20.4	14.5	7.8	12.5	4.5	3.5	2.7	4	1	tr	27	5
12N00049	79-102	Btk2	S	34.5	34.1	31.4	11.5	3.2	19.4	14.7	8.0	9.6	9.2	2.2	2.4	--	1	2	26	3
12N00050	102-138	B'k2	S	34.1	34.8	31.1	12.5	3.2	19.1	15.7	8.4	10.1	7.8	3.1	1.7				23	
12N00051	138-170	C	S	33.9	35.8	30.3	13.2	3.2	19.7	16.1	7.9	9.4	8.2	3.3	1.5	1	1	--	24	2

Bulk Density & Moisture				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-
				(Bulk Density)		Cole	(- - - - - - - - - - - Water Content - - - - - - - - - - -)						WRD	Aggst		
				33	Oven	Whole	6	10	33	1500	1500 kPa	Ratio	Whole	Stabl	(- - Ratio/Clay - -)	
	Depth			kPa	Dry	Soil	kPa	kPa	kPa	kPa	Moist	AD/OD	Soil	2-0.5mm	CEC7	1500 kPa
Layer	(cm)	Horz	Prep	(- - - g cm^{-3} - - -)			(- - - - - - - - - - - pct of < 2mm - - - - - - - - - - -)						cm^3 cm^{-3} %			
				DbWR1	DbWR1				DbWR1	3C2a1a		3D1				
12N00045	0-9	Ap1	S	1.37	1.58	0.047			22.9	14.7		1.025	0.11		0.67	0.50
12N00046	9-23	Ap2	S	1.45	1.58	0.028			21.3	13.1		1.025	0.11		0.57	0.40
12N00047	23-50	Bk	S	1.64	1.95	0.057			21.2	14.8		1.025	0.10		0.55	0.46
12N00048	50-79	Btk1	S	1.53	1.80	0.054			21.0	15.5		1.025	0.08		0.53	0.45
12N00049	79-102	Btk2	S	1.66	1.99	0.061			20.6	16.0		1.026	0.07		0.51	0.46
12N00050	102-138	B'k2	S	1.64	1.92	0.054			22.8	17.8		1.025			0.52	0.52
12N00051	138-170	C	S	1.62	1.90	0.054			22.7	16.3		1.023	0.10		0.51	0.48

*** Primary Characterization Data ***

Pedon ID: S11NE153004 (Sarpy County, Nebraska) Print Date: May 18 2012 3:32PM

Sampled As : Liston Fine-loamy, mixed, superactive, mesic Typic Eutrudept

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 12N0012

Water Content

Layer	Depth (cm)	Horz	Prep	-1- (- - Atterberg - -) (- - - Limits - - -) LL	-2- PI	-3- (- -- - - Bulk Density - -- - -) Field	-4- Recon 33 kPa	-5- Recon Oven Dry	-6- Field	-7- (- Water Content - - - - - - - - - - - - - - - -) Recon 33 kPa	-8- (- - - - - - - - - - - - - Sieved Samples - - - - - - - - - - - - - -) 6 kPa	-9- 10 kPa	-10- 33 kPa	-11- 100 kPa	-12- 200 kPa	-13- 500 kPa
				pct <0.4mm		(- - - - - - - g cm^{-3} - - - - - -)				(- % of < 2mm -)						
															3C1e1a	
12N00045	0-9	Ap1	S												19.8	
12N00046	9-23	Ap2	S												19.1	
12N00047	23-50	Bk	S												20.1	
12N00048	50-79	Btk1	S												22.4	
12N00049	79-102	Btk2	S												23.2	
12N00050	102-138	B'k2	S												23.9	
12N00051	138-170	C	S												23.6	

