Soil Survey of

Burt County, Nebraska

United States Department of Agriculture

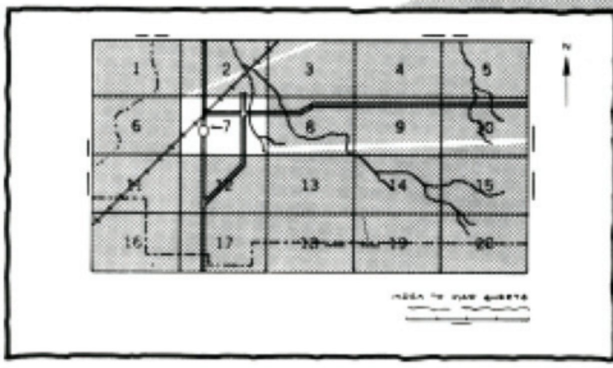
Soil Conservation Service

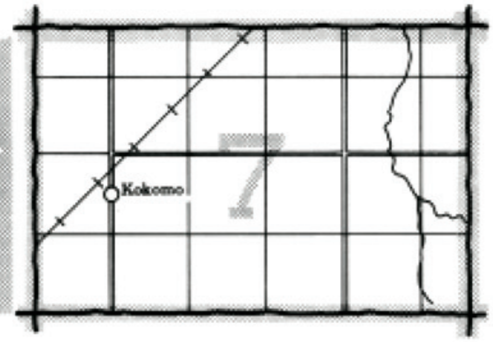
in cooperation with

University of Nebraska, Conservation and Survey Division

HOW TO USE

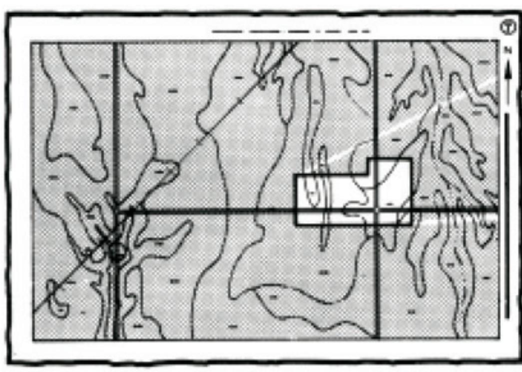
1. Locate your area of interest on the "Index to Map Sheets"

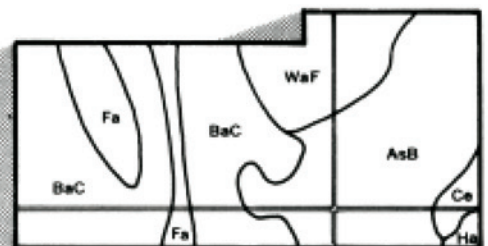




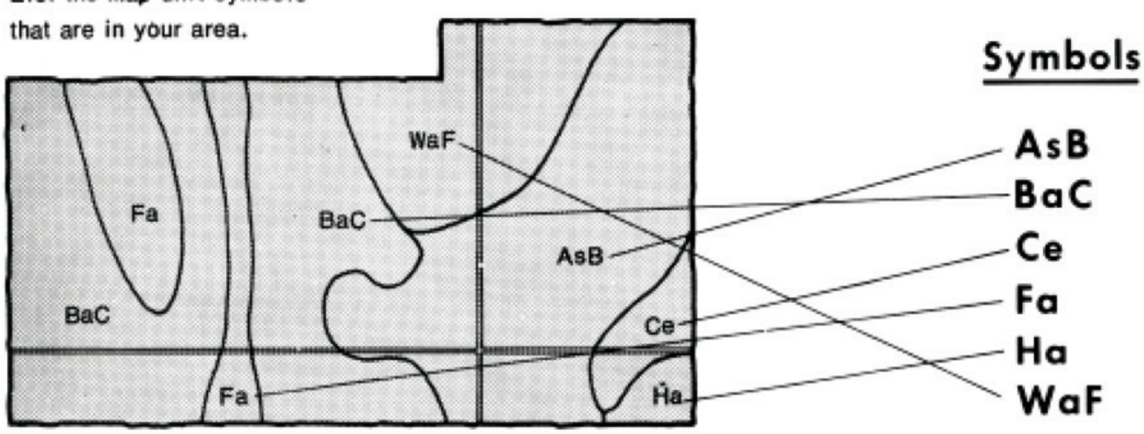
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



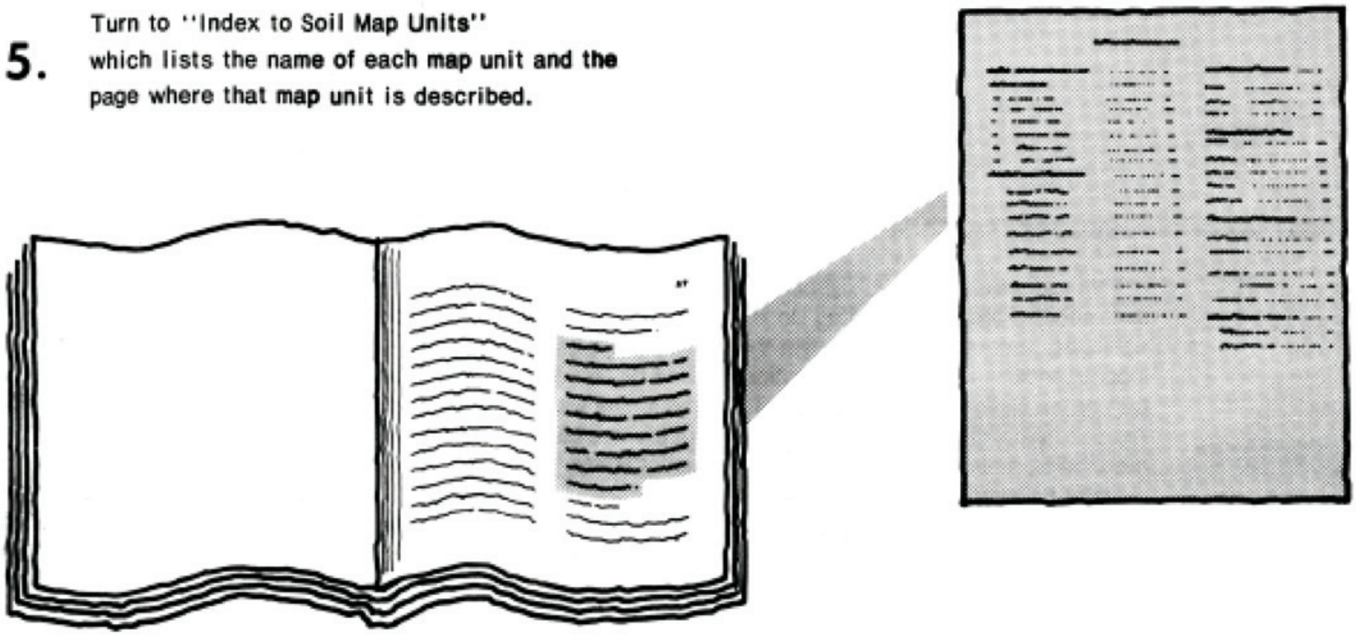


4. List the map unit symbols that are in your area.

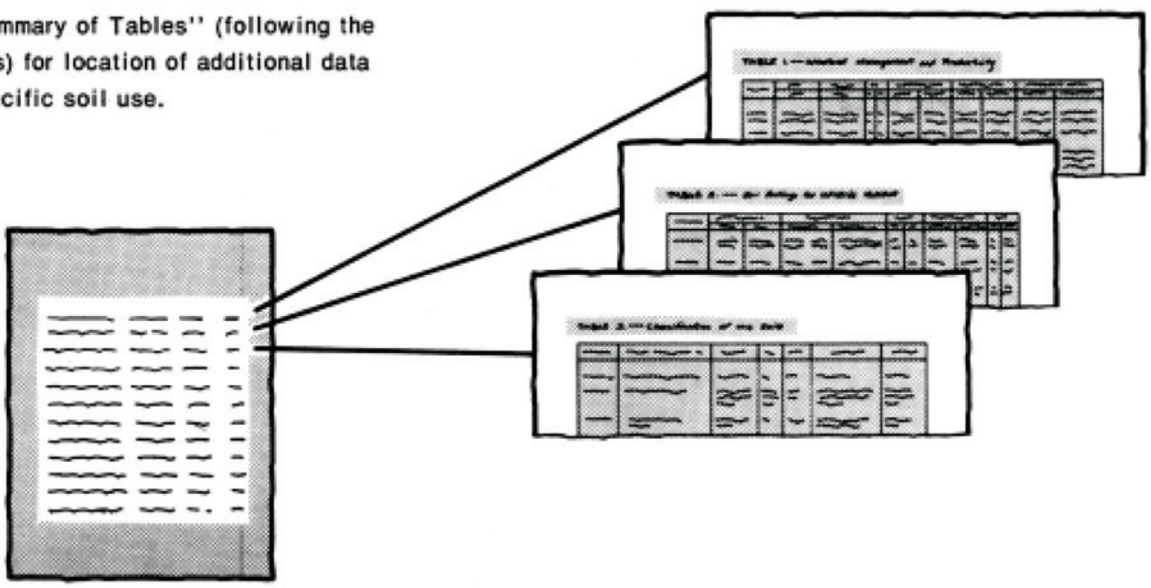


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, the University of Nebraska Conservation and Survey Division, the Lower Elkhorn and Middle Missouri Tribs Natural Resources Districts, and the Burt County Board of Supervisors. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1973-77. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Lower Elkhorn and Middle Missouri Tribs Natural Resources Districts.

Cover: Terraces, grassed waterways, contour farming, and farmstead windbreaks on soils in an area of Moody-Nora-Judson association.

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soil series

Issued October 1980

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summary of tables

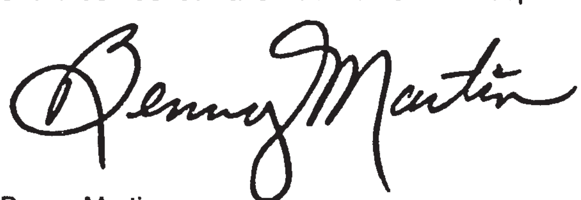
foreword

This soil survey contains information that can be used in land-planning programs in Burt County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



Benny Martin
State Conservationist
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soil survey of
Burt County, Nebraska

By Dean W. DaMoude, Soil Conservation Service

Fieldwork by Dean W. DaMoude and Mark E. Willoughby, Soil Conservation Service
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United States Department of Agriculture, Soil Conservation Service
in cooperation with the University of Nebraska, Conservation
and Survey Division

BURT COUNTY is in the northeastern part of Nebraska (fig. 1). It is bordered on the south by Washington and Dodge Counties; on the west by Cuming, Dodge, and Thurston Counties; on the north by Thurston County; and on the east by the Missouri River. Burt County has a total land area of 308,928 acres, or about 483 square miles. Tekamah, the county seat, is the largest town. Other towns in the county are Lyons, Oakland, Decatur, and Craig.

Farming and businesses related to farming are leading occupations in the county and provide a stable and prosperous foundation for the economy. However, other commerce and industry are also important in the towns of Tekamah, Oakland, and Lyons. Corn, soybeans, and alfalfa are extensively grown throughout Burt County, and lesser amounts of small grain and sorghum are grown. These crops provide cash income as well as most of the feed needed for the cattle, hogs, and sheep.

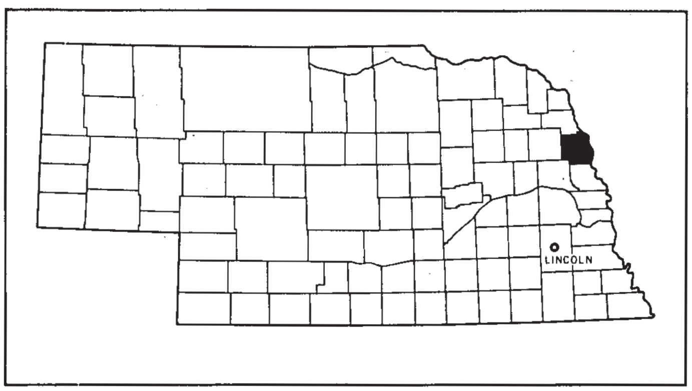

Figure 1.—Location of Burt County in Nebraska.

Soils in the stream valleys formed in alluvium or a mixture of alluvium and colluvium. These soils are mainly clayey and silty, but some soils adjacent to the Missouri River are sandy. Because of a seasonal high water table and flooding, wetness is a main hazard to the soils on low bottom lands. The principal concerns of management are maintenance of fertility, organic matter, and surface drainage, improvement of tilth on the clayey soils, and management of water for irrigation.

The major soils on uplands formed in loess and are silty. The soils of minor extent formed in glacial till and colluvium. Water erosion is the principal hazard on the upland soils. Conservation of water by controlling runoff, maintenance of organic matter, and improvement of fertility are major concerns of management.

Soils in Burt County range from nearly level to very steep. About 44 percent of the soils are nearly level with less than 2 percent slope; about 22 percent are gently sloping with 2 to 6 percent slope; about 16 percent are strongly sloping with 6 to 11 percent slope; about 14 percent are moderately steep with 11 to 17 percent slope; about 3 percent are steep with 17 to 30 percent slope; and less than 1 percent are very steep with 30 to 60 percent slope.

The soils are generally well suited to the common cultivated crops. About 84 percent of the county is cropland. The remainder is rangeland, woodland, and other areas such as towns, farmsteads, roads, water, and wasteland. About 12 percent of Burt County is dryland farmed and is in capability class I, 37 percent is in class II, 30 percent is in class III, and 14 percent is in class IV. Less than 0.5 percent of the county is in class V, 5 percent is in class VI, 0.5 percent is in class VII, and less than 0.1 percent is in class VIII. About 0.9 percent of the county is water areas.

About 2 percent of the soils in the county are excessively drained, 60 percent are well drained, 5 percent are moderately well drained, 12 percent are somewhat poorly drained, 17.5 percent are poorly drained, and 0.5 percent are very poorly drained. Soils in Burt County are deep, except for a small acreage that is moderately deep over sandstone.

Nearly all soils in Burt County are silty or clayey. A few areas on the Missouri River bluffs and adjacent to the Missouri River are sandy. The soils formed in loess, glacial till, alluvium, or colluvium.

The first soil survey of Burt County was made in 1922 (*3*). This survey updates the first survey and provides additional information and larger maps that show the soils in greater detail.

general nature of the county

This section provides general information about Burt County. It discusses history and population; climate; geology; ground water supply; physiography, relief, and drainage; manufacturing and business services of agriculture; transportation; school and church facilities; and trends in farming and soil use.

history and population

The first permanent settlement in Burt County was made in 1854 on the site of a claim staked out by B. R. Falson.

Burt County was one of the eight original counties in Nebraska. It was named in honor of Nebraska's first territorial governor, Francis G. Burt. The county was organized in 1854. It originally consisted of a large portion of the northeastern part of Nebraska; however, it was reduced to its present size by legislative action on February 12, 1879.

Before 1920, many small towns were in Burt County, but as transportation improved the small communities that were less important to the farmers began to disappear. The towns remaining are Tekamah, Oakland, Lyons, Craig, and Decatur.

The population of Burt County was 12,559 in 1920 and 9,247 in 1970. Most residents have vocations related to agriculture or earn their living by farming.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Winter in Burt County is cold; summer is generally quite hot but has occasional cool spells. Precipitation in winter is frequently snowfall. Precipitation during warm months is chiefly showers that result when warm, moist air moves in from the south. Rainfall from the showers often is heavy. Total annual rainfall is normally adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Tekamah in the period 1951 to 1973. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 25 degrees F, and the average daily minimum temperature is 14 degrees. The lowest temperature on record, which occurred at Tekamah on January 29, 1966, is -22 degrees. In summer the average temperature is 75 degrees, and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred on July 13, 1954, is 107 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 22 inches. Of this, 80 percent usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 3.12 inches at Tekamah on April 21, 1954. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 31 inches. The greatest snow depth at any one time during the period of record was 30 inches. On an average of 18 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms strike occasionally. These storms are local and of short duration and result in damage in narrow belts. Hailstorms occur at times during the warmer part of the year in regular patterns and in relatively small areas.

geology

The uppermost units of bedrock underlying Burt County include sandstone and shale of the Dakota Group (Lower Cretaceous age) and limestone and shale of Pennsylvanian age. The Dakota Group underlies the western three-fourths of the county, which is the area from the Missouri River bluffs westward and the extreme western part of the Missouri River bottom lands. Rocks of the Dakota Group are exposed at the land surface in places along the Missouri River bluffs and in some deeply incised valley areas along Elm and Tekamah Creeks. In most of the Missouri River bottoms, bedrock of the Dakota Group has been eroded away and the Pennsylvanian Shale and Limestone are the uppermost bedrock. The Pennsylvanian bedrock does not crop out in the county and is generally overlain by 90 to 110 feet of Quaternary age alluvium.

Unconsolidated materials overlying the bedrock range in thickness from less than 100 feet in the drainageways along the bluffs, and in some parts of the Logan Creek and Missouri River Valleys, to as much as 300 feet in the upland area southeast of Bertha (east of Oakland). Glacial till overlies the bedrock everywhere, except in the Missouri River and Logan Creek Valleys where it has been removed by erosion. In some areas, deposits of sand and gravel are in or at the base of the till and are generally thickest where they fill bedrock valleys. Thick deposits of sand and gravel are present beneath the Missouri River Valley and under much of the Logan Creek Valley and the adjacent stream terraces. A mantle of loess covers all the uplands and in many places is more than 50 feet thick.

ground water supply

The availability of ground water for domestic, livestock, and irrigation uses varies across the county. It depends upon the occurrence of saturated geologic materials that yield water to wells at the desired rates.

Along all of the Missouri River bottom lands, adequate supplies of ground water are available for both domestic and irrigation purposes.

On uplands between the Missouri River Valley and Logan Creek Valley, the potential for large capacity irrigation wells, and in places domestic wells, is much less than on the bottom lands. In most upland areas, domestic wells can be located where sand and gravel fills the bedrock valleys or where thin sandy deposits are interbedded with the till or outwash silts and clays. In some parts of the uplands, domestic and large capacity wells can be constructed in the Dakota Sandstone. Test drilling is necessary to determine those areas where substantial thicknesses of sandstone are present.

In the upland area from the Logan Creek Valley to the Burt-Cuming County line, substantial thicknesses of sand and gravel immediately overlie the bedrock in places. Wells in these places yield small to large amounts of water.

Water derived from the sand and gravel is generally quite hard but of suitable quality for domestic and irrigation purposes. Water from the Dakota sandstone is generally much more mineralized and in places contains high concentrations of iron and manganese. Water that requires treatment for domestic use because of the high amount of total dissolved solids can be suitable or unsuitable for irrigation, depending upon the kind of dissolved minerals, the soil, and the management.

On January 1, 1978, there were 334 registered irrigation wells in Burt County. Eighty percent of these wells were in the Missouri River bottom lands, and 13 percent were along Logan Creek Valley. The remaining 7 percent were in the loess uplands between the Logan Creek Valley and the Missouri River.

physiography, relief, and drainage

Burt County is in the Great Plains physiographic region. The strongest relief in the county occurs in the bluff areas that border the Missouri River Valley and Silver, Tekamah, and Blackbird Creeks. These areas are moderately steep to very steep. Maximum relief between the ridgetops and bottom land adjacent to well entrenched drainageways is about 175 to 225 feet.

Uplands make up about 59 percent of the county. Drainageways dissect all areas of the uplands, except a few small, nearly level areas that have shallow depressions in the western part of the county. The loess uplands consist of a sequence of ridgetops and side slopes, alternating with narrow stream valleys. The ridgetops are generally nearly level to gently sloping. The side slopes are moderately sloping to very steep.

Valleys of the Missouri River and Logan and Bell Creeks are nearly level. Small streams and drainageways transect these valleys to larger streams. Stream terraces make up 4 percent of the county, and bottom lands make up about 37 percent.

Burt County is drained mainly by the Missouri River and Logan, Bell, Silver, Elm, and Tekamah Creeks. Drainage generally is to the south or southeast, but Elm Creek and the lower part of Blackbird Creek flow north. Nearly all of the major creeks flow constantly, except during prolonged drought.

The lowest point in the county is in the southeastern corner and is 1,011 feet above sea level. The highest point is in the northwestern part and is 1,430 feet above sea level. The elevation at Tekamah is about 1,025 feet, at Oakland about 1,295 feet, and at Lyons about 1,299 feet.

manufacturing and business services of agriculture

Several products that are sold on national markets are manufactured or produced in Tekamah, Oakland, and

Lyons. These products include modular homes, welding gas, irrigation pipes, dairy products, meat products, alfalfa meal, cornmeal pellets, and seed corn. Some businesses produce, sell, and service irrigation equipment and farm machinery.