Carbon & Extractions

Layer	Depth (cm)	Horz	Prep	-1- (- - - - Total - - - - -) C	-2- N	-3- S	-4- Est OC	-5- OC (WB)	-6- C/N Ratio	-7- (- Dith-Cit Ext - -) Fe	-8- Al	-9- Mn	-10- (- -- Ammonium Oxalate Extraction -- - -) Al+½FeO	-11- DOEFe	-12- Al	-13- Si	-14- Mn	-15- (- Na Pyro-Phosphate -) C	-16- Fe	-17- Al	-18- Mn
				(- - - - - - % of <2 mm- - - - - - -)						(- - - - - - - - - - - - - - - % of < 2mm - - -- - - - - - - - - -)							mg kg^{-1}	(- - - - % of < 2mm - - - -)			
				4H2a	4H2a	4H2a				4G1	4G1	4G1		4G2a	4G2a	4G2a	4G2a	4G2a		4G3	4G3	4G3
12N00045	0-9	Ap1	S	2.39	0.16	0.01	1.3		8	0.8	tr	0.1	0.10	0.03	0.05	0.07	0.04	546.0		0.2	0.2	--
12N00046	9-23	Ap2	S	2.44	0.05	--	0.6		11	0.6	tr	0.1	0.09	0.02	0.04	0.07	0.03	425.4		0.2	0.2	--
12N00047	23-50	Bk	S	1.93	0.02	--	0.1		8	0.7	tr	tr	0.08	0.01	0.04	0.06	0.03	282.4		0.1	0.1	--
12N00048	50-79	Btk1	S	1.71	0.06	--	--		--	0.8	tr	tr	0.07	0.01	0.06	0.04	0.04	223.6		0.1	0.1	--
12N00049	79-102	Btk2	S	1.46	0.04	--	--		--	0.8	--	tr	0.06	0.01	0.05	0.03	0.04	312.8		0.1	tr	--
12N00050	102-138	B'k2	S	1.28	0.07	--	--		--	0.8	tr	0.1	0.06	0.01	0.04	0.04	0.04	300.7		0.1	0.1	--
12N00051	138-170	C	S	1.27	0.03	--	--		--	1.0	tr	0.1	0.06	0.01	0.05	0.03	0.04	447.4		0.1	0.1	--

CEC & Bases

Layer	Depth (cm)	Horz	Prep	-1- (- - - - - NH_4OAC Extractable Bases - -- -) Ca	-2- Mg	-3- Na	-4- K	-5- Sum Bases	-6- Acid-ity	-7- Extr Al	-8- KCl Mn	-9- CEC8 Sum Cats	-10- CEC7 NH_4 OAC	-11- ECEC Bases +Al	-12- Al Sat	-13- (- - - Base - - - -) (- Saturation -) Sum	-14- NH_4OAC
				(- - - - - - - - - - - - - - - cmol(+) kg^{-1} - -- - - - - - - - - - - - - - - -)							mg kg^{-1}	(- - - - cmol(+) kg^{-1} - - -)			(- - - - - - - - % - - - - - - - -)		
				4B1a1a	4B1a1a	4B1a1a	4B1a1a						4B1a1a				
12N00045	0-9	Ap1	S	63.3*	1.4	--	0.7	65.4					19.7				100
12N00046	9-23	Ap2	S	65.0*	1.7	--	0.6	67.3					18.6				100
12N00047	23-50	Bk	S	64.8*	2.3	--	0.5	67.6					17.8				100
12N00048	50-79	Btk1	S	64.5*	3.8	--	0.5	68.8					18.2				100
12N00049	79-102	Btk2	S	62.9*	4.5	--	0.6	68.0					17.6				100
12N00050	102-138	B'k2	S	61.4*	5.5	--	0.6	67.5					17.8				100
12N00051	138-170	C	S	61.3*	5.6	--	0.5	67.4					17.3				100

*Extractable Ca may contain Ca from calcium carbonate or gypsum. CEC7 base saturation set to 100.

*** Primary Characterization Data ***

Pedon ID: S11NE153004 (Sarpy County, Nebraska) Print Date: May 18 2012 3:32PM
Sampled As : Liston Fine-loamy, mixed, superactive, mesic Typic Eutrudept
USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 12N0012

Salt

Layer	Depth (cm)	Horz	Prep	-1- Ca	-2- Mg	-3- Na	-4- K	-5- CO_3	-6- HCO_3F	-7- Cl	-8- PO_4	-9- Br	-10- OAC	-11- SO_4	-12- NO_2	-13- NO_3	-14- H_2O	-15- Total Salts	-16- Elec Cond	-17- Pred Elec Cond	-18- Exch Na	-19- SAR	-20-
				(- - - - - - - - - - - - - - - - - - Water Extracted From Saturated Paste - - - - - - - - - - - - - - - - - -)																			
				(- - - - mmol(+) L^{-1} - - - -)(- - - - - - - - - - - - - - - - - - mmol(-) L^{-1} - - - - - - - - - - - - - - - -)														(- - - % - - -)	(- - dS m^{-1} - -)			
				4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2	4F2		4F2	4F1a1a1	%		
12N00045	0-9	Ap1	S	5.8	0.3	--	0.5	--	4.2	0.2	0.5	--	--	--	0.4	0.1	tr	72.0		0.57	0.30	--	
12N00046	9-23	Ap2	S	4.7	0.3	--	0.4	--	3.3	0.1	0.3	--	tr	--	0.2	0.2	tr	61.3		0.49	0.22	--	
12N00047	23-50	Bk	S	2.4	0.2	--	0.3	--	2.1	tr	0.2	--	--	--	0.1	0.1	tr	66.1		0.27	0.17	--	
12N00048	50-79	Btk1	S	2.3	0.4	--	0.2	--	2.1	0.1	0.1	--	--	--	tr	tr	tr	67.7		0.27	0.18	--	
12N00049	79-102	Btk2	S	2.3	0.5	0.3	0.1	--	2.0	0.1	0.3	--	tr	--	0.1	0.1	tr	62.1		0.28	0.24	--	
12N00050	102-138	B'k2	S	2.1	0.6	0.3	0.1	--	2.0	0.1	0.3	--	--	--	0.1	0.1	--	66.8		0.29	0.21	--	
12N00051	138-170	C	S	2.0	0.6	0.2	0.1	--	2.0	0.1	0.2	--	--	--	0.1	0.1	--	72.6		0.26	0.24	--	

pH & Carbonates

Layer	Depth (cm)	Horz	Prep	-1- KCl	-2- $CaCl_2$ 0.01M 1:2	-3- H_2O 1:1	-4- Sat Paste	-5- Oxid	-6- NaF	-7- Carbonate As $CaCO_3$ <2mm	-8- Carbonate As $CaCO_3$ <20mm	-9- Gypsum As $CaSO_4$*$2H_2O$ <2mm	-10- Gypsum As $CaSO_4$*$2H_2O$ <20mm	-11- Resist ohms cm^{-1}
				(- - - - - - - - - - - - - - - - - - pH - - - - - - - - - - - - - - - - - -)						(- - Carbonate - -)		(- - Gypsum - - -)		
										(- - - - - - - - - - - - % - - - - - - - - - - -)				
					4C1a2a	4C1a2a	4F2		4C1a1a1	4E1a1a1a1				
12N00045	0-9	Ap1	S		7.5	8.0	7.5		10.1	9				
12N00046	9-23	Ap2	S		7.5	8.1	7.5		10.4	16				
12N00047	23-50	Bk	S		7.6	8.0	7.8		10.4	15				
12N00048	50-79	Btk1	S		7.5	7.9	7.7		10.3	14				
12N00049	79-102	Btk2	S		7.5	7.9	7.4		10.2	12				
12N00050	102-138	B'k2	S		7.6	8.0	7.6		10.2	11				
12N00051	138-170	C	S		7.6	8.0	7.7		10.2	11				