The livestock feed industry is well established in Burt County. Cattle, sheep, and hogs are raised and fed. Fat livestock is shipped to Omaha, or Sioux City, Iowa, or purchased locally by order buyers or meat packers. Dairy and poultry products produced on the farm are marketed locally or outside the county. Grain and feed products not used on the farm are sold to livestock feeders and local elevators or to large terminal markets outside the county.

transportation

Burt County has good transportation facilities. Railroads provide adequate service to Tekamah, Oakland, and Lyons. Buslines serve most communities. Several public and private airstrips are available to small aircraft. Commercial air services are available at Omaha and Fremont, Nebraska, and at Sioux City, Iowa.

The county is traversed by several all-weather highways. East-west highways are Nebraska Highway 32 in the southern part of the county and Nebraska Highway 51 in the northern part. North-south highways are U. S. Highway 73 in the eastern part of the county and U. S. Highway 77 in the western part.

The rural road system is well developed. Most roads are on section lines and have a gravel or crushed rock surface. A few rural roads have an all-weather surface.

school and church facilities

Facilities for education through high school are available in all parts of the county. There are a few country elementary schools. Elementary and high schools are in Tekamah, Lyons, Oakland, and Decatur. Churches are in towns throughout the county.

trends in farming and soil use

Farming has been a major part of the economic development in Burt County since the first settlers staked their claims in 1854. Irrigated acreage increased from 640 acres in 1954 to 39,000 acres in 1977. Commercial fertilizers were not in general use before 1954, but 25,494 tons were used in 1977. Nitrogen is the major plant nutrient supplied by commericial fertilizers.

Corn is the chief cultivated crop in the county. Soybeans have steadily increased in acreage since 1954. The acreage of oats planted has shown a decrease and the acreage of alfalfa, winter wheat, wild hay, and grass crops has also declined slightly.

The number of livestock for meat production, such as cattle and hogs, has increased in the past 23 years, while the number of sheep and chickens has decreased.

Bluegrass sod is a commercial crop on some farms. Small vegetable gardens on farms provide fresh vegetables for family use and for some local markets. Popcorn is a cash crop and is sold outside the county. The acreage of each of these specialty crops is small.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one soil association can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one soil association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Zook-Colo association

Deep, poorly drained and somewhat poorly drained, nearly level, silty and clayey soils formed in alluvium; on bottom lands

This association consists mainly of nearly level areas on bottom lands in the valleys of Logan, Bell, and Blackbird Creeks and along the valleys of a few of the minor creeks. In places, it consists of small areas on stream terraces and foot slopes. Areas are long and narrow.

This soil association occupies about 6 percent of the county. Zook soils make up about 46 percent of this association, and Colo soils make up about 29 percent. The remaining 25 percent is soils of minor extent.

The Zook soils are nearly level, deep, and poorly drained. They are on the lowest parts of the bottom lands. Typically, the surface layer is black, firm silty clay loam about 29 inches thick. The subsoil is very dark gray, very firm silty clay about 15 inches thick. The underlying material to a depth of 60 inches is dark gray silty clay. In places the surface layer is silty clay.

The Colo soils are nearly level, deep, and somewhat poorly drained. They are slightly higher than Zook soils on bottom lands. Typically, the surface layer is very dark brown, black, and very dark gray, firm silty clay loam about 30 inches thick. Below the surface layer is a layer that is transitional to the underlying material. It is very dark gray, mottled, firm silty clay loam about 8 inches thick. The underlying material is very dark gray and grayish brown silty clay loam to a depth of 60 inches.

Of minor extent in this association are the Holly Springs, Judson, Calco, and Solomon soils. The Holly Springs and Calco soils are poorly drained, calcareous, and are on bottom lands. The Judson soils are well drained, gently sloping, and are on foot slopes. The Solomon soils are poorly drained, calcareous, clayey, and are on bottom lands.

Most areas of this association are used for cultivated crops, mainly corn, soybeans, alfalfa, small grain, and sorghum. A few areas are planted to introduced grasses that are used for pasture or cut for hay. Most of the areas are farmed under dryland conditions, but some areas are irrigated. Irrigation is by the gravity method or by sprinklers, and the water is pumped from wells or from Logan or Bell Creeks.

Wetness resulting from the underlying water table and occasional flooding are the principal concerns of management. Surface drainage is needed in places, particularly on the Zook soils. Subsurface perforated tile is suitable for improving drainage on the more permeable Colo soils. Effective drainage aids in more timely tillage operations. Maintaining high fertility, maintaining good tilth on the clayey soils, and good management of irrigation water are also concerns.

Farms average about 240 acres. Few farmsteads are in this association because of the flooding and wetness. Farming is diversified. It consists mainly of a combination of cash-grain farming and livestock operations. Soybeans and some alfalfa hay are grown for cash. However, most of the grain and hay is fed to cattle and hogs that are being raised for market. Most cash crops and livestock are marketed locally, but some livestock is shipped to terminal markets outside the county. Some farms are used for dairying. Some of the milk produced is shipped by trucks to dairy processing plants outside the county. Markets for produce are readily available.

2. Moody-Nora-Judson association

Deep, well drained, nearly level to strongly sloping, silty soils formed in loess and colluvium; on uplands and foot slopes

This association consists mainly of alternating divides on uplands that are dissected by narrow drainageways. Nearly level areas are on the broad divides. The narrow divides and colluvial foot slopes are gently sloping, and the side slopes are strongly sloping (fig. 2).

This association occupies about 36 percent of the county. Moody soils make up about 51 percent of this association, Nora soils 20 percent, and Judson soils 11 percent. The remaining 18 percent is soils of minor extent.

The Moody soils are nearly level to strongly sloping, deep, and well drained. They are on broad divides, ridgetops, and side slopes of the loess uplands. Typically, the surface layer is very dark grayish brown, friable silty clay loam about 11 inches thick. The subsoil is dark brown, brown, and pale brown, friable silty clay loam about 42 inches thick. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

The Nora soils are strongly sloping and moderately steep, deep, and well drained. They are on narrow ridgetops and side slopes of loess uplands. Typically, the surface layer is very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is very dark grayish brown, dark brown, and olive brown, friable silty clay loam and silt loam about 20 inches thick. The underlying material is light olive brown and grayish brown silt loam to a depth of 60 inches.

Judson soils are gently sloping, deep, and well drained. They are on colluvial foot slopes at the base of adjacent loess uplands. Typically, the surface layer is very dark brown, black, and very dark grayish brown, friable silty clay loam about 34 inches thick. The subsoil is brown and dark yellowish brown, friable silty clay loam to a depth of 60 inches.

Of minor extent in this association are the Colo, Belfore, Calco, Kennebec, and Crofton soils. The Colo soils are nearly level and somewhat poorly drained. They are on bottom lands along the lower reaches of the upland drainageways and in the larger stream valleys. The Belfore soils are nearly level, deep, and well drained. They are on the broad upland divides. The Calco soils are nearly level, calcareous, and poorly drained or very poorly drained. They are on narrow

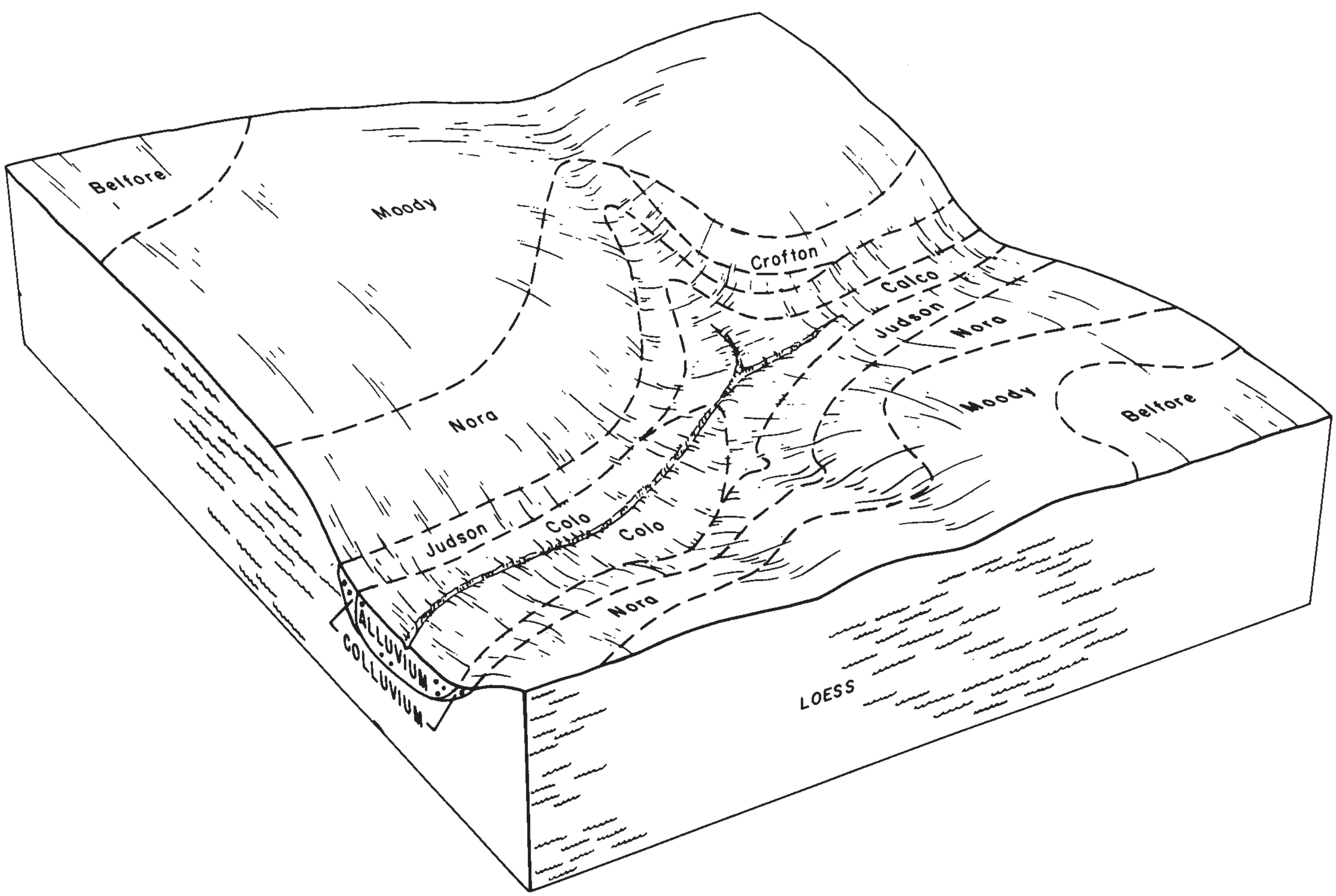

Figure 2.—Typical pattern of soils in the Moody-Nora-Judson association and their relationship to topography and parent material.

bottom lands along the upper reaches of the upland drainageways. The Kennebec soils are nearly level and moderately well drained. They are on bottom lands of the large upland drainageways. The Crofton soils are strongly sloping to moderately steep and well drained. They are on convex ridges and hillsides of the loess uplands.

Most areas of this association are used for cultivated crops, mainly corn, soybeans, alfalfa, small grain, and grain sorghum. Some small areas are planted to introduced grasses or a mixture of grasses and legumes. Some farms are irrigated by gravity methods or by sprinklers, generally the self-propelled, rotary type. Corn, soybeans, and alfalfa are the major irrigated crops. The potential for irrigation is moderate because a sufficient supply of irrigation water is not available in some areas.

Controlling erosion, conserving water, and maintaining fertility are the chief concerns of management. Wetness limits uses of the soils in some areas in the upland drainageways.

Farms average about 300 acres. Farming is diversified. The main enterprise is a combination of cash-grain farming and livestock operations. Soybeans are grown for cash. Much of the grain and hay is fed to cattle and hogs that are fattened for market. Most of the other farm produce is marketed locally. Fattened cattle and hogs commonly are marketed locally or shipped to terminal markets.

3. Ida-Monona-Judson association

Deep, well drained to excessively drained, gently sloping to very steep, silty soils formed in loess and colluvium; on uplands and foot slopes

This association consists of areas on loess uplands, bluffs, and foot slopes. The bluffs border the Missouri River Valley and are mainly loess and sandstone. The strongly sloping or moderately steep loess uplands are adjacent to the bluffs. These uplands are dissected by many drainageways that drain directly into the Missouri River (fig. 3). The gently sloping, colluvial foot slopes are adjacent to the uplands.

This association occupies about 23 percent of the county. Ida soils make up about 30 percent of this

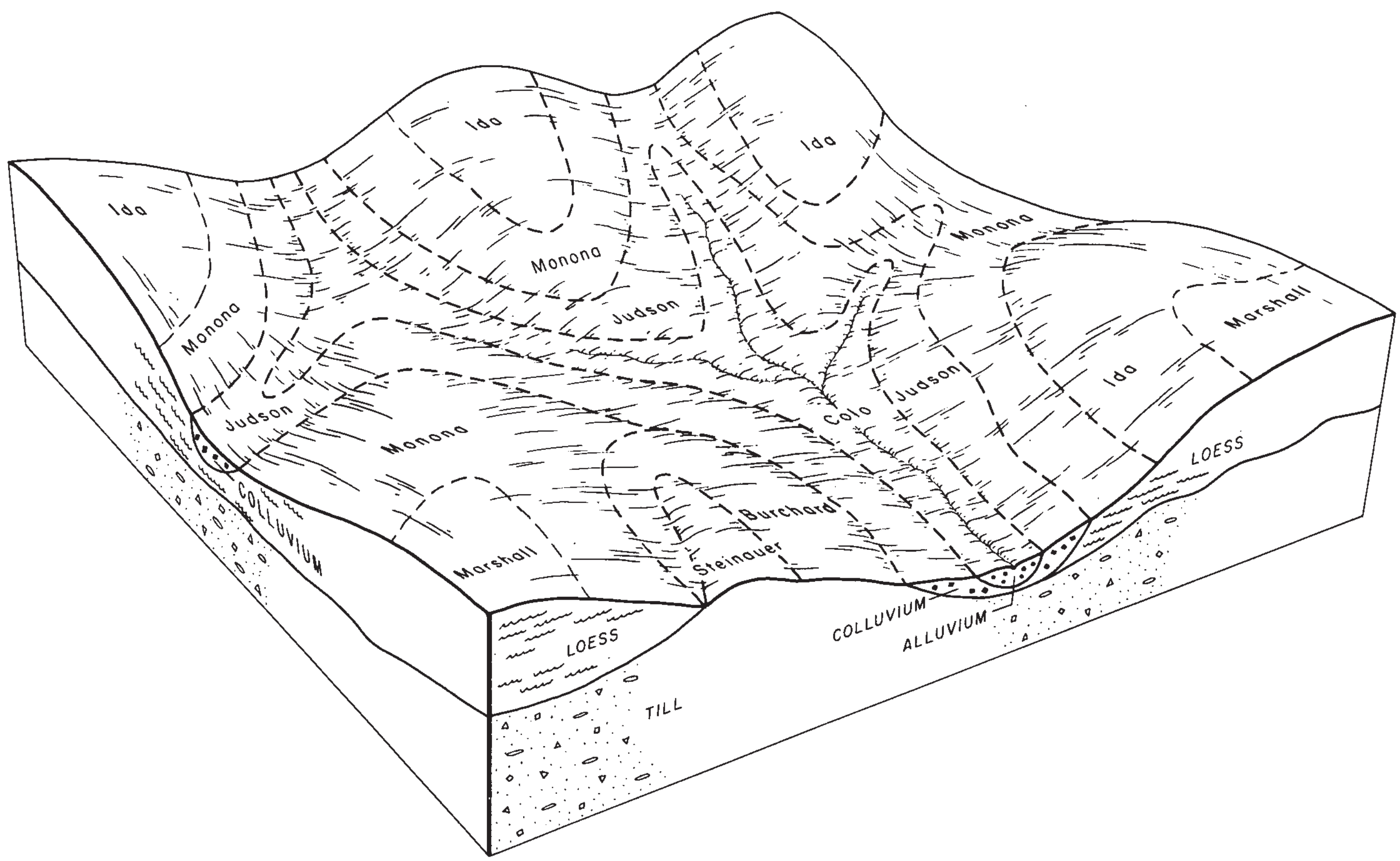

Figure 3.—Typical pattern of soils in the Ida-Monona-Judson association and their relationship to topography and parent material.

association, Monona soils 21 percent, and Judson soils 15 percent. The remaining 34 percent is soils of minor extent.

The Ida soils are strongly sloping to very steep. They are on narrow ridgetops and side slopes and are the dominant soils on bluffs of the Missouri River Valley. They are deep, well drained to excessively drained, and calcareous. Typically, the surface layer is dark brown, very friable silt loam about 7 inches thick. Beneath this the underlying material is brown and yellowish brown, calcareous silt loam to a depth of 60 inches.

The Monona soils are strongly sloping to moderately steep. They are on side slopes of the loess uplands, and are commonly in areas that are dissected by many drainageways and gullies. These soils are deep and well drained. Typically, the surface layer is very dark grayish brown, friable silt loam about 11 inches thick. The subsoil is dark brown and brown, friable silt loam about 19 inches thick. The underlying material to a depth of 60 inches is brown silt loam.

The Judson soils are gently sloping. They are on foot slopes below loess uplands and are deep and well drained. Typically, the surface layer is very dark brown, black, and very dark grayish brown, friable silty clay loam about 34 inches thick. The subsoil is brown and dark yellowish brown, friable silty clay loam to a depth of 60 inches.

Of minor extent in this association are the Buchard, Colo, Marshall, Steinauer, and Kennebec soils. The Burchard soils are strongly sloping to moderately steep and are on the lower side slopes and rounded knobs. They formed in glacial till. The Colo soils are nearly level, somewhat poorly drained, and are on bottom lands along lower reaches of the upland drainageways. The Marshall soils are nearly level to gently sloping, well drained, and are on the loess uplands. The Steinauer soils are excessively drained, moderately sloping to steep, and are on side slopes of the glacial till uplands. The Kennebec soils are moderately well drained, nearly level, and are on bottom lands.

Most areas of this association are used for cultivated crops, mainly corn, soybeans, alfalfa, small grain, and grain sorghum. A few areas are planted to introduced grasses and are used for pasture. Native grasses or stands of native trees are in small areas. The grasses are grazed or cut for hay. A small acreage of this association is irrigated by center-pivot sprinklers with water from deep wells. Deep wells that supply sufficient water for irrigation are difficult to obtain in this association.

Controlling erosion, conserving water, and maintaining fertility are the principal concerns of management. Wetness and occasional flooding delay planting early in spring in some years.

Farms average about 320 acres. Farming is diversified. The main enterprise is cash crops. There are some cash-grain farms and some livestock operations. Soybeans and most of the corn and alfalfa hay are grown for cash. Some grain and hay is fed to cattle and hogs that are being fattened for market. Most of the farm produce is marketed locally. Fattened cattle and hogs are commonly marketed locally or are shipped to terminal markets. Markets for most farm products are readily available.

4. Luton-Solomon-Forney association

Deep, poorly drained, nearly level, clayey soils formed in alluvium; on bottom lands

This association consists of nearly level areas on high bottom lands in the Missouri River Valley (fig. 4). The soils formed in fine textured sediment deposited by water. The seasonal high water table fluctuates between a depth of 1 and 3 feet, but is generally at a depth of about 4 feet in the growing season.

This association occupies about 18 percent of the county. Luton soils make up about 24 percent of this association, Solomon soils 18 percent, and Forney soils 16 percent. The remaining 42 percent is soils of minor extent.

The Luton soils are on the lower parts of the landscape. They are deep, nearly level, and poorly drained. Typically, the surface layer is very dark gray and black, very firm silty clay about 27 inches thick. The subsoil is dark olive gray and olive gray, very firm silty clay about 19 inches thick. The underlying material is olive gray clay to a depth of 60 inches.

The Solomon soils are on the lowest part of the landscape. They are deep, nearly level, and poorly drained. Typically, the surface layer is black, very firm, calcareous silty clay about 20 inches thick. The subsoil is very dark gray, very firm, mottled silty clay about 20 inches thick. The underlying material is dark gray silty clay to a depth of 60 inches. Fragments of snail shells and carbonate concretions are in most parts of the soil.

The Forney soils are on slightly higher positions than Solomon or Luton soils. They are deep, nearly level, and poorly drained. Typically, the surface layer is very dark gray, very firm silty clay about 9 inches thick. The underlying material is dark grayish brown, black, and dark olive gray stratified silty clay to a depth of 60 inches.