Phosphorous

Layer	Depth (cm)	Horz	Prep	-1- Melanic Index	-2- NZ %	-3- Acid Oxal	-4- Anion Exch Resin Available	-5- Anion Exch Resin Capacity	-6- Bray 1	-7- Bray 2	-8- Olsen	-9- H_2O	-10- Citric Acid	-11- Mehlich III	-12- KCl Extr NO_3
					(- - - - - - - - - - - - - - - - - - Phosphorous - - - - - - - - - - - - - - - - -)										
					(- mg kg^{-1} - - - - - - - - - - - - - - - - -)										
						4G2a			4D3					4D6b	
12N00045	0-9	Ap1	S			203.7			2.1					7.4	
12N00046	9-23	Ap2	S			254.8			0.2					5.7	
12N00047	23-50	Bk	S			234.9			0.1					6.2	
12N00048	50-79	Btk1	S			264.9			0.1					5.5	
12N00049	79-102	Btk2	S			276.2			0.1					5.2	
12N00050	102-138	B'k2	S			260.4			0.1					0.8	
12N00051	138-170	C	S			264.6			0.1					2.7	

Phosphorous

Layer	Depth (cm)	Horz	Prep	-1- Melanic Index	-2- NZ %	-3- Acid Oxal	-4- Anion Exch Resin Available	-5- Anion Exch Resin Capacity	-6- Bray 1	-7- Bray 2	-8- Olsen	-9- H_2O	-10- Citric Acid	-11- Mehlich III	-12- KCl Extr NO_3
					(- - - - - - - - - - - - - - - - - - Phosphorous - - - - - - - - - - - - - - - - -)										
					(- mg kg^{-1} - - - - - - - - - - - - - - - - -)										
														4D6a1	
12N00045	0-9	Ap1	S											1.8	
12N00046	9-23	Ap2	S											1.3	
12N00047	23-50	Bk	S											1.1	
12N00048	50-79	Btk1	S											1.5	
12N00049	79-102	Btk2	S											2.1	
12N00050	102-138	B'k2	S											3.2	
12N00051	138-170	C	S											3.5	

*** Primary Characterization Data ***

Pedon ID: S11NE153004 (Sarpy County, Nebraska) Print Date: May 18 2012 3:32PM

Sampled As : Liston Fine-loamy, mixed, superactive, mesic Typic Eutrudept

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 12N0012

Trace Elements Tier 1

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
Layer	Depth (cm)	Horz	Prep	Ag mg/kg 4H1a	As mg/kg 4H1a	Ba mg/kg 4H1a	Be mg/kg 4H1a	Cd mg/kg 4H1a	Co mg/kg 4H1a	Cr mg/kg 4H1a	Cu mg/kg 4H1a	Mn mg/kg 4H1a	Mo mg/kg 4H1a		Hg ug/kg 4H1a
12N00045	0-9	Ap1	HM	0.08	8.77	210.12	1.05	0.61	7.97	34.28	18.36	770.28	1.45		31
12N00046	9-23	Ap2	HM	0.08	8.13	189.60	1.08	0.82	8.22	37.35	21.06	673.34	1.58		36
12N00047	23-50	Bk	HM	0.08	11.26	180.04	1.14	0.92	7.80	39.19	21.41	467.54	1.89		38
12N00048	50-79	Btk1	HM	0.09	15.12	194.65	1.10	0.81	7.74	37.85	22.43	382.33	2.49		41
12N00049	79-102	Btk2	HM	0.07	10.16	191.55	1.09	0.75	8.20	36.46	22.02	396.96	1.91		36
12N00050	102-138	B'k2	HM	0.08	13.00	206.25	1.12	0.95	7.86	37.96	20.10	468.35	2.32		48
12N00051	138-170	C	HM	0.07	14.31	209.63	1.07	0.85	8.28	38.57	21.45	508.28	2.59		40

Trace Elements Tier 2

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-
Layer	Depth (cm)	Horz	Prep	Ni mg/kg 4H1a	P mg/kg 4H1a	Pb mg/kg 4H1a	Sb mg/kg 4H1a	Se ug/kg 4H1a	Sn mg/kg 4H1a	Sr mg/kg 4H1a	Tl mg/kg	V mg/kg 4H1a	W mg/kg 4H1a	Zn mg/kg 4H1a
12N00045	0-9	Ap1	HM	26.56	521.85	12.62	0.57	256.96	0.98	61.28		83.83	0.02	63.20
12N00046	9-23	Ap2	HM	28.27	524.39	12.14	0.53	398.09	0.98	89.93		93.27	0.02	64.44
12N00047	23-50	Bk	HM	30.18	509.86	11.86	0.53	289.01	0.99	106.36		98.67	0.03	70.65
12N00048	50-79	Btk1	HM	31.96	511.69	12.32	0.55	350.92	0.94	107.45		95.08	0.03	72.77
12N00049	79-102	Btk2	HM	29.82	539.44	12.42	0.42	296.28	0.95	103.21		90.29	0.02	74.29
12N00050	102-138	B'k2	HM	29.49	552.78	12.17	0.49	193.79	0.99	111.90		93.91	0.02	75.88
12N00051	138-170	C	HM	30.41	542.09	12.00	0.48	242.64	1.04	110.22		95.17	0.03	79.08

Major Elements

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
Layer	Depth (cm)	Horz	Prep	Al mg/kg 4H1b	Ca mg/kg 4H1b	Fe mg/kg 4H1b	K mg/kg 4H1b	Mg mg/kg 4H1b	Mn mg/kg 4H1b	Na mg/kg 4H1b	P mg/kg 4H1b	Si mg/kg 4H1b	Sr mg/kg 4H1b	Ti mg/kg 4H1b	Zr mg/kg 4H1b
12N00045	0-9	Ap1	HM	53029	41547	22332	16220	5393	943	7539	795	302796	176	2796	126
12N00046	9-23	Ap2	HM	54107	65794	22008	15854	6480	857	6467	869	270719	182	2777	119
12N00047	23-50	Bk	HM	57285	64204	24758	16314	7710	608	6469	810	277142	200	2985	125
12N00048	50-79	Btk1	HM	57662	59866	26254	15364	8270	480	6605	792	268107	198	2917	116
12N00049	79-102	Btk2	HM	56188	52826	25717	16096	8499	532	6782	762	283617	200	3021	128
12N00050	102-138	B'k2	HM	60026	47869	25257	16378	8696	610	6982	720	286527	206	3047	118
12N00051	138-170	C	HM	55742	45646	25203	16371	8457	659	6498	806	284853	195	3039	120

Mehlich3 Elements

				-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-	-21-
	Depth			Al	As	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	P	Pb	Se	Si	Sr	Zn
Layer	(cm)	Horz.	Prep.	(- - - -										-mg/kg-										- - - -)
				4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b	4D6b		4D6b	4D6b	4D6b
12N00045	0-9	Ap1	S	48.9	1.5	37.8	7894.9	0.4	1.3	0.1	3.1	37.5	233.5	147.2	233.8	0.6	11.5	1.7	7.4	3.2		405.3	12.4	2.6
12N00046	9-23	Ap2	S	45.5	3.3	30.1	11246.3	0.3	0.6	0.1	3.1	30.9	200.2	182.8	134.1	0.6	14.8	1.0	5.7	1.9		256.1	16.6	2.1
12N00047	23-50	Bk	S	49.9	4.1	40.0	12529.4	0.4	0.5	0.1	2.8	34.1	192.9	264.8	95.8	0.7	20.6	0.6	6.2	1.5		264.6	24.7	2.4
12N00048	50-79	Btk1	S	61.5	5.3	48.9	11925.7	0.4	0.5	0.1	2.9	39.8	185.5	406.1	99.9	0.8	23.1	1.0	5.5	1.7		322.8	30.1	2.5
12N00049	79-102	Btk2	S	48.9	2.6	47.1	12080.7	0.6	0.8	0.1	4.0	52.6	196.7	484.6	132.4	0.5	26.6	2.2	5.2	2.2		367.2	32.3	16.0
12N00050	102-138	B'k2	S	1.5	1.0	44.7	10039.0	0.5	0.9	0.2	2.7	47.2	188.0	510.6	169.0	0.9	28.5	2.6	0.8	2.0		382.4	31.8	4.6
12N00051	138-170	C	S	2.3	3.2	46.7	9833.7	0.4	1.1	0.2	2.6	49.6	183.0	526.2	198.4	0.6	26.2	2.3	2.7	2.5		388.8	31.6	3.9