Of minor extent in this association are the Blencoe, Blyburg, Owego, Holly Springs, Salix, Omadi, and Woodbury soils. The Blencoe, Blyburg, Salix, and Omadi soils are nearly level and are in slightly higher areas of the bottom lands. The Holly Springs, Woodbury, and Owego soils are in the low areas at about the same elevation as the major soils.

Most areas of this association are used for cultivated crops. The principal crops are corn, soybeans, alfalfa, and grain sorghum. A few areas are planted to introduced grasses and are commonly used for grazing. Some areas of this association are irrigated. Irrigation is by gravity methods or by center-pivot sprinklers, and generally the water is pumped from wells. Occasional

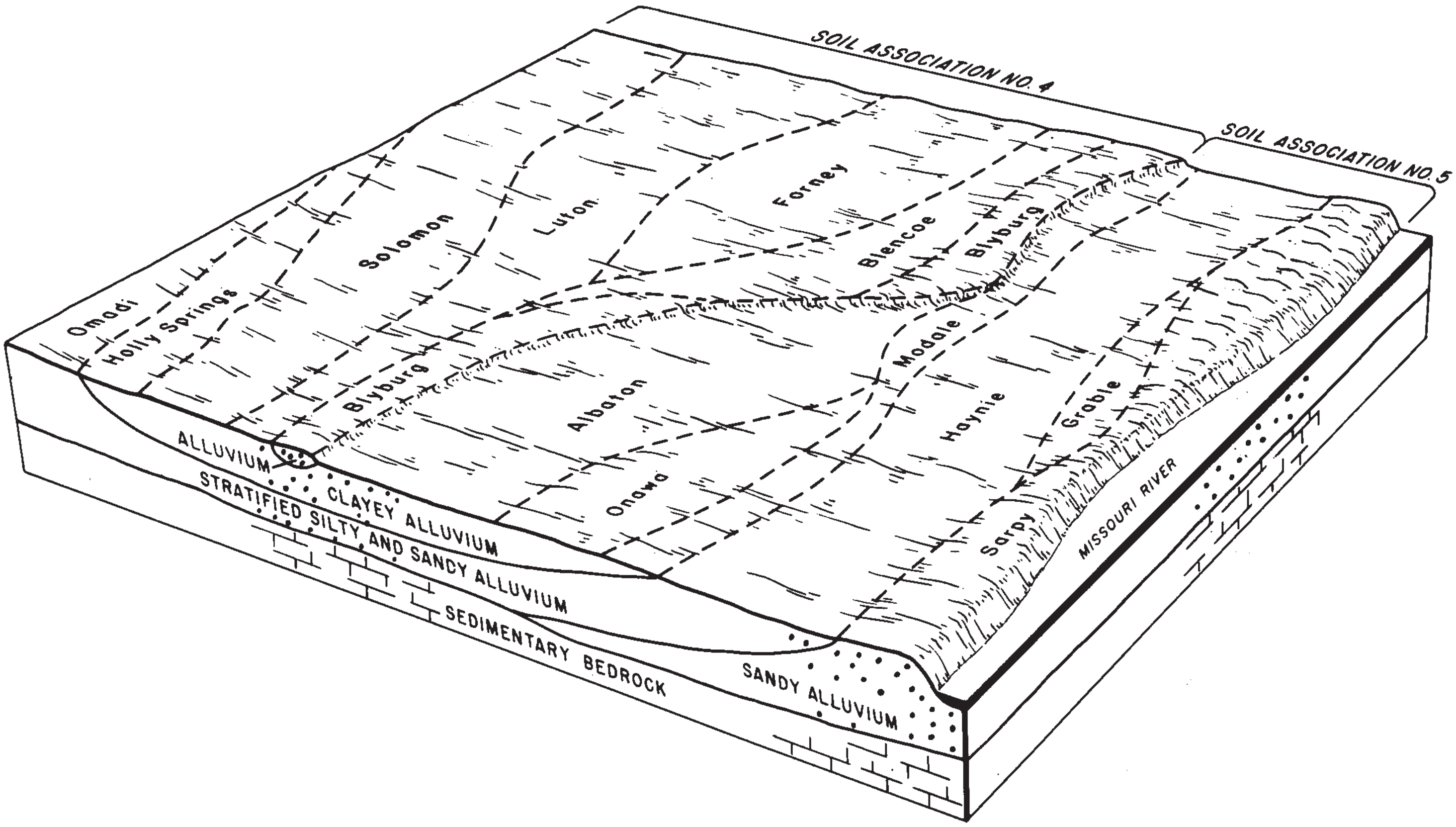

Figure 4.—Typical pattern of soils in the Luton-Solomon-Forney and the Haynie-Albaton-Sarpy associations and their relationships to topography and parent material.

flooding, wetness due to the water table, and poor soil workability are the major concerns of management. Surface ditches or land grading is generally needed to improve the drainage and permit timely tillage operations. Maintaining soil fertility, improving tilth on the clayey soils, and good water management of irrigation water are also concerns.

Farms average about 320 acres. Few farmsteads are in this association because of the flooding hazard and soil wetness. Cash-grain farming is the main enterprise. Most of the grain and hay are sold locally. Some grain is shipped to markets outside the county.

5. Haynie-Albaton-Sarpy association

Deep, moderately well drained, poorly drained, and excessively drained, nearly level and gently sloping, silty, clayey, and sandy soils formed in alluvium; on bottom lands

This association consists of areas on low bottom lands in the Missouri River Valley. The areas are nearly level, except some sandy areas near the river (see fig. 4). The soils formed in clayey, silty, or sandy sediment deposited by floodwater.

This association occupies about 8 percent of the county. Haynie soils make up about 26 percent of the association, Albaton soils 20 percent, and Sarpy soils 16 percent. The remaining 38 percent is soils of minor extent.

The Haynie soils are nearly level, deep, and moderately well drained. They are on the higher parts of the landscape. Typically, the surface layer is very dark grayish brown, very friable silt loam about 7 inches thick. The upper part of the underlying material is dark grayish brown, mottled, stratified silt loam and very fine sandy loam. Below this to a depth of 60 inches, the underlying material is dark grayish brown, mottled silt loam that has thin layers of silty clay loam and silty clay.

The Albaton soils are nearly level, deep, and poorly drained. They are on the lowest part of the landscape. Typically, the surface layer is very dark grayish brown, very firm silty clay about 8 inches thick. The underlying material is dark grayish brown, dark gray, and olive gray, mottled, stratified silty clay to a depth of 60 inches.

The Sarpy soils are nearly level to gently sloping, deep, and excessively drained. They are on bottom lands that are near channels of the Missouri River. Typically, the surface layer is dark grayish brown, loose fine sand about 4 inches thick. The underlying material is grayish brown, calcareous fine sand to a depth of 60 inches.

Of minor extent in this association are the Onawa, Grable, Modale, and Percival soils. These soils are nearly level and are on slightly higher positions in the landscape than the Albaton soils.

Most areas of this association are used for cultivated crops. The principal crops are corn, soybeans, and grain sorghum. Small areas have been planted to introduced grasses and are used for grazing. Along the Missouri River, trees are in small areas. Some farms are irrigated by gravity methods or by center-pivot sprinklers. Corn and soybeans are the principal irrigated crops. Potential for irrigation is high because a good supply of underground water is available.

Occasional flooding is the principal hazard to soils in this association, and wetness from the underlying water table is the principal limitation. Surface drainage is needed in places, particularly on the fine textured soils. A good drainage system aids timely tillage operations. Maintaining high fertility, increasing tilth on the Albaton soils, controlling weeds, and good management of irrigation water are the major concerns.

Farms average about 340 acres. Few farmsteads are in this association because of the flooding and wetness. Cash-grain farming is the main enterprise. Most of the grain crops are marketed locally, but some are shipped to grain terminals. Markets for most farm products are easily available.

6. Belfore-Moody-Marshall association

Deep, well drained, nearly level, silty soils formed in loess; on stream terraces

This association consists mainly of nearly level areas on stream terraces that are a part of the Logan Creek and Missouri River Valleys.

This association occupies about 4 percent of the county. Belfore soils make up about 67 percent of the association, Moody soils 15 percent, and Marshall soils 13 percent. The remaining 5 percent is soils of minor extent.

The Belfore soils are nearly level, deep, and well drained, They are on broad, nearly level stream terraces west of Logan Creek. Typically, the surface layer is very dark grayish brown, friable silty clay loam about 16 inches thick. The subsoil is dark brown and brown, friable silty clay loam about 30 inches thick. The underlying material is brown and pale brown silty clay loam to a depth of 60 inches.

The Moody soils are nearly level, deep, and well drained. They are on stream terraces east of Logan Creek. Typically, the surface layer is very dark grayish brown, friable silty clay loam about 15 inches thick. The subsoil is brown and yellowish brown, friable silty clay loam. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

The Marshall soils are nearly level, deep, and well drained. They are on stream terraces in the Missouri River Valley. Typically, the surface layer is very dark gray, friable silty clay loam about 15 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part of the subsoil is dark brown, the middle part is dark yellowish brown, and the lower part is yellowish brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

Of minor extent in this association are the Colo, Calco, and Judson soils. The somewhat poorly drained Colo and Calco soils are on bottom lands. The well drained Judson soils are on foot slopes on the loess uplands.

Most areas of this association are used for cultivated crops, mainly corn, soybeans, alfalfa, grain sorghum, and small grain. A few areas are planted to introduced grasses that are grazed or cut for hay. Some areas in this association are irrigated by gravity methods or sprinklers. Water is pumped from wells or from Logan Creek. The potential for irrigation is good because a sufficient supply of irrigation water is generally available.

Conserving water, maintaining fertility, and controlling weeds are the principal concerns of management.

Farms average about 240 acres. Farming is diversified. The main enterprise is a combination of cash-grain farming and livestock and dairy operations. Soybeans are grown for cash. Much of the grain and hay is fed to cattle and hogs that are raised and fattened for market. Fattened cattle and hogs commonly are marketed locally. Most of the farm produce is marketed locally, but a small percentage is shipped to terminal markets. Markets are readily available.

7. Ida-Burchard-Steinauer association

Deep, well drained to excessively drained, strongly sloping to very steep, silty and loamy soils formed in loess and glacial till; on uplands

This association consists of areas on uplands. A part of the areas are on bluffs that border the Missouri River Valley. The rest are on strongly sloping or moderately steep side slopes and ridgetops that are dissected by creeks and intermittent drainageways that drain to the Missouri River. Most areas are convex, but the lower slopes in some areas are concave.

This association occupies about 5 percent of the county. Ida soils make up about 32 percent of the association, Buchard soils 27 percent, and Steinauer soils 17 percent. The remaining 24 percent is soils of minor extent.

The Ida soils are strongly sloping to very steep. They are deep, well drained to excessively drained, and calcareous. These soils are on narrow, convex ridgetops and side slopes on uplands. They formed in loess. Typically, the surface layer is dark brown, friable silt loam about 8 inches thick. The underlying material is brown, calcareous silt loam to a depth of 60 inches.

The Burchard soils are strongly sloping to moderately steep. They are deep, well drained, and moderately permeable. These soils are on lower concave side slopes and low, rounded, convex knolls. They formed in glacial till. Typically, the surface layer is dark grayish brown, firm clay loam about 8 inches thick. The subsoil is dark yellowish brown and light olive brown, firm clay loam about 22 inches thick. The lower part of the subsoil is mottled and has many small masses of soft lime. The underlying material is mottled, light olive brown clay loam to a depth of 60 inches.

The Steinauer soils are moderately steep to steep. They are deep, somewhat excessively drained, and calcareous. These soils are on convex side slopes on uplands, commonly in a band along the middle or upper part of the slope. They are also on narrow, convex ridgetops and points of ridges. These soils formed in glacial till. Typically, the surface layer is dark grayish brown, firm clay loam about 7 inches thick. Beneath this is the clay loam underlying material. The upper part of the underlying material is pale brown and has reddish brown mottles and soft masses of lime; the lower part to a depth of 60 inches is pale brown and has concretions of lime.

Of minor extent in this association are the Monona, Judson, Colo, and Kennebec soils. The Monona soils are strongly sloping to moderately steep and well drained. They are on side slopes of loess uplands. The Judson soils are gently sloping and well drained. They are on colluvial foot slopes at the base of adjacent uplands. The Colo soils are nearly level and somewhat poorly drained. They are on bottom lands along the lower reaches of narrow, upland drainageways. The Kennebec soils are moderately well drained and nearly level. They are on bottom lands of drainageways.

Most areas of this association are used for cultivated crops. The principal crops are corn, alfalfa, small grain, and grain sorghum. Some soybeans are grown. A few areas are planted to introduced grasses and are used for pasture. Small areas of native rangeland or stands of native trees are along the bluffs or creek bottoms. The native grasses are grazed by cattle or cut for hay. Deep wells that supply sufficient water for irrigation are extremely difficult to obtain in this association.

Controlling erosion, conserving water, and maintaining fertility are the principal concerns of management. Wetness and occasional flooding delay planting early in spring in some years on the bottom lands in upland drainageways.

Farms average about 400 acres. Farming is diversified. About half of the farm enterprises are a combination of cash-grain farms and livestock operations. The rest are cash-grain farms. Soybeans, winter wheat, and most of the corn are grown for cash. However, most of the hay, grain sorghum, and oats are fed on the farm to cattle and hogs that are fattened for market.

Nearly all the farm produce is marketed locally. Fattened cattle and hogs commonly are marketed locally, but a small percentage of the livestock is shipped to terminal markets in large cities. Markets are readily available.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Crofton silt loam, 6 to 11 percent slopes, eroded, is one of several phases in the Crofton series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Sarpy-Grable Variant complex, 0 to 6 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimilar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Some soil boundaries and soil names may not match those of adjoining areas in adjacent counties. This can be a result of changes in mapping guidelines, slope groupings, correlation procedures, or concepts of soil classification.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Ab—Albaton silty clay, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is on bottom lands in the Missouri River Valley. This soil is occasionally flooded. Areas range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown, very firm silty clay about 8 inches thick. The underlying material to a depth of 60 inches is stratified, dark grayish brown and dark gray, mottled silty clay. The profile is calcareous throughout.

Included with this soil in mapping are small areas of Modale silt loam, Onawa silty clay, and Percival silty clay. Shallow swales and old stream channels are in some areas. The included soils are in slightly elevated areas and make up less than 5 percent of this map unit.

This Albaton soil has very slow permeability and moderate available water capacity. Content of organic matter is moderate, and natural fertility is low. Runoff is slow. The seasonal high water table ranges from a depth of about 1 foot in most wet years to a depth of about 3 feet in most dry years. It is slightly lower in the growing season. Tilth is generally poor, and this soil can be successfully tilled in only a fairly narrow range of soil moisture. Shrink-swell potential is high.

Most areas of this soil are used for farming. Some areas are irrigated. A few areas are in farmsteads and small wooded areas.

If this soil is used for dryland farming, it is suited to corn, soybeans, alfalfa, and sorghum and to introduced grasses for pasture. The main limitations for dryland farming are poor surface drainage, slow permeability, a high water table, and the clayey surface layer. Also, inadequate moisture as well as an uneven distribution of moisture limits crop production. To lessen tillage in spring when this soil is the wettest, many areas are tilled in fall by discing, plowing, or chiseling. Many areas have a system of surface ditches to improve runoff. Conservation tillage practices that keep crop residue on the surface are needed.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, tame grasses, and small grain. Because of the seasonal high water table, wetness is the main limitation. This soil is very sticky when wet and very hard when dry, and workability is generally poor. It should be tilled at the proper moisture content. In places, some land leveling is needed for gravity irrigation. A tailwater recovery system can be installed at the lower end of fields to recycle runoff irrigation water. Irrigation by sprinkler is suitable, but the low intake rate of this soil requires a slow application rate. Growing deep rooted legumes, such as alfalfa, helps improve permeability.

Only a small acreage of this soil is used for introduced grasses for pasture, although it is well suited to this use. Most cool-season grasses do well, but commercial fertilizers are needed to obtain maximum yields. Proper stocking and restricted use during wet periods help keep the grasses in good condition.

Where this soil is used for windbreaks, it is suited to trees and shrubs that tolerate a high water table. Planting and tillage of the trees are commonly delayed early in spring because of wetness. Competition from grasses and weeds is the principal hazard to establishment of seedlings. Careful spraying with a suitable herbicide helps control undesirable grasses and weeds. A light cultivation and supplemental watering can be used to close cracks caused by shrinking of the soil in dry weather.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suited to septic tank absorption fields because of flooding, wetness, and very slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill material and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil are important to the design of roads and streets. The use of coarse grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling.

This soil is in capability unit IIIw-1 dryland and capability unit IIIw-1 irrigated. It is in windbreak suitability group 2w.

Ac—Albaton silty clay, depressional, 0 to 1 percent slopes. This soil is deep, nearly level, and very poorly drained. It is in slightly depressed or narrow swalelike areas on bottom lands in the Missouri River Valley. This soil is frequently flooded. Areas are long and narrow and range from 5 to 30 acres.

Typically, the surface layer is very dark gray, very firm silty clay about 4 inches thick. The upper part of the underlying material is black, very dark gray, and dark gray, mottled silty clay that has thin strata of silt loam and very fine sandy loam less than 3 inches thick. The lower part of the underlying material is stratified, gray and olive gray, mottled silty clay. This profile is calcareous throughout.

Included with this soil in mapping are small intermittent lakes in the lower channeled areas. These lakes make up less than 10 percent of this map unit.

This Albaton soil has very slow permeability and moderate available water capacity. Content of organic matter and natural fertility are low. Runoff is slow or is ponded. The seasonal high water table ranges from 6 inches above the surface in wet years to a depth of 2 feet in dry years. Shrink-swell potential is high. Tilth is poor. This soil is too wet most of the year to cultivate; however, small areas are cultivated with adjacent fields.

About half of the areas of this soil are wooded; the rest have been cleared. Only a small acreage is tilled. Weeds generally take over where cultivation is attempted.

This soil is not suited to common cultivated crops because of the high water table, wetness, slow runoff or ponding, and frequent flooding. Introduced grasses for pasture are not suited because of the wetness.

This Albaton soil is not suited to windbreaks because of the high water table, wetness, and frequent flooding. Trees can be planted by hand to provide habitat for wildlife.

This soil is not suited to building sites and sanitary facilities because of the hazard of flooding and ponding for very long periods; therefore, alternate sites on other soils that are suited to these uses should be considered. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill material and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by the use of a gravel moisture barrier in the subgrade and by providing good surface drainage. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit Vw-7 dryland. It is in windbreak suitability group 10.

Be—Belfore silty clay loam, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. This soil formed in loess on uplands. It generally is on the highest part of the landscape on broad divides. Areas range from 10 to 240 acres.

Typically, the surface layer is friable silty clay loam about 14 inches thick. It is very dark brown in the upper part and very dark grayish brown in the lower part. The subsoil is silty clay loam about 34 inches thick. It is dark grayish brown and firm in the upper part, dark brown and dark yellowish brown and firm in the middle part, and olive brown and friable in the lower part. The underlying material to a depth of 60 inches is light olive brown, mottled silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Fillmore silt loam in shallow depressions and the gently sloping Moody silty clay loam on long narrow ridgetops. The included soils make up about 5 to 8 percent of this map unit.

This Belfore soil has moderately slow permeability and high available water capacity. Runoff is slow. Moisture is released readily to plants. Content of organic matter is moderate and natural fertility is high. Shrink-swell potential is high. The rate of water intake is low. Tilth is good.

Nearly all of the areas of this soil are used for cultivated dryland crops. A small acreage is irrigated. Only a few areas are in native vegetation or pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Conservation of water is an important concern of management. Conservation tillage practices, such as disc-plant or chisel-plant, help conserve moisture and increase the content of organic matter (fig. 5). Lime is needed to reduce soil acidity if alfalfa is grown.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa and to introduced

Figure 5.—Keeping crop residue on the surface of Belfore silty clay loam helps prevent soil blowing and conserves moisture.

grasses for pasture. Row crops can be grown continuously if proper amounts and kinds of fertilizers are applied and if weeds and insects are properly controlled. Conservation tillage practices help conserve moisture. Gravity and sprinkler irrigation can be used for common crops. Land leveling and a tailwater recovery system are generally needed for the most efficient use of water for furrow irrigation. The center-pivot sprinkler irrigation is particularly well suited.