*** Primary Characterization Data ***

Pedon ID: S11NE153004 (Sarpy County, Nebraska) Print Date: May 18 2012 3:32PM

Sampled As : Liston Fine-loamy, mixed, superactive, mesic Typic Eutrudept

USDA-NRCS-NSSC-National Soil Survey Laboratory ; Pedon No. 12N0012

Clay Mineralogy

Layer	Depth (cm)	Horz	Fraction	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-
						X-Ray					Thermal					Elemental				EGME	Interpretation
													SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	Retn	
						7A1b1						7A4a									
				(- - - - - - peak size - - - - - - - -)							(- - - - - - - - % - - - - - - - -)		(- - - - - - - - - - - - - - - - % - - - - - - - - - - - - - - - - -)							mg g^{-1}	
12N00047	23-50	Bk	tcly	MT 4	KK 2	MI 2					KK 33										SMEC
12N00048	50-79	Btk1	tcly	MT 3	KK 2	MI 2	VR 1				KK 29										SMEC
12N00050	102-138	B'k2	tcly	MT 3	KK 2	MI 2					KK 31										SMEC
12N00051	138-170	C	tcly	MT 3	KK 3	MI 2					KK 32										SMEC

FRACTION INTERPRETATION:

tcly - Total Clay,

MINERAL INTERPRETATION:

KK - Kaolinite MI - Mica MT - Montmorillonite VR - Vermiculite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

LOCATION LISTON IA
Established Series
RAL-PTC-TWN
12/2003

LISTON SERIES

The Liston series consists of very deep, well drained soils on convex shoulder slopes on uplands. These soils formed in calcareous pre-Illinoian glacial till. Slopes range from 9 to 75 percent. Mean annual air temperature is about 9 degrees C (49 degrees F). Mean annual precipitation is about 74 centimeters (29 inches).

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Typic Eutrudepts

TYPICAL PEDON: Liston clay loam, on a southwest-facing, convex, 14 percent slope, in a pasture at an elevation of 390 meters (1,280 feet) above sea level. (Colors are for moist soil unless otherwise stated.)

A--0 to 13 centimeters (0 to 5 inches); very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; many very fine and fine roots; many very fine and fine tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary. [10 to 18 centimeters (4 to 7 inches) thick]

Bw--13 to 30 centimeters (5 to 12 inches); brown (10YR 4/3) clay loam; moderate fine subangular blocky structure; firm; many very fine roots; many very fine and fine tubular pores; common faint dark brown (10YR 3/3) organic coats on vertical faces of peds; strongly effervescent; moderately alkaline; clear smooth boundary. [0 to 41 centimeters (0 to 16 inches) thick]

Bk1--30 to 46 centimeters (12 to 18 inches); yellowish brown (10YR 5/4) clay loam; moderate fine subangular blocky structure; firm; many very fine roots; common very fine and fine tubular pores; common fine and medium very pale brown (10YR 8/2) masses of carbonate; few fine and medium very pale brown (10YR 8/2) carbonate concretions; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2--46 to 74 centimeters (18 to 29 inches); yellowish brown (10YR 5/4) clay loam; moderate medium and coarse prismatic structure parting to moderate fine subangular blocky; firm; common very fine roots; common very fine and fine tubular pores; common medium and coarse very pale brown (10YR 8/2) masses of carbonate; few fine and medium very pale brown (10YR 8/2) carbonate concretions; few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk3--74 to 97 centimeters (29 to 38 inches); yellowish brown (10YR 5/4) clay loam; moderate medium and coarse prismatic structure parting to moderate fine angular blocky; firm; common very fine roots; common very fine and fine tubular pores; common medium and coarse very pale

brown (10YR 8/2) masses of carbonate; few fine and medium very pale brown (10YR 8/2) carbonate concretions; few fine distinct grayish brown (2.5Y 5/2) redoximorphic depletions and few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; clear smooth boundary. [Combined thickness of the Bk horizons is 20 to 97 centimeters (8 to 38 inches).]