This soil is suited to introduced grasses for pasture. Pasture is generally smooth brome or a mixture of smooth brome and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet can cause surface compaction. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

This Belfore soil is suited to trees and shrubs in windbreaks. Ability of adapted species to grow is fair. Competition for moisture from weeds and grasses is the most important limitation to seedling trees. Weeds can be controlled in windbreaks by cultivating between the rows, by hand hoeing within the rows, or by careful use of appropriate herbicides. Newly planted trees need supplemental moisture during periods when rainfall is not sufficient.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption area. The high shrink-swell potential is a limitation for building sites. Foundations for buildings need to be designed so that they have sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and high shrink-swell potential of this soil are limitations for roads and streets. The use of coarser grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime helps prevent excessive shrinking and swelling and increases strength. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil.

This soil is in capability unit I-1 dryland and capability unit I-3 irrigated. It is in windbreak suitability group 3.

Bf—Belfore silty clay loam, terrace, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It is on stream terraces. Areas range from 6 to 120 acres.

Typically, the surface layer is friable silty clay loam about 16 inches thick. It is very dark grayish brown. The subsoil is friable silty clay loam about 30 inches thick. It is dark brown in the upper part and brown and mottled in the lower part. The underlying material is brown and pale brown silty clay loam to a depth of 60 inches. The underlying material is calcareous, mildly alkaline, and mottled. In small areas the surface layer is 16 to 24 inches thick, and in places the surface layer is silt loam.

Included with this soil in mapping, and making up less than 3 percent of the map unit, are a few alkali areas that range from 1/2 acre to 3 acres. Also included are small areas of Moody and Judson soils that make up about 3 to 10 percent of the map unit. On a low terrace along Logan Creek, this soil has a seasonal high water table at a depth of 4 to 8 feet.

This Belfore soil has moderately slow permeability and high available water capacity. Runoff is slow. Moisture is released readily to plants. The organic matter content and natural fertility are moderate. The rate of water intake is low. Tilth is good. Shrink-swell potential is high.

Nearly all areas of this soil are used for dryland farming. A few areas are irrigated. Small areas are used for native grasses, generally in small plots near farmsteads.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Conservation of water is an important concern of management. Conservation tillage practices and returning crop residue to the soil help conserve moisture, increase organic matter content, and improve fertility. Lime is needed to reduce soil acidity if alfalfa is grown.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, introduced grasses, and small grain. Row crops can be grown continuously if proper amounts and kinds of fertilizers are applied and if weeds and insects are properly controlled. Gravity and sprinkler irrigation can be used for common crops. Land leveling and a tailwater recovery system are generally needed for the most efficient use of water for furrow irrigation. The center-pivot sprinkler irrigation is particularly well suited.

This soil is suited to introduced grasses for pasture. Pasture is generally smooth brome or a mixture of smooth brome and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes compaction. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. The ability of adapted species to survive is good. Competition for moisture from weeds and grasses is the most important limitation to seedling trees in a windbreak. Weeds can be controlled in windbreaks by cultivation between the rows, by hand hoeing within the rows, or by careful use of appropriate herbicides. Newly planted trees need supplemental moisture during periods when rainfall is not sufficient.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption area. The high shrink-swell potential is a limitation for building sites. Foundations for buildings need to be designed so that they have sufficient strength to withstand shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and high shrink-swell potential of this soil are limitations for roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime helps prevent excessive shrinking and swelling and increases strength. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil.

This soil is in capability unit I-1 dryland and capability unit I-3 irrigated. It is in windbreak suitability group 3.

Bn—Blencoe silty clay loam, 0 to 1 percent slopes. This soil is nearly level and somewhat poorly drained. It is on bottom lands in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 20 to 100 acres.

Typically, the surface layer is silty clay loam about 13 inches thick. The upper 10 inches of the surface layer is very dark grayish brown and firm. The lower 3 inches is mottled grayish brown and is friable. The subsoil is firm and is about 24 inches thick. It is very dark gray silty clay in the upper part and very dark gray silty clay loam in the lower part. The underlying material to a depth of 60 inches is dark grayish brown, mottled silt loam.

Included with this soil in mapping are small areas of Blencoe silty clay at a slightly lower elevation and Blyburg soils at a slightly higher elevation. The included soils make up from 3 to 10 percent of this map unit.

This Blencoe soil has slow permeability in the surface layer and subsoil and moderate permeability in the underlying material. The available water capacity is high. Content of organic matter is moderate, and natural fertility is medium. Runoff is slow. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 3 feet in most dry years. Tilth is generally good, and the soil can be cultivated over a wide range of soil moisture. Shrink-swell potential is high in the subsoil and moderate in the underlying material.

About half the areas of this soil are used for dryland farming. Small areas are irrigated, and a few areas are in introduced grasses and are used for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, and alfalfa. Flooding, slow runoff, and the high water table are the principal limitations. Surface drainage ditches in most areas of this soil help increase runoff and lessen the wetness. Conservation tillage practices that leave crop residue on the surface improve tilth and increase the content of organic matter.

If this soil is irrigated, it is suited to corn, soybeans, and grain sorghum and to alfalfa, small grain, and introduced grasses. Soil wetness is the main limitation. Tillage is commonly delayed early in spring. This soil is flooded occasionally, but damage to crops generally is not serious. Leveling is commonly needed for gravity irrigation. Tailwater recovery systems at the lower end of fields help recycle the runoff of irrigation water. Irrigation by sprinklers is well suited to this soil.

This soil is well suited to introduced grasses for pasture, but only small areas are planted to cool-season grasses. Applications of fertilizer are generally needed for maximum forage production of introduced grasses. Proper stocking and rotation grazing help keep the grasses from being overgrazed.

This soil provides a fair site for trees and shrubs in windbreaks. The survival rate for seedlings is fair, and good growth can be obtained where the windbreaks are managed properly. Good seedbed preparation is needed to establish the trees. Timely cultivation and careful spraying with selected herbicides help control competition from weeds and grasses. Species of trees that tolerate occasional wetness need to be selected.

This soil is not suitable for building sites and septic tank absorption fields because of the hazard of flooding and wetness. Sewage lagoons need to be protected from flooding by dikes or be constructed on compacted fill to raise the bottom of the lagoon several feet above the water table. Roads need to be protected from flooding and wetness. They should be constructed on compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by providing good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-2 dryland and capability unit IIw-1 irrigated. It is in windbreak suitability group 2s.

Bo—Blencoe silty clay, 0 to 1 percent slopes. This soil is nearly level and somewhat poorly drained. It is on bottom lands in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 10 to 80 acres.

Typically, the surface layer is very dark gray, very firm silty clay about 15 inches thick. The subsoil is about 21 inches thick. The upper part of the subsoil is very dark gray, very firm silty clay; the middle part is very dark grayish brown, firm silty clay loam and has reddish brown mottles; and the lower part is dark grayish brown, firm silty clay loam. The underlying material is dark grayish brown silt loam and has yellowish brown mottles. In small areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Blyburg, Forney, and Luton soils. The Blyburg soils have less clay in the upper part of the profile and are at a slightly higher elevation. The Forney and Luton soils have more clay in the lower part of the profile and are at a slightly lower elevation. The included soils make up less than 10 percent of this map unit.

This Blencoe soil has slow permeability in the surface layer and subsoil and moderate permeability in the underlying material. Available water capacity is high. Content of organic matter is moderate, and natural fertility is medium. Runoff is slow. The seasonal high water table ranges from a depth of about 1 foot in most wet years to a depth of about 3 feet in most dry years. Tilth is generally poor, and this soil can be successfully tilled only in a fairly narrow range of soil moisture. Shrink-swell potential is high in the subsoil and moderate in the underlying material.

Nearly all areas of this soil are used for dryland farming. Some areas are irrigated, and a few small areas are in pasture or in woods.

If this soil is used for dryland farming, it is suited to corn, soybeans, alfalfa, and grain sorghum and to introduced grasses for pasture. Poor tilth, slow permeability, and a high water table are limitations. Maintaining good tilth and preparing a good seedbed are difficult. Fall tillage lessens the tillage required in spring when the soil is wet. In many areas a system of surface ditches is used to increase runoff. Conservation tillage practices that keep crop residue on the soil surface, such as disc-plant, help improve tilth and intake of water.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum and to close-sown crops, such as alfalfa, small grain, and introduced grasses. Wetness caused by the seasonal high water table is the main limitation. Tillage is difficult because this soil is very firm when moist and very hard and cloddy when dry. Leveling is generally needed for gravity irrigation. Tailwater recovery systems at the lower end of fields help recycle runoff irrigation water. Irrigation by sprinklers is suitable, but the low intake rate of the soil requires a slow application rate.

This soil is suited to introduced grasses for pasture, but only small areas generally adjacent to farmsteads are used for this purpose. Mixtures of cool-season grasses and legumes are suited to this soil and produce good yields of forage if properly fertilized and managed. Rotation grazing and proper stocking help protect the pasture from being overgrazed.

Trees and shrubs in windbreaks are fairly well suited to this soil. Seedlings generally survive and grow if competing grasses and weeds are controlled. This can be accomplished by good site preparation and timely cultivation. Careful and timely application of selected herbicides help control weeds and grasses. Only species that tolerate occasional wetness should be selected.

This soil is not suitable for building sites and septic tank absorption fields because of the flooding and wetness; therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or constructed on compacted fill to raise the bottom of the lagoon several feet above the water table. Roads need to be protected from flooding and wetness. They should be constructed on compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength. Damage to roads by frost action can be reduced by providing good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-1 dryland and capability unit IIw-1 irrigated. It is in windbreak suitability group 2s.

Bs—Blyburg silt loam, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It is on bottom lands in the Missouri River Valley. It formed in calcareous, silty alluvium. Areas of this soil are rarely flooded. Areas range from 20 to 100 acres.

Typically, the surface layer is very dark gray and black, very friable silt loam about 19 inches thick. It is calcareous in the lower part. The upper part of the underlying material is dark brown silt loam, and the lower part to a depth of 60 inches is brown, stratified silt loam and very fine sandy loam. In places, below a depth of 44 inches, are thin strata of material that is finer textured or coarser textured than typical. Also, in small areas that have been leveled, thickness of the surface layer ranges from 5 to 26 inches, depending on the amount of soil removed or filled in.

Included with this soil in mapping are small areas of Blencoe silty clay and Forney silty clay. These Blencoe and Forney soils are at a slightly lower elevation than the Blyburg soils, and they absorb moisture more slowly. The included soils make up 3 to 10 percent of this map unit.

This Blyburg soil has moderate permeability and high available water capacity. Moisture is released readily to plants. Content of organic matter is moderate, and natural fertility is medium. Tilth is good. Runoff is slow. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. A few areas are irrigated, and the rest is mainly in farmsteads and windbreaks.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, grasses, and legumes. If this soil is tilled in fall and the surface remains bare, soil blowing is a hazard. Conservation tillage practices, such as disc-plant, chisel-plant, and no-till plant, help reduce soil blowing, maintain and improve the organic matter content and fertility, and increase infiltration of water and air.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, small grain, and introduced grasses. Row crops can be grown in consecutive years if the proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Good fertility and management of the irrigation water are needed for high production. Gravity and sprinkler systems are suitable for applying irrigation water.

Only a small acreage of this soil is used for introduced grasses for pasture, although it is well suited to this use. Most areas used for pasture are near farmsteads. Forage production of most cool-season grasses is high where a good fertility program is used. Proper stocking and rotation grazing help prevent overgrazing.

This soil is suited to trees and shrubs in windbreaks. Ability of adapted species to survive is good. Seedlings generally obtain good growth if competing weeds and grasses are controlled. This can be accomplished by good site preparation and by careful and timely cultivation between the tree rows. Lack of rainfall is a limitation in some years, and supplemental water for windbreaks may be needed.

If this soil is used for building sites and sanitary facilities, the hazard of rare flooding needs to be considered. Constructing dwellings and buildings on elevated, well compacted fill helps protect them against flooding. Septic tank absorption fields and sewage lagoons need to be protected from flooding by dikes. The slow absorption of effluent is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and maintaining adequate side ditches helps provide good surface drainage.

This soil is in capability unit I-1 dryland and capability unit I-6 irrigated. It is in windbreak suitability group 1.

BtG—Boone-Rock outcrop complex, 20 to 60 percent slopes. This complex consists of moderately deep, excessively drained soils and outcrops of rock on uplands. It commonly is on the lower part of bluffs adjacent to the Missouri River Valley (fig. 6). Slopes are steep and very steep. Areas range from 5 to 100 acres.

Boone soils make up about 60 to 75 percent of this complex and Rock outcrop makes up about 25 to 40 percent.

Typically, the Boone soil has a surface layer of very dark gray, very friable loamy fine sand about 8 inches thick. The underlying material is brown, loose loamy fine sand about 13 inches thick. Weakly cemented sandstone is at a depth of about 21 inches. In places, the surface layer is fine sand.

Typically the Rock outcrop is yellowish brown, very pale brown, pale brown, or brown sandstone that is exposed on the surface. In areas the outcrops are shale.

Included with this complex in mapping, and in similar positions on the landscape, are small areas of glacial till and of deep, well drained Ida silt loam. The inclusions make up 10 to 20 percent of this map unit.

The Boone soils have rapid permeability and low available water capaity. Runoff is rapid. Moisture is readily released to plants. The organic matter content and natural fertility are low. Shrink-swell potential is low.

Native grasses or native trees are in nearly all of the areas of this complex.

The Boone soils are generally not suited to farming because of the steepness of slope and the hazard of erosion. They are better suited to native grasses or trees than to most other uses. A few small areas are cultivated, and these can be reseeded to native grasses.

Overgrazing by livestock reduces and deteriorates the protective plant cover. Proper grazing use, timely deferred grazing, and a planned grazing system of use and rest help improve the native grasses.

The Boone soils are generally not suited to trees and shrubs in windbreaks because most areas are too steep for tree planting machinery and because the soil is too erodible. Scattered stands of adapted species can be planted for wildlife habitat.

Slope is the main limitation of this complex for most uses. Areas of this unit should have onsite investigation before construction is undertaken. Septic tank absorption fields and sewage lagoons are not suited to areas of this map unit; therefore, alternate sites on other soils that are suited to these uses should be considered. The Boone soils in this map unit are poorly suited to building sites and roads because of steepness of slope and the moderate depth to rock. Dwellings and small commercial buildings need to be designed to accommodate the slope. Road construction requires extensive cutting and filling to lessen the grade. The bedrock needs blasting in places. Disturbed areas need to be mulched and revegetated to prevent soil blowing and water erosion.

This complex is in capability unit VIIs-4 dryland and windbreak suitability group 10.

BuD2—Burchard clay loam, 6 to 11 percent slopes, eroded. This soil is deep, well drained, and strongly sloping. It is on side slopes on till uplands. Rills are common after rains. Areas range from 5 to 15 acres.

Typically, the surface layer is dark grayish brown, friable clay loam about 7 inches thick. It has been mixed with material from the upper part of the subsoil by plowing. The subsoil is firm clay loam about 23 inches thick. The upper part of the subsoil is brown, and the lower part is brown, mottled, and calcareous. The upper part of the underlying material is grayish brown, calcareous clay loam about 16 inches thick, and the lower part is light brownish gray, calcareous clay loam to a depth of 60 inches. In places the surface soil is 20 inches thick.

Included with this soil in mapping are small eroded areas of Monona silt loam and Ida silt loam. The included soils make up 10 to 20 percent of this map unit.

This Burchard soil has moderately slow permeability and high available water capacity. Runoff is medium or rapid, depending on the kind and amount of vegetative cover. Moisture is released readily to plants. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is moderate, and hazard of frost action is high. The rate of water intake is low. Tilth is fair.

Figure 6.—An outcrop of Dakota sandstone in Boone-Rock outcrop complex, 20 to 60 percent slopes. Native grasses and trees, such as sumac, dogwood, and green ash, grow on this soil.

Nearly all areas of this soil are used for dryland farming. Very few areas are irrigated. A few areas are in introduced grasses that are used for pasture, and a few areas are wooded.

If this soil is used for dryland farming, it is suited to corn, grain sorghum, small grain, grasses, and alfalfa. Because of the slope, close-grown crops are better suited than row crops. Conservation of water is needed because of the slope and runoff. Terraces help conserve surface water and prevent erosion. Conservation tillage practices help conserve moisture for use by crops and prevent excessive loss of moisture by evaporation. Erosion by water is the principal hazard. Terracing, farming on the contour, and using grassed waterways help prevent erosion. Improving fertility is important on this eroded soil and can be accomplished by using barnyard manure and commercial fertilizer and by conserving crop residue.

This soil is suited to irrigation. The main crops are corn, alfalfa, small grain, and introduced grasses. Because of the hazard of erosion and the difficulty of managing water efficiently, sprinklers are better suited than other methods of irrigation. Keeping a large amount of crop residue on the surface and using contour farming, grassed waterways, and terraces help prevent erosion.

This soil is suited to such introduced grasses for pasture as smooth brome or a mixture of smooth brome and alfalfa or orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Ability of adapted species to survive is fair. Competition for moisture from weeds and undesirable grasses is an important limitation. Weeds and grasses in the row can be controlled by cultivation with a disc, by hand hoeing or rototilling, or by careful use of appropriate herbicides. Erosion and loss of moisture by runoff can be controlled by planting a cover crop between the rows of trees or by planting trees on the contour in combination with terraces. In places, newly planted trees may need supplemental watering when moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. Grading is needed to modify the slope for these uses. Sewage lagoons require extensive grading to modify the slope and shape the lagoon. The moderately slow permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings need to be designed so that they have sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit IIIe-8 dryland and capability unit IVe-3 irrigated. It is in windbreak suitability group 3.

BuE2—Burchard clay loam, 11 to 17 percent slopes, eroded. This soil is deep, well drained, and moderately steep. It is on side slopes of till uplands. Rills and small gullies are common after heavy rains. Areas range from 10 to 40 acres.

Typically, the surface layer is dark grayish brown, firm clay loam about 8 inches thick. Commonly, it has been mixed with material from the upper part of the subsoil by tillage. The subsoil is firm clay loam about 22 inches thick. The upper part of the subsoil is dark yellowish brown, and the lower part is light olive brown, mottled, and has many small masses of lime. The underlying material is light olive brown, mottled clay loam to a depth of 60 inches. In some areas the surface layer is 8 to 15 inches thick, or the surface layer is loam or silty clay loam.

Included with this soil in mapping are areas of the eroded Steinauer soils on positions similar to this Burchard soil. Also included are small areas of soils that have a profile of reddish loam and sandy loam and soils that have small stones and gravel on the surface because of erosion. The included soils make up 10 to 20 percent of this map unit.

This Burchard soil has moderately slow permeability and high available water capacity. Runoff is medium or rapid depending upon the kind and amount of vegetative cover. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is only fair.

Nearly all areas of this soil are used for dryland farming. Practically none of the areas are irrigated. A few areas are used for introduced grasses.

If this soil is used for dryland farming, it is poorly suited to corn and grain sorghum and is well suited to small grain, introduced grasses, and alfalfa. Erosion by water is the principal hazard. Conservation of water is an important concern of management. Terraces help conserve surface water and prevent erosion. Conservation tillage practices that maintain crop residue on the surface help conserve moisture, control erosion, and improve tilth. Contour farming and grassed waterways help prevent additional erosion. Improving fertility is important on this eroded soil and can be accomplished by use of commercial fertilizers, incorporation of barnyard manure, and management of crop residue.

Irrigation is not suited to this soil because of the moderately steep slopes, the hazard of erosion by irrigation water, and the difficulty of managing the water efficiently.

This soil is suited to introduced grasses for pasture. Pasture generally is smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Rotation grazing, proper stocking, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Capability of adapted species to survive is fair. Weeds and undesirable grasses can be controlled by hand hoeing within the row of trees or by careful use of appropriate herbicides. Erosion and loss of moisture by runoff can be controlled by planting trees on the contour in combination with terraces. Newly planted trees may need supplemental watering when moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. Grading is required for many uses. Septic tank absorption fields can be constructed on the contour after grading. The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Sewage lagoons are not suited to this soil because of the steepness of slope; therefore, alternate sites on other soils that are suited to this use should be considered. Dwellings and small commercial buildings need to be designed to accommodate the slope, or the site needs to be graded to accommodate the structure. The low strength of this soil should be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent erosion.

This soil is in capability unit IVe-8 dryland. It is in windbreak suitability group 3.

Ca—Calco silty clay loam, 0 to 2 percent slopes. This soil is deep, nearly level, and poorly drained. It is commonly on bottom lands in drainageways on uplands. A few areas are on broad bottom lands of Logan and Bell Creeks and in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 5 to 70 acres.