C1--97 to 140 centimeters (38 to 55 inches); brown (10YR 5/3) clay loam; massive; firm; common very fine roots; common very fine and fine tubular pores; common fine and medium very pale brown (10YR 8/2) masses of carbonate; common fine and medium very pale brown (10YR 8/2) carbonate concretions; common fine and medium distinct strong brown (7.5YR 4/6) redoximorphic concentrations; strongly effervescent; moderately alkaline; gradual smooth boundary.

C2--140 to 170 centimeters (55 to 67 inches); about 50 percent strong brown (7.5YR 5/6) and about 50 percent grayish brown (2.5Y 5/2) clay loam; massive; firm; common very fine and fine tubular pores; common fine and medium very pale brown (10YR 8/2) masses of carbonate; few fine and medium very pale brown (10YR 8/2) carbonate concretions; few distinct very dark brown (7.5YR 2/2) manganese stains on faces of peds and in pores; strongly effervescent; moderately alkaline; gradual smooth boundary.

C3--170 to 203 centimeters (67 to 80 inches); about 50 percent strong brown (7.5YR 5/6) and about 50 percent gray (2.5Y 6/1) clay loam; massive; firm; common very fine and fine tubular pores; common fine and medium very pale brown (10YR 8/2) masses of carbonate; few fine and medium very pale brown (10YR 8/2) carbonate concretions; few distinct very dark brown (7.5YR 2/2) manganese stains on faces of peds and in pores; strongly effervescent; moderately alkaline.

TYPE LOCATION: MLRA 107B-Iowa and Missouri Deep Loess Hills, Crawford County, Iowa subset; about 9.5 miles northeast of Dennison; about 840 feet north and 1,410 feet west of the southeast corner of sec. 28, T. 85 N., R. 38 W.; USGS Kiron quadrangle; lat. 42 degrees 8 minutes 29.4 seconds N. and long. 95 degrees 16 minutes 8.9 seconds W., NAD 83

RANGE IN CHARACTERISTICS:
Depth to carbonates--0 to 25 centimeters (0 to 10 inches)
Content of clay in the particle-size control section (weighted average)--27 to 35 percent
Content of sand in the particle-size control section (weighted average)--25 to 45 percent

A or Ap horizon:
Hue--10YR
Value--2 or 3
Chroma--1 or 2
Texture--loam or clay loam
Clay content--24 to 35 percent
Sand content--30 to 52 percent
Rock fragment content--1 to 5 percent
Calcium carbonate equivalent--5 to 10 percent

Reaction--neutral to moderately alkaline
Moist bulk density--1.45 to 1.60 g/cc

AB horizon (if it occurs):
Hue--10YR
Value--2 or 3
Chroma--1 or 2
Texture--clay loam
Clay content--27 to 35 percent
Sand content--25 to 45 percent
Rock fragment content--1 to 5 percent
Calcium carbonate equivalent--5 to 15 percent
Reaction--slightly alkaline or moderately alkaline
Moist bulk density--1.60 to 1.70 g/cc
Thickness: 0 to 15 centimeters (0 to 6 inches)

Bw horizon:
Hue--10YR or 2.5Y
Value--4 or 5
Chroma--3 or 4
Texture--clay loam
Clay content--27 to 38 percent
Sand content--25 to 40 percent
Rock fragment content--1 to 5 percent
Calcium carbonate equivalent--5 to 15 percent
Reaction--slightly alkaline or moderately alkaline
Moist bulk density--1.65 to 1.80 g/cc

Bk horizon:
Hue--10YR or 2.5Y
Value--4 or 5
Chroma--2 to 4
Texture--clay loam
Clay content--34 to 40 percent
Sand content--25 to 35 percent
Rock fragment content--1 to 5 percent
Calcium carbonate equivalent--15 to 25 percent
Reaction--slightly alkaline or moderately alkaline
Moist bulk density--1.7 to 1.85 g/cc