Typically, the surface soil is very dark gray and black, firm silty clay loam about 39 inches thick. The subsoil is very dark gray, mottled, firm silty clay loam about 9 inches thick. The underlying material to a depth of 60 inches is very dark gray, mottled silty clay loam. In most areas, the entire profile is calcareous and has small fragments of snail shells; however, in a few small areas the profile is noncalcareous. In some areas the surface layer is silt loam.

Included with this soil in mapping are small areas of the finer textured Zook soils at a slightly lower elevation. Also included are small areas of Calco silty clay loam, wet, at a lower elevation. The included soils make up less than 8 percent of this map unit.

This Calco soil has moderately slow permeability and high available water capacity. Runoff is slow. The seasonal high water table ranges from a depth of about 1 foot in most wet years to a depth of about 3 feet in most dry years. It is generally highest in spring. Moisture is released readily to plants. Content of organic matter and natural fertility are high. Shrink-swell potential is high in the surface layer and moderate below the surface layer. The rate of water intake is low. Tilth is fair.

Most areas of this soil are used for dryland farming. Only a few areas are irrigated. A few areas are used for introduced grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, small grain, and sorghum. Alfalfa and grasses can be grown for hay and pasture. Row crops can be grown year after year if proper amounts of fertilizers are applied and if weeds and insects are controlled. The principal limitation is soil wetness. Tillage generally is delayed early in spring because of the high water table. Tile drains and surface ditches help lower the water table and control wetness. Dikes along drainageways, dams upstream, or a combination of terraces, grassed waterways, and dams within the watershed help protect this soil from flooding. Conservation tillage practices that keep crop residue on the surface and use of cover crops help maintain good tilth.

If this soil is irrigated, it is suited to corn, grain sorghum, soybeans, introduced grasses, and alfalfa. Wetness, caused by the seasonal high water table, is the main limitation. This soil is subject to flooding on an average of once every 3 to 10 years, but crop losses are generally slight. Where a suitable outlet is available, tile drains or ditches can be installed to help lower the water table. Land leveling or grading helps improve surface drainage and increase efficiency of irrigation. Gravity and sprinkler irrigation are suited.

This soil is suited to introduced grasses for pasture. The pasture is generally smooth brome, brome mixed with alfalfa, or orchardgrass and alfalfa. Grazing when the soil is wet can cause surface compaction and poor tilth. Proper stocking, rotation grazing, and restricted use during wet periods help keep the grasses in good condition. Pasture responds in places to applications of nitrogen and phosphate fertilizers.

Windbreaks and wildlife plantings are suited to this soil. Ability to survive is good for trees and shrubs that tolerate the moderately high water table and occasional flooding. Controlling undesirable grasses and weeds in windbreaks is a concern of management. They can be controlled by clean cultivation, hand hoeing, or careful use of selected herbicides.

This soil is not suitable for building sites and septic tank absorption fields because of the hazard of flooding and wetness. Sewage lagoons need to be protected from flooding by dikes or constructed on compacted fill to raise the bottom of the lagoon several feet above the water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil should be considered in the design of roads and streets. The use of coarse grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by providing good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-4 dryland and capability unit IIw-3 irrigated. It is in windbreak suitability group 2s.

Cb—Calco silty clay loam, wet, 0 to 2 percent slopes. This soil is deep, nearly level, and very poorly drained. It is on bottom lands in flat drainageways that do not have a well defined channel. Areas of this soil are occasionally flooded during periods of heavy rain and high streamflow. Areas range from 3 to 15 acres.

Typically, the surface soil is black, firm silty clay loam about 44 inches thick. The underlying material to a depth of 60 inches is very dark gray, mottled silty clay loam.

Included with this soil in mapping are small areas of the noncalcareous Colo soils. The included soils make up less than 8 percent of this map unit.

This Calco soil has moderately slow permeability and high available water capacity. Runoff is slow. The organic matter content and natural fertility are high. The seasonal high water table is at the surface in most wet years but ranges to a depth of 2 feet in most dry years. The water table is generally highest in spring. Shrink-swell potential is high in the surface soil and moderate in the underlying material.

Most areas of this soil are used for pasture or range, except small areas adjacent to cultivated fields. Areas are also used as habitat for wildlife.

Unless extensively drained, this soil is not suited to common cultivated crops. Perforated tile, land shaping, and V-ditches can provide the internal and external drainage needed.

Areas of this soil are small and are better suited to pastureland and hayland than most other uses. The most common plants are Kentucky bluegrass, sedges, redtop, reed canarygrass, and annual weeds. In most pastureland, artificial drainage is necessary for good production of introduced grasses.

This soil is poorly suited to trees or shrubs in windbreaks. Capability of adapted species to survive is poor. Only those species that tolerate a very high water table and flooding are suited. The establishment of trees and shrubs can be a serious problem in wet years. In places the soil requires special protection to keep seedlings from drowning. If possible, planting should be delayed until the water table has receded to a sufficiently low level.

This soil is not suitable for building sites and sanitary facilities because of flooding and wetness; therefore, alternate sites on other soils that are suited to these uses should be considered. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. The low strength of this soil should be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength.

This soil is in capability unit Vw-7 dryland. It is in windbreak suitability group 10.

Cd—Carr silt loam, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It is on bottom lands in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 10 to 30 acres.

Typically, the surface layer is dark grayish brown, very friable silt loam about 8 inches thick. The underlying material is stratified fine sandy loam, silt loam, and very fine sandy loam about 32 inches thick. The upper part of the underlying material is gray, and the lower part is dark grayish brown and mottled with thin strata of very fine sand, fine sand, and silty clay loam to a depth of 60 inches. In small areas, the surface layer is loam or loamy very fine sand. Loamy very fine sand and fine sand are below a depth of 40 inches.

Included with this soil in mapping are small areas of the finer textured Grable soil at a lower elevation and areas of the coarser textured Sarpy soils at a slightly higher elevation. The included soils make up about 8 to 10 percent of this map unit.

This Carr soil has moderately rapid permeability and moderate available water capacity. Runoff is slow. Moisture is released readily to plants. Organic matter content and natural fertility are low. The rate of water intake is moderately high. Tilth is good. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. Only a few areas are irrigated. A small acreage is in stands of native trees.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, and small grain and to grasses and legumes for hay or pasture. Row crops can be grown in consecutive years if management is at a high level. Droughtiness and soil blowing are common problems in dryland farming. Conservation tillage practices, such as disc-plant and chisel-plant, help control soil blowing, increase organic matter content, and conserve moisture.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. Conservation tillage systems, such as tillage with a disc or chisel and no-till planting, help control soil blowing and prevent moisture from evaporating rapidly. Land leveling is needed for efficient furrow irrigation. The center-pivot and other sprinklers are well suited to this soil.

This soil is suited to introduced grasses for pasture. Pasture is generally smooth brome, smooth brome mixed with alfalfa, or orchardgrass and alfalfa. Proper stocking and rotation grazing help keep the grasses in good condition. Pasture commonly responds well to applications of nitrogen and phosphorous fertilizers.

This soil is suited to windbreaks and to plantings for wildlife habitat. Ability of adapted species to survive and grow is fair. Those trees and shrubs that are suited to a moderately coarse soil and that tolerate somewhat droughty conditions are better suited than most other species. Lack of moisture and soil blowing are the principal hazards in establishing trees. Soil blowing can be reduced or prevented by maintaining strips of sod or a cover crop between the tree rows. Supplemental irrigation of the seedlings may be needed in seasons of insufficient rainfall.

This soil is not suitable for building sites and septic tank absorption fields because of the hazard of flooding.

Sewage lagoons need to be protected from flooding by dikes and need to be sealed or lined to prevent seepage. Roads need to be protected from flooding. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. Damage to roads by frost action can be reduced by the use of a gravel moisture barrier in the subgrade and by providing good surface drainage. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-3 dryland and capability unit IIw-8 irrigated. It is in windbreak suitability group 1.

Cf—Colo silt loam, overwash, 0 to 1 percent slopes. This soil is nearly level and somewhat poorly drained. It is on bottom lands along major drainageways on uplands. Areas of this soil are occasionally flooded. Areas are generally long and narrow and range from 20 to 120 acres.

Typically, the surface soil is very dark grayish brown, friable silt loam about 12 inches thick (fig. 7). Beneath this is a layer of black, friable silty clay loam about 30 inches thick. The underlying material to a depth of 60 inches is very dark gray silty clay loam and has fine, yellowish brown mottles in the lower 18 inches.

Included with this soil in mapping and generally at a slightly lower elevation are small areas of the calcareous Calco silty clay loam and the Colo silty clay loam. Also included are a few small areas of Kennebec silt loam, overwash, at a slightly higher elevation. The included soils make up less than 10 percent of this map unit.

This Colo soil has moderately slow permeability and high available water capacity. Moisture is released readily to plants. The organic matter content is moderate, and natural fertility is high. Runoff is slow. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 3 feet in most dry years. Tilth is good. Shrink-swell potential is high.

Most areas of this soil are used for dryland farming. A few areas are irrigated. A small acreage is in native grasses and trees.

If this soil is used for dryland farming, it is well suited to corn, soybeans, alfalfa, and grain sorghum. Perforated tile, open ditches, and diversion dikes can be constructed on this soil to reduce the wetness. Dikes and terraces on the adjacent, higher lying soils help protect this soil from flooding.

If this soil is irrigated, it is suited to such commonly grown crops as corn, soybeans, grain sorghum, alfalfa, introduced grasses, and small grain. Wetness caused by the seasonal high water table is the main limitation. This soil is subject to occasional flooding in spring and early in summer. Drainage by open ditches or tile drains helps lower the water table, and ditches help remove water where suitable outlets are available. Land leveling or grading helps improve drainage and increase efficiency of irrigation. Gravity and sprinkler irrigation are well suited.

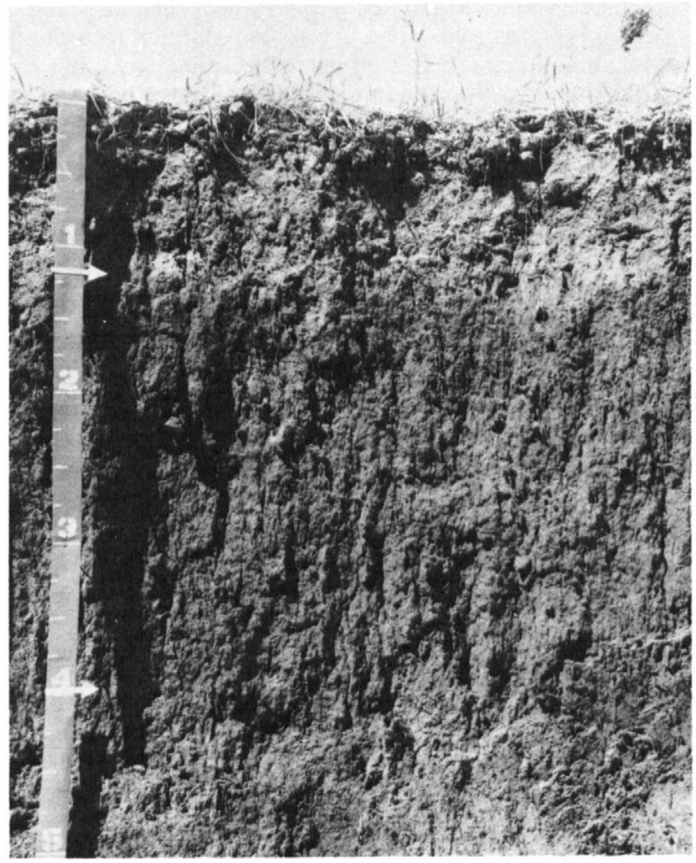

Figure 7.—Profile of Colo silt loam, overwash. The light colored material on the surface is a recent deposit of alluvium over the older Colo profile. The scale is in feet.

This soil is well suited to introduced grasses for pasture and hay. Proper stocking, application of fertilizers, and rotation grazing help keep the grasses in good condition.

Trees and shrubs planted in windbreaks have a good chance to survive and grow if properly managed. Good site preparation, timely cultivation between the rows of trees, and proper use of selected herbicides help insure good growth. Only species that tolerate a moderately high water table should be selected. Those areas that have trees and grass provide fair sites for hunting of upland small game.

This soil is not suitable for building sites and sanitary facilities because of flooding and wetness; therefore, alternate sites on other soils that are suited to these uses should be considered. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. Storm sewers or other suitable outlets are needed to convey runoff. The low strength and high shrink-swell potential of this soil should be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by using a gravel moisture barrier in the subgrade and by providing good surface drainage. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-4 dryland and capability unit IIw-4 irrigated. It is in windbreak suitability group 2s.

Cg—Colo silty clay loam, 0 to 1 percent slopes. This soil is nearly level and somewhat poorly drained. It is on the bottom lands of major upland drainageways. Areas of this soil are occasionally flooded. Areas generally parallel the course of the streams and range from 30 to 100 acres.

Typically, the surface soil is firm silty clay loam about 30 inches thick. The upper part of the surface layer is very dark brown, the middle part is black, and the lower part is very dark gray. Beneath this is a transitional layer of very dark gray, mottled, firm silty clay loam about 8 inches thick. The underlying material to a depth of 60 inches is silty clay loam. It is very dark gray in the upper part and grayish brown in the lower part. The profile is noncalcareous throughout. In small areas the underlying material is silty clay, or stratified, light colored silt loam is on the surface.

Included with this soil in mapping are small areas of Calco, Kennebec, and Judson soils. The Calco soils are calcareous throughout the profile and occupy areas adjacent to the foot slopes. The Kennebec soils contain less clay than Colo soils, are at a slightly higher elevation, and are commonly nearer the stream channel. The Judson soils have better development, are better drained, and are on foot slopes. The included soils make up less than 10 percent of this map unit.

This Colo soil has moderately slow permeability and high available water capacity. Moisture is released readily to plants. The organic matter content and natural fertility are high. Runoff is slow. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 3 feet in most dry years. Tilth is fair. Shrink-swell potential is high.

Most areas of this soil are used for dryland farming. A few areas are irrigated. Some areas are mainly in mixed stands of native grasses and trees.

If this soil is used for dryland farming, the most common crops are corn, soybeans, alfalfa, and grain sorghum. Perforated tile and open ditches help lower the water table and thus reduce wetness. Tillage is generally delayed in spring because of the wetness. Rotation of crops help minimize losses that result from diseases and insects. Conservation tillage practices that keep crop residue on the surface improve tilth and prevent loss of moisture by evaporation.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, small grain, and introduced grasses. Wetness caused by the seasonal high water table is the main limitation. The occasional flooding is a problem, but crop losses are generally slight. Installing tile drains or open ditches where a suitable outlet is available helps lower the water table. Land leveling or grading helps improve drainage and increase the efficiency of irrigation. Gravity and sprinkler irrigation systems are suited.

Cool-season grasses for pasture are well suited to this soil. The application of fertilizers, rotation grazing, and proper stocking are important to good management. Pasture can also be successfully irrigated.

This soil is suited to trees and shrubs in windbreaks. The ability of adapted species to survive and grow is good if competing grasses and weeds are controlled. Species that tolerate wetness should be selected. Weeds and undesirable grasses can be controlled by timely cultivation between rows and by careful use of suitable herbicides in the row.

This soil is not suitable for building sites and septic tank absorption fields because of the hazard of flooding and wetness. Sewage lagoons need to be protected from flooding by dikes or constructed on compacted fill to raise the bottom of the lagoon several feet above the water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by providing good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-4 dryland and capability unit IIw-3 irrigated. It is in windbreak suitability group 2s.

CrD2—Crofton silt loam, 6 to 11 percent slopes, eroded. This soil is deep, strongly sloping to moderately steep, and well drained. It is on narrow convex ridgetops and uneven side slopes on uplands. This soil formed in loess. Rills and small gulleys are common after heavy rains. Areas range from 5 to 10 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The underlying material is silt loam. The upper part of the underlying material is olive brown, and the lower part is light olive brown to a depth of 60 inches. The profile is calcareous and has lime concretions in all parts. Yellowish brown mottles are throughout the underlying material. In places, the underlying material is exposed at the surface.

Included with this soil in mapping are small areas of the more strongly developed, darker, eroded Nora soils in about the same landscape as this Crofton soil. The included soils make up 5 to 10 percent of this map unit.

This Crofton soil has moderate permeability and high available water capacity. Runoff is moderate, depending mainly on the kind and amount of vegetative cover. Moisture is released readily to plants. Small rills and a few gullies are common. Content of organic matter is low. Because of the high content of free carbonates, the availability of phosphorus is low. The rate of water intake is moderate. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. Only a few areas are irrigated. A small acreage is in native grasses.

If this soil is used for dryland farming, it is poorly suited to corn, grain sorghum, small grain, soybeans, grasses, and legumes. Erosion by water is the principal hazard. If this soil is used for row crops, erosion is difficult to control; consequently, planting of soybeans should be kept to a minimum. Conservation tillage practices that maintain crop residue on the soil surface, such as no-till plant, help prevent excessive soil loss. Terracing and farming on the contour help control erosion. Application of fertilizers helps overcome the low content of nitrogen and available phosphorus in this soil. Returning of crop residue or the use of barnyard manure helps improve fertility and decrease erosion. Phosphorus is needed for good production of alfalfa.

If this soil is irrigated, it is poorly suited to corn and grain sorghum and to close-sown crops, such as alfalfa and introduced grasses. This soil is better suited to sprinkler irrigation than most other methods. Other methods of irrigation are difficult to manage, and the cost of land preparation is high. The rate of water application needs to be adjusted so that it does not result in runoff. Terraces and grassed waterways are effective in controlling erosion. Conservation tillage practices help control erosion.

Introduced grasses for pasture are suited to this soil. Pasture generally consists of smooth brome; a mixture of smooth brome and alfalfa; or orchardgrass, smooth brome, and alfalfa. Establishing a grass cover on the slopes helps control erosion. Proper management, rotation grazing, and restricted use during wet periods help keep the grasses in good condition.

This soil is suited to trees and shrubs that tolerate a high content of calcium in the soil. Susceptibility to water erosion is the main hazard. Moisture competition from grasses and weeds can be controlled by cultivation between the rows, by hand hoeing within the row, or by careful use of appropriate herbicides. Planting trees on the contour and planting a cover crop between the rows can lessen erosion. Terraces help prevent runoff and water erosion. Newly planted trees may need watering when moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. Slopes need to be modified by grading for these uses. Septic tank absorption fields can be constructed on the contour after grading. Septic tank absorption fields should be enlarged to overcome the moderate permeability of this soil. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. Buildings should be properly designed and located to accommodate the slope. Cuts and fills are generally needed to provide a suitable grade for roads. The low strength of this soil should be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the drainage needed. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit IVe-8 dryland and capability unit IVe-6 irrigated. It is in windbreak suitability group 5.

CrE2—Crofton silt loam, 11 to 15 percent slopes, eroded. This soil is deep, moderately steep, and well drained. It is on narrow ridgetops, rounded knolls, and short, uneven side slopes on loess uplands. Rills and small gullies form during heavy rains. Areas range from 5 to 10 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The upper part of the underlying material is pale brown silt loam, and the lower part is brown silt loam to a depth of 60 inches. This soil is calcareous and has lime concretions on the surface and throughout the profile. Reddish brown and yellowish brown relict mottles are common beneath the surface layer. In many areas, the underlying material is exposed at the surface because of water erosion.

Included with this soil in mapping are small areas of the more strongly developed, slightly darker, eroded Nora soils. The included soils make up 5 to 10 percent of this map unit.

This Crofton soil has moderate permeability and high available water capacity. Runoff is rapid in cultivated areas and moderate in rangeland that has a good vegetative cover. Moisture is released readily to plants. Erosion by water is the most serious hazard. Small rills and a few gullies are common. Content of organic matter is low. Because of the high content of free carbonates, availability of phosphorus is low. The rate of water intake is moderate. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. The rest is mainly in native grasses and used for grazing.

If this soil is used for dryland farming, it is poorly suited to corn, grain sorghum, small grain, grasses, and legumes. If row crops are grown, erosion is difficult to control. Conservation tillage and grassed waterways help prevent excessive soil loss. Most areas can be terraced and then cultivated on the contour. This soil is low in nitrogen. It is also low in available phosphorus because of the high content of carbonates. Keeping crop residue on the surface helps improve fertility and helps control erosion. Phosphorous fertilizers are needed for production of legumes.

This soil is not suited to irrigation because the slope gradient is too steep and the hazard of erosion is excessive. Water erosion is a problem, and water management is difficult in irrigated areas.

The introduced grasses for pasture are generally suited to this soil. Pasture is mainly smooth brome; a mixture of smooth brome and alfalfa; or a mixture of smooth brome, orchardgrass, and alfalfa. Establishing and maintaining pasture is effective in controlling erosion. Overgrazing contributes to excessive runoff and poor tilth. Proper stocking, rotation grazing, and restricted use during wet periods help keep the grasses in good condition. Commercial fertilizers and barnyard manure applied to introduced grasses help increase production.

This soil is suited to trees and shrubs in windbreaks. The ability of adapted species to survive is fair. Species that tolerate a high content of calcium should be selected. Moisture competition from grasses and weeds needs to be controlled when establishing seedlings. This can be done by cultivation between the tree rows, by hand hoeing or rototilling within the rows, or by careful use of appropriate herbicides. Water erosion is a severe hazard. Planting trees on the contour and establishing a cover crop between the rows helps control erosion. Also, terraces help prevent runoff and erosion. Newly planted trees may need watering when natural moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. Grading is required for many uses. Septic tank absorption fields can be constructed on the contour after grading. Septic tank absorption fields need to be enlarged to overcome the moderate permeability of the soil. Sewage lagoons are not suited because of the slope; therefore, alternate sites on other soils that are suited to this use should be considered. Dwellings and small commercial buildings need to be designed to accommodate the slope, or sites need to be graded to accommodate the structure. The low strength of this soil should be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the drainage needed. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit IVe-8 dryland. It is in windbreak suitability group 8.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is in broad, shallow basins or depressions on loess covered stream terraces. Ponding is frequent on this soil, but generally of short duration. Areas range from 6 to 60 acres.

Typically, the surface layer is friable silt loam about 18 inches thick. The upper part of the surface layer is very dark gray, and the lower part is dark gray. The subsoil is very firm silty clay about 30 inches thick. The upper part of the subsoil is very dark gray, and the lower part is very dark grayish brown. The underlying material is dark grayish brown silty clay loam to a depth of 60 inches. Small stains of iron and manganese are common in the underlying material. In small areas, the surface layer is more than 18 inches thick.

Included with this soil in mapping are small areas of soils in the lowest part of the depressions in which water ponds during spring. The included soils make up 3 to 8 percent of this map unit.

This Fillmore soil has very slow permeability and moderate available water capacity. Runoff is very slow or ponded. Ponding after heavy rains is the main hazard. A perched water table is above the clayey subsoil. The seasonal high water table is slightly above the surface in most wet years and at a depth of about 1 foot in most dry years. If this soil is not artificially drained or has no outlets, it has little or no runoff. The very slow permeability of the subsoil allows only a small amount of the ponded water to move through the soil. Most of the surface water is removed by artificial drainage or evaporation. Content of organic matter is moderate, and natural fertility is medium. The rate of water intake is low. Shrink-swell potential is high.

Most areas of this soil are used for dryland farming. A few areas are in native grasses. Only a small acreage is irrigated.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, and alfalfa. Planting and cultivation are commonly delayed in spring because of wetness. Crops are generally planted late in spring but are occasionally drowned by rains and need replanting. Crop production is limited unless adequate drainage can be provided by ditches or other acceptable means.

If this soil is irrigated it is suited to row crops, such as corn and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. Wetness caused by the excess water from ponding is the main limitation. This soil is difficult to work, because it is commonly wet when tillage is needed. Flooding can be controlled by dikes or diversion terraces, which prevent excess runoff from adjacent areas. Gravity and sprinkler irrigation are suitable. Reuse systems can be installed to recycle excess irrigation water. If suitable outlets are available, this soil can be drained by V-ditches or perforated tile.

Introduced grasses for pasture are suited to this soil. Pasture commonly consists of reed canarygrass, switchgrass, and some Kentucky bluegrass in areas that are not drained. If drained, pasture commonly consists of smooth brome or a mixture of smooth brome and orchardgrass. Grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and applications of nitrogen fertilizers help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Only those species that tolerate ponding are suited. Special methods of planting are needed to keep seedlings from drowning. Farming the adjacent soils on the contour and using minimum tillage help decrease runoff onto the Fillmore soils. Planting the trees on raised or fill areas also helps prevent loss from flooding.

This soil is not suitable for building sites and sanitary facilities because of ponding and the very slow permeability; therefore, alternate sites on other soils that are suited to these uses should be considered. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIIw-2 dryland and capability unit IIIw-2 irrigated. It is in windbreak suitability group 2w.

Fo—Forney silty clay, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is on the lower part of the second bottoms in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 10 to 400 acres.

Typically, the surface layer is very dark gray, very firm silty clay about 9 inches thick. The underlying material to a depth of 22 inches is dark grayish brown, very firm silty clay. Below this, the underlying material to a depth of 60 inches is buried strata of black, dark olive gray, and very dark grayish brown silty clay. In areas, the profile is calcareous throughout and not so stratified.

Included with this soil in mapping are small areas of Blencoe silty clay soils at a slightly higher elevation. The included soils make up less than 8 percent of this map unit.

This Forney soil has very slow permeability and moderate available water capacity. Runoff is very slow. Moisture is released slowly to plants. A seasonal high water table ranges from a depth of about 1 foot in most wet years to a depth of 3 feet in most dry years. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is high. The rate of water intake is very low. Tilth is poor.

Most areas of this soil are used for dryland farming. A few areas are irrigated. Only a small acreage is used for introduced grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Soil wetness and the very firm consistence of this soil influence use and management. Surface water stands in low areas for several days after rains, and this delays tillage operations. Upon drying, the soil cracks. This can damage plant roots. Land leveling and ditches improve drainage. Tilling late in fall so this soil will freeze and thaw in winter improves tilth. Soil blowing is a hazard in winter if the soil does not have an adequate snow cover or other protection. Soil workability is generally poor because the soil is very sticky when wet and very hard when dry.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. Because of the seasonal high water table, wetness is the main limitation. This soil is difficult to till because it is very firm when moist and very hard and cloddy when dry. It should be tilled at the proper moisture content. This soil generally needs leveling for gravity irrigation. Tailwater recovery systems can be installed at the lower end of fields to recycle runoff irrigation water. Irrigation by sprinklers is suitable, but the low intake rate of the soil requires a slow application rate. Growing legumes, such as alfalfa, tends to open the soil and improve permeability. Sprinklers that operate in sets at one location should be adjusted to provide the proper application rate.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of a mixture of smooth brome and alfalfa or a mixture of orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and applications of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Species should be selected that can adapt to a moderately high water table. Competition for moisture from grasses and weeds can be controlled by timely cultivation between the rows and by careful use of appropriate herbicides in the rows. During dry weather, the soil may crack, thus exposing the roots to drying. A shallow cultivation and supplemental watering is needed in places to close the crack.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and very slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes.

Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling.

This soil is in capability unit IIIw-1 dryland and capability unit IIIw-1 irrigated. It is in windbreak suitability group 2w.

Gb—Grable silt loam, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It is on low bottom lands in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 5 to 40 acres.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 8 inches thick. The upper part of the underlying material is dark grayish brown, stratified very fine sandy loam and silt loam, and the lower part is grayish brown, fine sand to a depth of 60 inches.

Included with this soil in mapping are small areas of Carr soils that are silt loam and very fine sandy loam throughout the profile and are at a slightly higher elevation. Also included are small areas of the excessively drained, sandy Sarpy soils at a higher elevation and a few small areas of the silty Haynie soils at an elevation similar to this Grable soil. The included soils make up 5 to 10 percent of this map unit.

This Grable soil has moderate permeability in the upper part and very rapid permeability in the lower part. It has moderate available water capacity. Runoff is slow. Moisture is released readily to plants. The seasonal high water table is at a depth of about 6 feet in most wet years. Content of organic matter is moderately low, and natural fertility is medium. The rate of water intake is moderate. Tilth is good. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. A few areas are irrigated, and a few are in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if the proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Conservation of water and control of soil blowing are important concerns of management. Conservation tillage systems and proper management of crop residue help conserve moisture and reduce soil blowing.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, small grain, and introduced grasses. Row crops can be grown in consecutive years if the proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Land leveling is generally needed for gravity irrigation to increase efficiency of water use. Sprinkler irrigation is well suited. Conservation tillage practices help conserve moisture and reduce soil blowing.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The capability of adapted species to survive is good. Competition for moisture from grasses and weeds is a concern of management. Cultivation between the rows and proper use of appropriate herbicides or hand hoeing in the rows help control weeds and grasses.

This soil is not suitable for building sites because of the hazard of flooding. It is not suitable for septic tank absorption fields and sewage lagoons unless they are protected from flooding by dikes. Sewage lagoons need to be sealed or lined to prevent seepage. Roads need to be protected from flooding. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is in capability unit IIs-5 dryland and capability unit IIs-6 irrigated. It is in windbreak suitability group 1.

He—Haynie silt loam, 0 to 2 percent slopes. This soil is deep, nearly level, and moderately well drained. It is at the highest elevation on bottom lands in the Missouri River Valley. Areas of this soil are rarely flooded. Areas are long and narrow and range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 7 inches thick. The upper part of the underlying material is stratified, dark grayish brown, mottled silt loam and very fine sandy loam, and the lower part is dark grayish brown, mottled silt loam that has thin strata of silty clay loam and silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Carr, Grable, and Sarpy soils. The Carr soils are well drained, coarser textured in the underlying material than this Haynie soil, and at a slightly higher elevation. The Grable soils are well drained, contain less clay, and are at a similar elevation. The Sarpy soil is excessively drained, sandy, and at a higher elevation. In some low places, areas of soils have a seasonal high water table at a depth of 3 to 5 feet. The included soils make up 3 to 10 percent of this map unit.

This Haynie soil has moderate permeability and high available water capacity. Runoff is slow. Moisture is readily released to plants. The seasonal high water table is at a depth of more than 6 feet in most years. Content of organic matter is low, and natural fertility is medium. Reaction is mildly alkaline, but liming is generally not required. Tilth is generally good. The rate of water intake is moderate. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. Some areas are irrigated. A few small areas are used for introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Conservation of water and control of soil blowing are important concerns of management. Conservation tillage practices that leave crop residue on the surface help conserve moisture and reduce soil blowing.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, small grain, and introduced grasses for pasture. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. The same conservation practices that control erosion for dryland management can be used for irrigation. Land leveling for gravity irrigation is generally needed for efficient water use. Sprinkler irrigation is well suited to this soil.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Competition for moisture from grasses and weeds is a common concern of management. Weeds and undesirable grasses can be controlled by rototilling or careful use of appropriate herbicides in the row or by cultivation with a disc or other similar equipment between the rows.

The hazard of rare flooding needs to be considered if this soil is used for building sites and sanitary facilities. Dwellings and buildings need to be constructed on elevated, well compacted fill to protect them from flooding. Dikes can be used to protect septic tank absorption fields and sewage lagoons. The low strength of this soil should be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit I-1 dryland and capability unit I-6 irrigated. It is in windbreak suitability group 1.

Hf—Haynie silt loam, channeled. This soil is on bottom lands in the Missouri River Valley. Areas are long and narrow. They consist mainly of the deepened channel of major streams and the silty deposits along the stream or, in places, a mixture of the silty deposits and dredged material that has been removed from the channel. The channel part consists of deep, wide, dredged areas and the associated mounds or ridges of material deposited by the dredging operations. Areas of this soil are occasionally flooded.

Haynie soils make up about 50 percent of this map unit and the dredged stream channels and steep banks make up 50 percent.

Typically, the surface layer of the Haynie soil is very dark grayish brown, friable silt loam about 6 inches thick. The underlying material is dark grayish brown silt loam to a depth of 60 inches.

Included with this soil in mapping are areas of very stratified soils with lenses of silty clay loam or silty clay that has been dredged from the channel and smoothed out. Also included are areas of mixed soil material that have slopes of 3 to 10 percent. The included soils make up 5 to 15 percent of this map unit.

This Haynie soil has moderate permeability and high available water capacity. Runoff is slow, and moisture is readily released to plants. Content of organic matter is moderately low, and fertility is medium. The rate of water intake is moderate. Shrink-swell potential is low.

Most areas of this soil are used for wildlife habitat. In places, small areas are graded and are used for farming. However, large areas that have been smoothed are included with the adjacent soils in mapping. Many areas have been seeded to smooth brome to reduce erosion; however, some areas are covered with weeds. Because of the continuous maintenance required for the channel, the roughness and steepness of the dredged soil material, and the cost of fencing, this soil is of little value for pasture.

This soil is not generally suited to windbreaks or the planting of trees and shrubs because the areas must be clear for the dredging equipment to operate.

Areas of this Haynie soil are suitable as habitat for openland wildlife. Vegetation and weeds in the areas furnish cover. A plentiful supply of food and water is available. Areas of this soil provide a suitable habitat for nesting birds and small and large animals.

This soil is not suitable for sanitary facilities, building sites, and roads because of the combined effects of flooding and channel maintenance. Alternate sites on other soils that are suited to these uses should be considered. Roads need bridges across areas of this soil.

This soil is in capability unit VIe-7 dryland. It is in windbreak suitability group 10.

Hg—Haynie Variant silt loam, 0 to 1 percent slopes. This soil is deep, nearly level, and moderately well drained. It is on high bottom lands in the Missouri River Valley. Areas of this soil are rarely flooded. Areas were formerly old settling basins for water from upland streams. They range from 20 to 80 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. To a depth of about

50 inches, the upper part of the underlying material is grayish brown, stratified silt loam and very fine sandy loam, and the lower part to a depth of 60 inches is black, calcareous silty clay. In areas, the lower part of the underlying material is silty clay loam at a depth of 40 to 50 inches or more; in small areas, silty clay is above a depth of 30 inches; in about 15 to 25 percent of the areas silty clay is at a depth between 30 and 40 inches; and in places, silt loam is less than 30 inches thick because of land leveling for gravity irrigation.

This Haynie Variant soil has moderate permeability in the upper part of the profile and slow permeability in the lower part. Available water capacity is high. Runoff is slow. The perched, seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 4 feet in most dry years. Moisture is released readily to plants. Content of organic matter is moderately low. Natural fertility is medium, and the levels of phosphorus and nitrogen are commonly deficient. The clayey substratum has high shrink-swell potential. The rate of water intake is moderate. Tilth is good.

Most areas of this soil are used for dryland farming. Some areas are irrigated.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. A cropping system that includes conservation tillage practices conserves moisture and prevents soil blowing.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum and to close-sown crops, such as alfalfa, introduced grasses, and small grain. For gravity irrigation, some land leveling is generally needed to provide even distribution of water and to allow uniform drainage. Because this soil has clayey material at a depth of 30 to 50 inches, it is able to hold water in the upper part of the underlying material and in the surface layer for longer periods than soils that are similar, but do not have this material. Thus, fewer applications of irrigation water are needed. Sprinkler irrigation is well suited to this soil.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome or a mixture of smooth brome and alfalfa. Proper stocking, rotation grazing, and restricted use during wet periods help keep the grasses in good condition. Application of fertilizers on pasture increases production.

Trees and shrubs in windbreaks, plantings for wildlife habitat, and recreational areas are suited to this soil. Capability of adapted species to survive is good. Moisture competition from grasses and weeds is a concern in the management of trees. Grasses and weeds can be controlled by cultivation between the rows and by careful use of appropriate herbicides or rototilling in the row, and by hand hoeing near seedlings.

The hazard of rare flooding needs to be considered if this soil is used for building sites and sanitary facilities. Dwellings and buildings need to be constructed on elevated, well compacted fill to protect them from flooding. Constructing buildings with basements on elevated fill helps overcome wetness caused by the high water table. This soil is not suitable for septic tank absorption fields unless the filter fields are placed in fill at a sufficient height above the seasonal high water table to function adequately. Sewage lagoons need to be protected from flooding by dikes and levees and should be lined to prevent seepage if the bottom of the lagoon is above the clayey substratum. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-4 dryland and capability unit IIw-6 irrigated. It is in windbreak suitability group 1.

Hp—Holly Springs silty clay loam, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is in old swales or depressions, generally in the lowest part of the landscape, on bottom lands in the Missouri River and Logan Creek Valleys. Areas of this soil are occasionally flooded. Areas range from 40 to 100 acres.

Typically, the surface layer is black, very firm, calcareous silty clay loam about 20 inches thick. The subsoil is very dark gray, mottled firm silty clay about 20 inches thick. The underlying material is an older buried soil. It is very dark gray silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Calco silty clay loam and Colo silty clay loam at a slightly higher elevation and the more clayey Solomon soils at a similar or slightly lower elevation. Also included are small areas of soils that are alkali and range from 1/2 acre to 3 acres. The included soils make up 5 to 12 percent of this map unit.

This Holly Springs soil has moderately slow permeability in the upper part of the profile and very slow permeability in the lower part. The available water capacity is moderate. Runoff is slow. Moisture is released slowly to plants. The seasonal high water table ranges from a depth of about 1 foot in most wet years to a depth of about 3 feet in most dry years. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is high. The rate of water intake is very low. Tilth is fair.

Most areas of this soil are used for dryland farming. Some areas are irrigated.

If this soil is used for farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Soil wetness and the firm consistence of this soil influence use and management. Surface water stands in low areas for several days after heavy rains, and this delays tillage operations. Upon drying, the soil cracks. Land leveling and surface ditches are commonly needed to improve drainage. Tillage of this soil late in fall improves tilth for spring planted crops. Without adequate snow cover or other kind of protection, soil blowing is a hazard during winter. Workability is generally poor because the soil is sticky when wet and hard when dry. The soil should be tilled only when the surface layer has the proper moisture content. Conservation tillage practices, such as disc-plant, keep crop residue on the surface, help prevent soil blowing, and conserve moisture.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and winter wheat. Because of the seasonal high water table, wetness is the main limitation. The soil is difficult to till because it is sticky when moist and hard and cloddy when dry. It should be tilled at the proper moisture content. This soil generally needs leveling if it is to be irrigated by a gravity system. Tailwater recovery systems can be installed at the lower end of fields to recycle runoff of irrigation water. Irrigation by sprinklers is suitable, but a slow application rate is needed. Deep-rooted legumes, such as alfalfa, tend to increase the permeability of this soil. Sprinklers that operate in sets at one location should be adjusted to provide the proper application rate.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of seedlings to survive is good if species are selected that tolerate the moderately high water table. Competition for moisture from grasses and weeds is a concern of management. Weeds and grasses can be controlled by cultivating between the rows with a disc or other suitable equipment. Hand hoeing, rototilling, or appropriate herbicides can be used in the tree row to control weeds and grasses. This soil cracks during dry weather and exposes the roots, causing them to dry. Shallow cultivation and supplemental watering are needed in places to close the cracks.

This soil is not suitable for building sites because of the flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of the flooding, wetness, and very slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-4 dryland and capability unit IIw-1 irrigated. It is in windbreak suitability group 2w.

IdD2—Ida silt loam, 6 to 11 percent slopes, eroded. This soil is deep, strongly sloping, and well drained. It is on narrow ridgetops, rounded knolls, and short, uneven side slopes in the loess uplands. Rills and small gullies are common after heavy rains. Areas range from 5 to 60 acres.

Typically, the surface layer is brown, very friable silt loam about 6 inches thick. The underlying material is silt loam. It is dark yellowish brown in the upper part and yellowish brown in the lower part to a depth of 60 inches. The profile is calcareous throughout.

Included with this soil in mapping are small areas of the more strongly developed, darker Monona soils in landscapes similar to this Ida soil. The included soils make up 5 to 12 percent of this map unit.

This Ida soil has moderate permeability and high available water capacity. Runoff is moderate, depending mainly on the kind and amount of vegetation. Moisture is released readily to plants. Erosion by water is the main hazard to farming. Content of organic matter and natural fertility are low. Because of the high content of free carbonates, the availability of phosphorus is low. The rate of water intake is moderate. Tilth is generally good. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. Only a few areas are irrigated. Small areas are in rangeland and used for grazing. A few areas are in introduced grasses for pasture.

If this soil is used for dryland farming, common crops are corn, soybeans, grain sorghum, small grain, grasses, and legumes. Where this soil is used for row crops, erosion is difficult to control. Planting of soybeans should be kept to a minimum because of this. Conservation tillage practices, such as disc-plant, chisel-plant, no-till plant, and grassed waterways, help prevent excessive soil loss. Most areas have slopes that can be terraced and then cultivated on the contour. This soil is low in content of nitrogen. It is also low in available phosphorus because of the high content of carbonates. Keeping crop residue on the surface of this soil helps improve fertility and control erosion. Applications of phosphate fertilizer are needed for good production of alfalfa.