C horizon:
Hue--7.5YR, 10YR, 2.5Y, or 5Y
Value--4 to 6
Chroma--1 to 6
Texture--clay loam
Clay content--30 to 40 percent

Sand content--25 to 35 percent
Rock fragment content--1 to 5 percent
Calcium carbonate equivalent--10 to 15 percent
Reaction--slightly alkaline or moderately alkaline
Moist bulk density--1.8 to 1.9 g/cc

COMPETING SERIES: This is the Storden series.
Storden--have a clay content of 18 to 27 percent in the particle-size control section

GEOGRAPHIC SETTING:
Parent material--calcareous pre-Illinoian glacial till
Landform--convex shoulder slopes on uplands
Slopes--9 to 75 percent
Elevation--305 to 457 meters (1,000 to 1,500 feet) above sea level
Mean annual air temperature--8 to 11 degrees C (47 to 52 degrees F)
Mean annual precipitation--66 to 81 centimeters (26 to 32 inches)
Frost-free period--145 to 175 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Burchard, Deloit, Ida, Marshall, and Monona soils.
Burchard--are in lower landscape positions on concave back slopes, do not have carbonates within a depth of 30 centimeters (12 inches), and have an argillic horizon
Deloit--are in lower landscape positions on foot slopes and have mollic epipedons that are more than 61 centimeters (24 inches) thick
Ida--are in landscape positions similar to those of the Liston soils, have a clay content of 18 to 25 percent in the particle-size control section and have a sand content of less than 10 in the particle-size control section
Marshall--are in higher landscape positions on summits, have a clay content of 30 to 35 percent in the particle-size control section, and have sand content of less than 10 percent in the particle-size control section
Monona--are in higher landscape positions on summits, have a clay content of 20 to 30 percent in the particle-size control section, and have sand content of less than 10 percent in the particle-size control section

DRAINAGE AND PERMEABILITY:
Drainage class--well drained--a saturated zone does not occur within a depth of 183 centimeters (6 feet) during April to June in most years
Permeability--moderately slow
Surface runoff potential--medium to high

USE AND VEGETATION:
Most areas are pastured. A few areas are cultivated. Bluegrass is the principal pasture species. The native vegetation is big bluestem, little bluestem, indiangrass, switchgrass, sideoats grama and other grasses of the tall grass prairie and scattered oak trees.

DISTRIBUTION AND EXTENT:
LRR M, MLRA 107; western Iowa. These soils are of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Woodbury County, Iowa, 2003

REMARKS:
Particle-size control section--the zone from a depth of 25 to 100 centimeters (10 to 40 inches) (Bw, Bk1, Bk2, Bk3, and C1 horizons);
series control section--the zone from the surface to a depth of 152 centimeters (0 to 60 inches) (A, Bw, Bk1, Bk2, Bk3, C1, and C2 horizons).

Diagnostic horizons and features recognized in this pedon:
ochric epipedon--the zone from the surface to a depth of 13 centimeters (0 to 5 inches) (A horizon);
calcic horizon--the zone from a depth of 30 to 97 centimeters (12 to 38 inches) (Bk1, Bk2, and Bk3 horizons);
udic moisture regime.

Cation-exchange activity class is supported by lab sample number S97IA-047-015, National Soil Survey Laboratory.

Taxonomy version--second edition, 1999.

The redoximorphic features occurring in the Bk, and C horizons are not considered as indicators of present-day wetness and therefore were not considered in the classification of these soils.

This series replaces the Steinauer series that was correlated in the Soil Survey of Woodbury County, Iowa (1972).

Pre-Illinoian glacial till does not have shale fragments, has half as much very coarse sand in the sand fraction, has a moderate shrink-swell potential, and has less calcium carbonate and less dolomite content than early Wisconsin (Tazewell) glacial till.

Refer to DMUid 277,044 in NASIS for property data.

ADDITIONAL DATA:
Laboratory data--National Soil Survey Laboratory, Lincoln, Nebraska pedon S97IA047015 (http://ssldata.sc.egov.usda.gov/).

National Cooperative Soil Survey
U.S.A.