If this soil is irrigated, it is suited to close-sown crops, such as alfalfa and introduced grasses for pasture, and is poorly suited to row crops, such as corn, soybeans, and sorghum. Irrigation generally is not suited to soils that have slopes of 9 percent or more because of excessive erosion and difficulty in controlling the water. This soil is suited only to sprinkler irrigation. Other methods of irrigation are too difficult to manage, and the cost of land preparation is high. The rate of water application needs to be adjusted so that it does not result in excessive runoff. Terraces and grassed waterways help control erosion. Crop residue can be used as a surface mulch to help control erosion.

This soil is suited to introduced grasses for pasture. Most pasture consists of smooth brome or a mixture of smooth brome and alfalfa. Establishing and maintaining pasture is an effective way to help control erosion. Proper stocking, rotation grazing, and restricted use during wet periods help keep the grasses in good condition. Applications of commercial fertilizers and barnyard manure improve production.

This soil is suited to trees and shrubs that tolerate a high content of calcium. Water erosion is a severe hazard. Competition for moisture from grasses and weeds commonly restricts establishment of seedlings. Careful use of appropriate herbicides, hand hoeing, or rototilling within the tree row help control weeds and grasses. Planting trees on the contour and planting a cover crop between the rows can lessen erosion. Newly planted trees may need watering during the first year if moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. For these uses, the slope needs to be modified by grading. Septic tank absorption fields should be constructed on the contour after grading. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Buildings need to be properly designed and located to accommodate the slope. Cuts and fills are generally needed to provide a suitable grade for roads. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Maintaining adequate side ditches and crowning the road by grading help provide the needed surface drainage. Erosion of ditchbanks and side slopes can be severe along roads. An adequate grass cover helps prevent erosion.

This soil is in capability unit IIIe-8 dryland and capability unit IVe-6 irrigated. It is in windbreak suitability group 8.

IdE—Ida silt loam, 11 to 17 percent slopes. This soil is deep, moderately steep, and well drained. It is on narrow ridgetops, rounded knolls, and short, uneven side slopes in the loess uplands. Areas range from 5 to 10 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The underlying material is brown silt loam to a depth of 60 inches. The profile is calcareous throughout. Reddish or brownish loamy material of the Loveland Formation is in some places.

Included with this soil in mapping are small areas of the more strongly developed, darker Monona soils at a lower elevation. The included soils make up 5 to 10 percent of this map unit.

This Ida soil has moderate permeability and high available water capacity. Runoff is rapid. Moisture is released readily to plants. Natural fertility and content of organic matter are low. The rate of water intake is moderate. Tilth is generally good. Shrink-swell potential is low.

Most areas of this soil are in native woods. Some areas are used for rangeland.

If this soil is used for dryland farming, it is poorly suited to close-sown crops, such as wheat, oats, grasses, and legumes. Erosion by water is the principal hazard. If this soil is used for corn and sorghum, controlling erosion is difficult. Conservation tillage practices, such as disc-plant, chisel-plant, and no-till plant, help prevent excessive soil loss and conserve moisture. Some areas that have smooth slopes can be terraced and then farmed on the contour. This soil has low content of nitrogen. Phosphorus is not readily available because of the high content of carbonates. Return of crop residue and application of barnyard manure to the soil help improve fertility and control soil erosion. Applications of phosphorous fertilizers are needed for satisfactory production of alfalfa.

Irrigation is not generally suited to this soil because controlling excessive erosion and managing irrigation water on the moderately steep slopes are difficult.

This soil is suited to introduced grasses for pasture. Establishing and maintaining pasture is an effective way to control erosion. Proper stocking, rotation grazing, and restricted use during wet periods help keep the grasses in good condition.

Where this soil is used for planting windbreaks, it is suited to trees and shrubs that tolerate a high content of calcium. The ability of adapted species to grow is fair. Susceptibility to water erosion is a severe hazard. Planting trees on the contour and a cover crop between the rows helps prevent erosion. Terraces also help prevent runoff and water erosion. Competition for moisture from grasses and weeds can be controlled by cultivation between the rows or by use of appropriate herbicides.

Slope limits the use of this soil for sanitary facilities and building sites. This soil is not suited to septic tank absorption fields or sewage lagoons unless it has been extensively graded; therefore, alternate sites on other soils that are better suited to these uses should be considered. Dwellings and small commercial buildings need to be designed to accommodate the slope, or the site needs to be graded to accommodate the structure. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit IVe-9 dryland. It is in suitability group 8.

IdE2—Ida silt loam, 11 to 17 percent slopes, eroded. This soil is deep, moderately steep, and well drained. It is on narrow ridgetops, rounded knolls, and short, uneven side slopes on uplands. This soil formed in loess. Rills are common after heavy rains. Areas range from 5 to 100 acres.

Typically, the surface layer is dark brown, very friable silt loam about 7 inches thick. The underlying material is silt loam. It is brown in the upper part and yellowish brown in the lower part to a depth of 60 inches. The profile is calcareous throughout. Reddish or brownish loamy material of the Loveland Formation is in some places.

Included with this soil in mapping are small areas of the more strongly developed, darker Monona soils on lower parts of side slopes. Also included in positions below the Ida soil are small areas of eroded Steinauer soils. The included soils make up 5 to 8 percent of this map unit.

This Ida soil has moderate permeability and high available water capacity. Runoff is rapid. Moisture is released readily to plants. Content of organic matter and natural fertility are low. The availability of phosphorus is low because of the high content of free carbonates. The rate of water intake is moderate. Tilth is generally good. Shrink-swell potential is low.

Nearly all the areas of this soil are used for dryland farming. The rest are used mainly for rangeland. A few areas are used for introduced grasses and for pasture.

If this soil is used for dryland farming, it is poorly suited to corn, grain sorghum, small grain, grasses, and legumes. Soybeans are not suited to this moderately steep soil because of the erodibility. Erosion by water is the principal hazard. If this soil is used for row crops, erosion is difficult to control. Conservation tillage practices that keep crop residue on the surface help prevent excessive erosion and moisture loss. Most areas can be terraced and then farmed on the contour. This soil is low in content of nitrogen. It is also low in available phosphorus because of the high content of carbonates. Returning crop residue to the soil or adding other forms of organic matter, such as barnyard manure, helps improve fertility and control erosion. Phosphorous fertilizers are particularly needed for the production of alfalfa.

This soil is generally not suited to irrigation because the slope is too steep and management of the water is too difficult. Excessive water erosion is difficult to control and soil losses are high.

This soil is suited to introduced grasses for pasture. The pasture is mainly smooth brome or a mixture of smooth brome and alfalfa. Some areas of pasture are reseeded to native grasses and mowed for hay. Use of this soil for pasture is an effective way to help control erosion. Proper stocking, rotation grazing, and restricted use during wet periods help keep the grasses in good condition.

If this soil is used for planting windbreaks, it is suited to trees and shrubs that tolerate a high content of calcium. The ability of adapted species to grow is fair. Susceptibility to water erosion is severe. Planting trees on the contour and planting a cover crop between the rows can lessen erosion. Terraces also help reduce runoff and control water erosion. Moisture competition from grasses and weeds limits the establishment of seedlings. Cultivation between the rows with a disc or other suitable equipment and hand hoeing in the row help control weeds.

Slope limits the use of this soil for sanitary facilities and building sites. This soil is not suited to septic tank absorption fields or sewage lagoons unless extensive grading is possible; therefore, alternate sites on other soils that are better suited to these uses should be considered. Dwellings and small commmerical buildings need to be designed to accommodate the slope, or the site needs to be graded to accommodate the structure. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches provide the needed surface drainage. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent erosion.

This soil is in capability unit IVe-8 dryland. It is in windbreak suitability group 8.

IdF—Ida silt loam, 17 to 30 percent slopes. This soil is deep, steep, and somewhat excessively drained. It is on short, uneven side slopes, mainly in the bluff area that borders the Missouri River Valley. Areas range from 5 to 30 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. Beneath this is a transitional layer of dark grayish brown, friable silt loam about 6 inches thick. The underlying material to a depth of 60 inches is brown silt loam. The profile is calcareous throughout.

Included with this soil in mapping are small areas of the more strongly developed Monona soils on side slopes and narrow ridgetops. The included soils make up 5 to 10 percent of this map unit.

This Ida soil has moderate permeability and high available water capacity. Moisture is released readily to plants. The content of organic matter is low. Runoff is rapid. Shrink-swell potential is low.

Nearly all areas of this soil are in rangeland and used for grazing.

This soil is too steep for the commonly grown cultivated crops. The hazard of erosion is very severe, and cultivation of the steep slopes is difficult.

This soil is generally not suited to introduced grasses. However, it is well suited to native grasses. Grazing that leaves one-half of the production for the following year enables the grass to store carbohydrates in the root system and insures a healthy stand. Overgrazing reduces the protective cover and causes deterioration of the natural vegetation. Proper grazing use, timely deferred grazing, and a planned grazing system of use and rest help maintain or improve the range condition.

Trees and shrubs in windbreaks are generally not suited to this soil because of the steepness of slope and the hazard of excessive erosion. In special places where an area is planned for wildlife habitat, trees and shrubs can be planted by hand. Species should be selected that tolerate an excessive amount of carbonates.

This soil is not suitable for sanitary facilities because of the steep slope; therefore, alternate sites on other soils that are suited to these uses should be considered. Buildings need to be designed to accommodate the slope, or the site needs to be graded to accommodate the structure. Road construction requires extensive cutting and filling to reduce the grade. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit VIe-9 dryland. It is in windbreak suitability group 10.

IdF2—Ida silt loam, 17 to 30 percent slopes, eroded. This soil is deep, steep, and somewhat excessively drained. It is on short, uneven side slopes, generally in the bluff area adjacent to the Missouri River Valley. Rills and small gullies are common after heavy rains. The areas range from 5 to 15 acres.

Typically, the surface layer is dark brown, friable silt loam about 5 inches thick. Below this is a transitional layer of grayish brown, friable silt loam about 2 inches thick. The upper part of the underlying material is dark yellowish brown silt loam about 8 inches thick, and the lower part to a depth of 60 inches is yellowish brown silt loam. The profile is calcareous throughout.

Included with this soil in mapping are small areas of Ida soils that are not so steep. Small areas of Steinauer soils that formed in glacial till are below the Ida soil. The included soils make up 5 to 12 percent of this map unit.

This Ida soil has moderate permeability and high available water capacity. Runoff is rapid. Moisture is released readily to plants. Erosion by water is the principal hazard. Gullies and small rills are common in cultivated areas. The organic matter content and natural fertility are low. The rate of water intake is moderate. Shrink-swell potential is low.

Most areas of this soil are used for cultivated crops. A small acreage is in introduced grasses. A few areas are in windbreaks.

This soil is too steep for the commonly grown cultivated crops. The hazard of erosion is severe, and farming the steep slopes is difficult.

This soil is better suited to rangeland than to most other uses. A good cover of grasses needs to be maintained. Grazing that leaves one-half of the forage production for the following year enables the grasses to store carbohydrates in the root system and insures a healthy stand. Overgrazing reduces the protective cover and causes deterioration of the natural vegetation. Proper grazing, timely deferred grazing, and a planned grazing system of use and rest help maintain or improve the range condition.

Trees and shrubs in windbreaks are generally not suited to this soil because of the steepness of slope and the hazard of excessive erosion. Trees and shrubs can be planted by hand for wildlife habitat areas.

This soil is not suitable for sanitary facilities because of the steep slope; therefore, alternate sites on other soils that are suited to these uses should be considered. Buildings need to be designed to accommodate the slope, or the site needs to be graded to accommodate the structure. Road construction requires extensive cutting and filling to reduce the grade. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit VIe-8 dryland. It is in windbreak suitability group 10.

IdG—Ida silt loam, 30 to 60 percent slopes. This soil is deep, very steep, and excessively drained. It is on narrow bluffs that border the Missouri River Valley. In some areas, the slope is nearly vertical. Short slopes or catsteps are common, and large gullies and intermittent drainageways are a part of the landscape. Areas are long and narrow and range from 5 to 30 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 4 inches thick. The underlying material is dark yellowish brown silt loam to a depth of 60 inches. The profile is calcareous throughout.

Included with this soil in mapping are small areas of Ida soils that are not so steep and small areas of Boone soils that have similar slopes. Also included are small outcrops of glacial till and sand. The included soils and outcrops make up 6 to 10 percent of this map unit.

This Ida soil has moderate permeability and high available water capacity. Runoff is very rapid. Moisture is released readily to plants. Because of the very steep slope, erosion by water is the principal hazard. Gullies are common. The organic matter content and natural fertility are low. Shrink-swell potential is low.

All areas of this soil are used for rangeland and trees.

Because of the very steep slope, this soil is not suited to cultivated crops or to mowing of grasses or legumes for hay.

This soil is better suited to rangeland than to most other uses. A good cover of native grasses needs to be maintained. Grazing that leaves one-half of the forage production for the following year enables the grass to store nutrients in the root system and insures a healthy stand. Overgrazing reduces the protective cover and causes deterioration of the natural vegetation. Erosion by water is a severe hazard unless an adequate cover of grass is maintained. Proper grazing use, timely deferred grazing, and a planned grazing system of use and rest help maintain or improve the range condition.

This soil is not suited to trees or shrubs in windbreaks because of the very steep slopes, excessive loss of moisture by runoff, and the very severe hazard of erosion. Trees for wildlife habitat areas can be hand planted.

This soil is not suitable for building sites or sanitary facilities because of the very steep slopes; therefore, alternate sites on other soils that are suited to these uses should be considered. Road construction requires extensive cutting and filling to reduce the grade. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit VIIe-9 dryland. It is in windbreak suitability group 10.

JuC—Judson silty clay loam, 2 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It is on colluvial-alluvial foot slopes, commonly between side slopes on uplands and the adjacent lower lying flood plain. The areas are long and narrow and range from 10 to 80 acres.

Typically, the surface soil is friable silty clay loam about 34 inches thick. The upper part of the surface layer is very dark brown, the middle part is black and very dark brown, and the lower part is very dark grayish brown. The subsoil to a depth of 60 inches is brown, friable silty clay loam in the upper part and dark yellowish brown, firm silty clay loam in the lower part.

Included with this soil in mapping are small areas of the somewhat poorly drained Colo and Calco soils on bottom lands, the less developed Kennebec soils on bottom lands, and the Moody, Monona, Marshall, and Nora soils on loess uplands. The included soils make up 5 to 10 percent of this map unit.

This Judson soil has moderate permeability and high available water capacity. Runoff is medium. The erosion by water is the principal hazard where this soil is farmed. Moisture is readily released to plants. The organic matter content and natural fertility are high. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is good.

Nearly all areas of this soil are used for dryland farming. A few areas are irrigated.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and legumes. Row crops can be grown in consecutive years if a high level of management is used. Erosion by water causes rills after heavy rains. Where this soil is on alluvial fans, crops are subject to occasional flooding of very short duration but are generally not damaged. Grasses, waterways, and terraces on the adjacent, higher soils help prevent soil and water loss. Conservation of water is important to management. Conservation tillage practices help conserve moisture, control erosion, and maintain the content of organic matter.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. Row crops can be grown in consecutive years if a high level of management is used. The hazard of erosion by water is moderate. Where row crops are irrigated by a gravity system, contour furrows can be supplemented with terraces. Bench leveling can be used to shape the surface of the soil so that all types of gravity irrigation can be used. Where erosion is controlled, this soil is suited to sprinklers. Terraces and contour farming help control erosion. Keeping crop residue on the surface and keeping tillage to a minimum help control erosion and conserve moisture.

Introduced grasses for pasture are suited to this soil. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Proper stocking, rotation grazing, and restricted use during wet periods help keep the grasses in good condition. Application of nitrogen fertilizers increases the production of grasses.

This soil is well suited to trees and shrubs in windbreaks. It provides a good site, and the capability of adapted species to grow is fair. Competition for moisture from grasses and weeds is a concern in establishing and managing the windbreaks. Cultivation between the rows or use of appropriate herbicides in the row helps control undesirable vegetation. Newly planted trees and shrubs may need supplemental watering during periods of below normal rainfall.

This soil is suited to septic tank absorption fields. Sewage lagoons require some grading to modify the slope and shape the lagoon and need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings need to be designed so that they have sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. Terraces and diversions can be constructed on the adjacent, higher lying soils to keep runoff water from dwellings and buildings. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and providing adequate side ditches help provide the needed surface drainage.

This soil is in capability unit IIe-1 dryland and capability unit IIIe-3 irrigated. It is in windbreak suitability group 3.

Kg—Kennebec silt loam, channeled. This soil is in areas along natural drainageways on uplands that are deeply cut by stream channels. The channels range from 10 to 30 feet in depth and are as wide as 250 feet in places. Areas are long and narrow and range from 5 to 80 acres. The narrow bottoms of these areas are frequently flooded.

Typically, the surface layer is grayish brown, friable silt loam about 10 inches thick. Beneath this is black, friable silt loam and silty clay loam to a depth of 60 inches. In a few places, layers of loam are below a depth of 40 inches.

Included with this soil in mapping are small areas of Judson, Colo, and Calco soils. Judson soils are better drained and are on narrow foot slopes. The Colo and Calco soils are more poorly drained and on narrow bottom lands. The included soils make up 3 to 10 percent of this map unit.

This Kennebec soil has moderate permeability and high available water capacity. Runoff is very rapid. Natural fertility and organic matter content are high. The seasonal high water table ranges from a depth of about 4 feet in wet years to a depth of about 5 feet in dry years. Water erosion and instability of the gully heads are severe hazards. The planting of trees, shrubs, or grasses in conjunction with the use of other conservation practices help stabilize streambanks and keep them from sloughing. Shrink-swell potential is moderate.

Nearly all areas of this soil are in trees, grasses, weeds, or other vegetation that can be established. This soil is too dissected by channels for cultivated crops, planting of trees in windbreaks, and seeding of introduced grasses for pasture. The areas are mainly used for rangeland and as habitat for wildlife. Proper grazing use and planned grazing systems of use and rest help maintain or improve the range condition.

This soil is not suitable for sanitary facilities, building sites, and roads because of the hazard of flooding; therefore, alternate sites on other soils that are suited to these uses should be considered. Bridges are needed for roads.

This soil is in capability unit VIe-7. It is in windbreak suitability group 10.

Ko—Kennebec silt loam, occasionally flooded, 0 to 2 percent slopes. This soil is deep, moderately well drained, and nearly level. It is on bottom lands of major streams and drainageways throughout the loess and till uplands. Areas of this soil are occasionally flooded. Areas range from 10 to 100 acres.

Typically, the surface layer is light brownish gray, friable silt loam about 12 inches thick. Beneath this is an older, buried surface layer. This buried layer is black, friable silt loam about 34 inches thick. The underlying material is black or very dark grayish brown silt loam and silty clay loam.

Included with this soil in mapping are small areas of somewhat poorly drained Colo silt loam at a lower elevation and closer to the channel of drainageways than this Kennebec soil.

This Kennebec soil has moderate permeability and high available water capacity. The organic matter content and natural fertility are high. Runoff is slow. Tilth is good. Shrink-swell potential is moderate.

Most areas of this soil are farmed. A few areas are in introduced grasses for pasture.

If this soil is used for dryland farming, it is well suited to corn, soybeans, alfalfa, and grain sorghum. Soil blowing is a hazard, particularly if the soil is plowed in fall. Soil blowing can be reduced by using conservation tillage practices, such as disc-plant, chisel-plant, or no-till plant. These practices also conserve moisture and help maintain fertility and organic matter content.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, small grain, and introduced grasses for pasture. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Conservation tillage practices, such as disc-plant or chisel-plant, can be used. Land leveling for gravity irrigation is generally needed for efficient water use. Gravity and sprinkler irrigation are well suited to this soil.

This soil is well suited to trees and shrubs in windbreaks. The ability of adapted species to survive is good. Seedlings generally survive and grow if competing vegetation is controlled or removed. Weeds and grasses can be controlled by cultivation between the rows and by rototilling in the row. Proper seedbed preparation is needed to provide a good stand of trees and shrubs.

A few areas of this soil are in introduced grasses for pasture. Application of fertilizers, proper stocking, and rotation grazing help provide good vigor and growth of the grasses. Some areas of pasture are successfully irrigated.

This soil is not suitable for septic tank absorption fields and building sites because of the hazard of flooding. Sewage lagoons and septic tank absorption fields need to be protected from flooding by dikes or should be placed in fill raised to a sufficient height above flood level. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-3 dryland and capability unit IIw-6 irrigated. It is in windbreak suitability group 1.

Lu—Luton silty clay, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is on bottom lands of the Missouri River Valley. Also, in places, it is in old, abandoned river channels, on the lowest part of the landscape on the second bottoms. Areas of this soil are occasionally flooded. Areas range from 40 to 600 acres.

Typically, the surface soil is very firm silty clay about 27 inches thick. The surface soil is very dark gray in the upper part and black in the lower part. The subsoil is very firm, mottled silty clay about 19 inches thick. The upper part of the subsoil is dark olive gray, and the lower part is olive gray. The underlying material is olive gray, mottled clay to a depth of 60 inches. In places, the profile is calcareous throughout or is stratified.

Included with this soil in mapping are areas of Blencoe silty clay that is silty in the lower part of the profile. The included soil makes up 3 to 5 percent of this map unit.

This Luton soil has very slow permeability and moderate available water capacity. Runoff is medium. Moisture is released slowly to plants. The seasonal high water table ranges from a depth of about 1 foot in most wet years to a depth of 3 feet in most dry years. It is generally lower during the growing season. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is high. The rate of water intake is very low.

Most areas of this soil are used for dryland farming. A few areas are irrigated. Only a small acreage is in native or introduced grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Soil wetness and the very firm consistency of this soil influence use and management. Surface water stands in low areas for several days after rains, and this delays tillage operations. Upon drying the soil cracks, and the cracking can damage plant roots. Land leveling and V-shaped surface ditches help improve drainage. This soil is commonly tilled late in fall so that freezing and thawing in winter improves tilth (fig. 8). If snow cover or other kind of protection is not adequate, soil blowing can be a hazard during winter. Soil workability is poor because this soil is very sticky when wet and very hard when dry. Tillage needs to be done at the proper moisture content.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. Wetness, caused by the seasonal high water table, is the main limitation. The soil is difficult to till because it is very firm when moist and very hard and cloddy when dry. It should be tilled at the proper moisture content. This soil generally needs leveling for gravity irrigation. Tailwater recovery systems can be installed at the lower

Figure 8.—Fall tillage is good management on Luton silty clay because it improves tilth.

end of fields to recycle runoff irrigation water. Irrigation by sprinklers is suitable, but the low intake rate of the soil requires a slow application rate. Legumes, such as alfalfa, tend to improve the permeability. Sprinklers that operate in sets at one location should be adjusted to provide the proper application rate.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of a mixture of smooth brome and alfalfa or a mixture of orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is fair. Species should be used that are adapted to the moderately high water table. Competition for moisture from grasses and weeds can be controlled by timely cultivation between the rows and by careful use of appropriate herbicides in the rows. During dry weather the soil may crack and thus expose the roots to drying. A shallow cultivation and supplemental watering may be needed to close the cracks.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and very slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling.

This soil is in capability unit IIIw-1 dryland and capability unit IIIw-1 irrigated. It is in windbreak suitability group 2w.

Ma—Marshall silty clay loam, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It is on broad divides on the loess uplands. Areas range from 10 to 60 acres.

Typically, the surface layer is friable silty clay loam about 15 inches thick. The upper part of the surface layer is black, and the lower part is very dark grayish brown. The friable subsoil is silty clay loam about 31 inches thick. The upper and middle parts of the subsoil are dark brown, and the lower part is dark yellowish brown. The underlying material is dark yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of gently sloping Marshall soils on side slopes. The included soils make up less than 5 percent of this map unit.

This Marshall soil has moderate permeability and high available water capacity. Runoff is medium. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming. A small acreage is irrigated. Only a few small areas are in native or tame grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Conservation tillage practices, such as tillage with a disc or chisel, help conserve moisture for use by crops, control erosion, and improve fertility. Lime is needed in places to correct soil acidity if alfalfa is grown.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses for pasture, and small grain. This soil tends to form clods upon drying if tilled when wet. Furrow and sprinkler irrigation are well suited. Borders can be used for alfalfa and close-sown crops. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Land leveling increases the efficiency of water use under furrow irrigation. The center-pivot sprinkler irrigation is well suited. The application rate of water needs to be adjusted so that it does not exceed the intake rate of this moderately fine textured soil.

This soil is suited to introduced grasses for pasture. Pasture is commonly smooth brome; a mixture of smooth brome and alfalfa; or smooth brome, orchardgrass, and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to grow is good. Weeds can be controlled by cultivation between the rows and by hand hoeing, rototilling, or careful use of appropriate herbicides in the row. Newly planted trees may need supplemental watering during times of insufficient rainfall.

This soil is suited to sanitary facilities. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings need to be designed so that they have sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil should be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage.

This soil is in capability unit I-1 dryland and capability unit I-3 irrigated. It is in windbreak suitability group 3.

MaC—Marshall silty clay loam, 2 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It is on ridgetops on the loess uplands. Areas range from 10 to 60 acres.

Typically, the surface layer is friable silty clay loam about 13 inches thick. The upper part of the surface layer is very dark gray, and the lower part is dark brown. The subsoil is friable silty clay loam about 42 inches thick. The upper part of the subsoil is dark brown, and the lower part is dark yellowish brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the eroded Marshall soils on side slopes and the nearly level Marshall soils on narrow divides. The included soils make up less than 5 percent of this map unit.

This Marshall soil has moderate permeability and high available water capacity. Runoff is medium. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming, but some areas are irrigated. Only a few small areas are in grass.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Water erosion is the principal hazard. Row crops can be grown in consecutive years if a high level of management is used. Conservation of water is an important concern of management. Terraces help control erosion and loss of surface water. Conservation tillage practices help conserve moisture, build content of organic matter, and control erosion.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as small grain, alfalfa, and introduced grasses for pasture. Row crops can be grown in consecutive years if a high level of management is used. Erosion by water is the main hazard. Conservation tillage practices, such as no-till plant, disc-plant, or chisel-plant, help control erosion and conserve moisture. Terraces or bench leveling help conserve surface water and control erosion. Contour furrows can be used with row crops. Sprinkler irrigation is suited if erosion is controlled. The center-pivot sprinkler irrigation is well suited if the application rate of water is controlled so that it does not exceed the intake rate on this moderately fine textured, gently sloping soil. Gravity irrigation is poorly suited to row crops, unless the slope is modified.

This soil is suited to introduced grasses in pasture. Pasture generally is smooth brome; a mixture of smooth brome and alfalfa; or smooth brome, orchardgrass, and alfalfa. Rotation grazing, proper stocking, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to grow is fair. Competition for moisture from weeds and undesirable grasses is a concern. Weeds can be controlled by cultivation between the rows, by hand hoeing or rototilling within the rows, or by careful use of appropriate herbicides. Newly planted trees may need supplemental watering when moisture is insufficient. Planting the trees on the contour in combination with terraces helps conserve water and control erosion.

This soil is suited to septic tank absorption fields. Sewage lagoon areas require grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage.

This soil is in capability unit IIe-1 dryland and capability unit IIe-3 irrigated. It is in windbreak suitability group 3.

MaC2—Marshall silty clay loam, 2 to 6 percent slopes, eroded. This soil is deep, gently sloping, and well drained. It is on ridgetops and side slopes on the loess uplands. Rills are common after heavy rains. Areas range from 5 to 40 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. Material from the upper part of the subsoil is mixed with the surface layer in tillage. The remaining part of the subsoil is friable silty clay loam and about 29 inches thick. The upper part is dark brown, the middle part is dark yellowish brown, and the lower part is yellowish brown. The underlying material is yellowish brown and light olive brown silty clay loam to a depth of 60 inches. The underlying material has strong brown and grayish brown relict mottles. In areas, the subsoil is exposed at the surface and, in a few areas, the underlying material is exposed.

Included with this soil in mapping are small areas of the uneroded Marshall soils on landscape positions similar to this Marshall soil. Also included are small areas of the uneroded Monona soils that have slightly steeper slopes than this Marshall soil and are at a lower elevation. The included soils make up 5 to 10 percent of this map unit.

This Marshall soil has moderate permeability and high available water capacity. Runoff is medium or rapid, depending on the kind and amount of vegetative cover. Moisture is readily released to plants. Content of organic matter is moderately low, and natural fertility is medium.

Shrink-swell potential is moderate. The rate of water intake is low. Tilth is fair.

Nearly all areas of this soil are used for dryland farming. Only a few areas are irrigated. A small acreage is in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Loss of soil and surface water through erosion is serious on this soil. Erosion is the principal hazard. Contour farming, terraces, and grassed waterways help conserve surface water and control erosion. Conservation of water is an important concern. Methods of conservation tillage, such as disc-plant and no-till plant, help conserve moisture for use by crops, control erosion, and build up the content of organic matter. Application of barnyard manure helps improve tilth and fertility.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses for pasture, and small grain. Erosion by water is the main hazard. Mulch planting, that is, keeping tillage to a minimum and returning crop residue to the soil, helps slow erosion and improve fertility. Terraces or bench leveling can be used to conserve surface water and control erosion. Applications of barnyard manure improve tilth and fertility, especially on the light colored areas. Sprinkler irrigation is well suited. The rate of water application should be adjusted so that it does not exceed the intake rate on this gently sloping, moderately fine textured soil. Gravity irrigation can be used where the slope is modified by leveling, where crops are planted on the contour, or where the water is spread between borders.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome; a mixture of smooth brome and alfalfa; or smooth brome, orchardgrass, and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive and grow is good. Competition for moisture from weeds and grasses is commonly a problem. Weeds and grasses can be controlled by cultivation between the rows and application of appropriate herbicides in the row. Planting the trees on the contour and using terraces reduce runoff and erosion. Newly planted trees commonly need supplemental watering when rainfall is insufficient.

This soil is suited to septic tank absorption fields. Sewage lagoon areas require grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage.

This soil is in capability unit IIe-8 dryland and capability unit IIIe-3 irrigated. It is in windbreak suitability group 3.

Mb—Marshall silty clay loam, terrace, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It is on stream terraces that are a part of the Missouri River Valley. Areas range from 10 to 60 acres.

Typically, the surface layer is very dark gray, friable silty clay loam and about 15 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part of the subsoil is dark brown, the middle part is dark yellowish brown, and the lower part is yellowish brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches. In small areas, the surface layer is darker and thicker than in the typical profile.

Included with this soil in mapping are small areas of the more weakly developed Judson soils on foot slopes and areas of soils in which the seasonal high water table is at a depth of 4 to 5 feet in spring. The included soils make up 5 to 10 percent of this map unit.

This Marshall soil has moderate permeability and high available water capacity. Runoff is medium. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming, but some areas are irrigated. Only a few small areas are in introduced grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Conservation tillage methods, such as no-till plant and disc-plant, help conserve moisture and prevent soil blowing.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. This soil becomes cloddy upon drying if tilled when wet. Runoff from the adjacent, higher soils can be controlled by diversions and terraces on those soils. Land leveling is generally needed for the most efficient use of water in gravity irrigation. The center-pivot sprinkler irrigation is well suited. The application rate of water needs to be adjusted so that it does not exceed the intake rate of the soil.

This soil is suited to introduced grasses for pasture. The pasture is commonly smooth brome or a mixture of smooth brome and alfalfa. Rotation grazing, proper stocking, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. The competition for moisture from weeds and grasses is a major concern. Weeds can be controlled by cultivation between the rows, by hand hoeing or rototilling in the rows, or by careful use of appropriate herbicides. Newly planted trees need supplemental water during periods of insufficient moisture.

This soil is suited to septic tank absorption fields. Sewage lagoon areas require grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage.

This soil is in capability unit I-1 dryland and capability unit I-3 irrigated. It is in windbreak suitability group 1.

Mk—Modale silt loam, 0 to 2 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It is on low bottom lands in the Missouri River Valley. Areas of this soil are occasionally flooded. The areas range from 20 to 100 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. To a depth of 24 inches the underlying material is dark grayish brown and grayish brown, stratified, mottled, calcareous silt loam. Below that to a depth of 60 inches it is dark grayish brown calcareous silty clay. In small areas, the surface layer is silty clay loam 4 to 7 inches thick. In some small areas, the lower part of the underlying material has thin strata of silt loam or very fine sandy loam.

Included with this soil in mapping are small areas of the moderately well drained Haynie silt loam at a slightly higher elevation and areas of Haynie silt loam and Onawa silty clay at an elevation similar to this Modale soil. The included soils make up 3 to 10 percent of this map unit.

This Modale soil has moderate permeability in the upper part of the profile and slow permeability in the lower part. The available water capacity is high. Runoff is slow. Moisture is released moderately to plants. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of 3 feet in most dry years. Content of organic matter is moderately low, and natural fertility is medium. Shrink-swell potential is high. The rate of water intake is moderate.

Most areas of this soil are used for dryland farming, but a few areas are irrigated. Only a small acreage is in pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Soil wetness early in spring, when rainfall is highest, is the principal hazard. Water stands on the surface in low areas for short periods after heavy rains, and this delays tillage operations. Land leveling and V-shaped ditches are commonly needed for good drainage. This soil is generally tilled late in fall. If snow cover or other protection is not adequate, soil blowing is a hazard during winter. Soil workability is generally fair because the surface layer is friable silt loam.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. Soil wetness is the main limitation. Tillage is delayed early in spring. Crops are occasionally flooded, but damage is generally not serious. The soil generally needs leveling for gravity irrigation. Tailwater recovery systems can be installed at the lower end of the fields to recycle runoff irrigation water. Sprinklers are well suited to this soil.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is too wet causes compaction and poor tilth. Proper stocking rates, rotation grazing, and applying nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Species should be selected that tolerate the moderately high water table. The ability of adapted species to survive is good. Competition for moisture from grasses and weeds can be controlled by timely cultivation between rows and by careful use of appropriate herbicides in the row.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons should be protected from flooding by dikes and should be constructed on compacted fill to raise the bottom of the lagoon several feet above the water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-2 dryland and capability unit IIw-2 irrigated. It is in windbreak suitability group 2s.

MnD—Monona silt loam, 6 to 11 percent slopes. This soil is deep, strongly sloping, and well drained. It is on side slopes on the loess uplands. Areas range from 5 to 20 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 11 inches thick. The subsoil is friable silt loam about 19 inches thick. The upper part of the subsoil is dark brown, and the lower part is brown. The underlying material is brown, mottled silt loam to a depth of 60 inches. In small eroded areas, lime is nearer the surface than in the typical profile.

Included with this soil in mapping and in landscapes similar to this Monona soil are small areas of Burchard clay loam that formed in glacial till and of weakly developed Ida soils. The included soils make up 5 to 10 percent of this map unit.

This Monona soil has moderate permeability and high available water capacity. Runoff is medium or rapid, depending on the kind and amount of vegetative cover. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate. The rate of water intake is moderate. Tilth is good.

Nearly all areas of this soil are used for dryland farming. A few areas are in introduced grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Conservation of water is an important concern of management because of the slope and potential runoff. Conservation tillage practices that keep crop residue on the surface help conserve moisture, increase content of organic matter, and control erosion. Water erosion is the principal hazard. Terraces help prevent water erosion and conserve surface water. Farming on the contour and grassed waterways also help control erosion.

If this soil is irrigated, it is poorly suited to row crops, such as corn and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses for pasture, and small grain. This soil tends to become cloddy upon drying, if tilled when wet. Erosion by water is the main hazard. Conservation tillage practices help slow runoff and prevent erosion. Terraces and grassed waterways conserve surface water and help control erosion. Gravity irrigation is not suited because of the strong slopes. The center-pivot sprinklers are better suited than other methods of irrigation for most crops.

This soil is suited to introduced grasses for pasture. Generally, pasture is smooth brome; a mixture of smooth brome and alfalfa; or smooth brome, orchardgrass, and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Ability of adapted species to survive is good. Weeds and grasses can be controlled by cultivation between the rows, by hand hoeing or rototilling in the rows, or by careful use of appropriate herbicides. Erosion is a hazard on this strongly sloping soil. Erosion and competition by weeds can be controlled by planting a cover crop between the rows. Planting trees on the contour, in combination with terraces, also helps control erosion. Newly planted trees need supplemental watering during times of insufficient moisture.

Slope limits the use of this soil for sanitary facilities and building sites. For these uses, grading is needed to modify the slope. Septic tank fields can be constructed on the contour after grading. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Buildings need to be properly designed and located to accommodate the slope, or the site should be graded to accommodate the structure. Foundations of buildings should be designed for sufficient strength to withstand shrinking and swelling. Foundations can also be backfilled with sand or gravel. Cuts and fills are generally needed to provide a suitable grade for roads. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Constructing adequate side ditches and crowning the road by grading help provide the needed surface drainage. Erosion of ditchbanks and side slopes can be severe along roads. An adequate grass cover helps prevent erosion.

This soil is in capability unit IIIe-1 dryland and capability unit IVe-6 irrigated. It is in windbreak suitability group 3.

MnD2—Monona silt loam, 6 to 11 percent slopes, eroded. This soil is deep, well drained, and strongly sloping. It is on side slopes on uplands. This soil formed in loess. Rills and small gullies are common after heavy rains. Areas range from 20 to 60 acres.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. Material from the upper part of the subsoil is commonly mixed with the surface layer in tillage. The subsoil is dark yellowish brown, friable silt loam about 18 inches thick. The underlying material is silt loam. The upper part of the underlying material is yellowish brown, and the lower part is light yellowish brown to a depth of 60 inches. In places, lime is in the underlying material. A few areas are reddish, loamy material of the Loveland Formation.

Included with this soil in mapping are small areas of uneroded Monona soils and areas of eroded Burchard clay loam that formed in glacial till. The included soils make up 5 to 10 percent of this map unit.

This Monona soil has moderate permeability and high available water capacity. Runoff is medium or rapid, depending on the kind and amount of vegetative cover. Moisture is readily released to plants. Content of organic matter is moderately low, and natural fertility is medium. Shrink-swell potential is moderate. The rate of water intake is moderate. Tilth is good.

Nearly all areas of this soil are used for dryland farming. A few small areas are used for introduced grasses or native grasses.

If this soil is used for dryland farming, it is suited to corn, grain sorghum, small grain, grasses, and alfalfa. Close-sown crops are better suited than row crops. Conservation of water is an important concern of management. Erosion by water is the principal hazard. Terraces conserve surface water and help prevent erosion. Contour farming and grassed waterways also help control erosion. Conservation tillage practices, such as disc-plant, help conserve moisture and increase content of organic matter. Improving fertility is important on this eroded soil and can be accomplished by applying commercial fertilizers, incorporating barnyard manure, and conserving all crop residue.

If this soil is irrigated, it is poorly suited to corn, sorghum, alfalfa, introduced grasses for pasture, and small grain. Soil erosion is the principal hazard. Conservation tillage practices keep crop residue on the surface, slow erosion, and improve fertility. Terraces and grassed waterways conserve surface water and control erosion. Gravity irrigation is poorly suited to this soil because of the strong slopes and susceptibility to erosion. Sprinkler irrigation is generally better suited than other methods. The rate of water intake needs to be carefully adjusted to control runoff from this medium textured soil. Phosphorus and nitrogen fertilizers are particularly needed.

This soil is suited to introduced grasses for pasture. These are generally smooth brome and alfalfa. Proper stocking, rotation grazing, and applications of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Weeds and undesirable grasses can be controlled by tilling with a disc or other suitable equipment between the rows. Erosion and loss of moisture by runoff can be controlled by planting a cover crop between the rows and planting trees on the contour in combination with terraces. Newly planted trees need supplemental watering when moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. For these uses, grading is needed to modify the slope. Septic tank absorption fields can be constructed on the contour after grading. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Buildings need to be properly designed and located to accommodate the slope. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. Cuts and fills are generally needed to provide a suitable grade for roads. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Constructing adequate side ditches and crowning the road by grading help provide the needed surface drainage.

This soil is in capability unit IIIe-8 dryland and capability unit IVe-6 irrigated. It is in windbreak suitability group 3.

MnE—Monona silt loam, 11 to 17 percent slopes. This soil is deep, well drained, and moderately steep. It is on side slopes on uplands. This soil formed in loess. Areas range from 10 to 40 acres.

Typically, the surface layer is friable silt loam about 14 inches thick. The upper part of the surface layer is very dark grayish brown, and the lower part is very dark brown. The subsoil is brown, friable silt loam about 18 inches thick. The underlying material is yellowish brown silt loam to a depth of 60 inches. In places, small areas are reddish or brownish loamy material of the Loveland Formation.

Included with this soil in mapping are small areas of eroded Monona soils and weakly developed, calcareous Ida silt loam. These soils are in landscapes similar to those of this Monona soil. The included soils make up 5 to 10 percent of this map unit.

This Monona soil has moderate permeability and high available water capacity. Runoff is rapid or very rapid, depending upon the kind of vegetative cover. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate. The rate of water intake is moderate. Tilth is good.

Most areas of the soil are used for dryland farming. A few areas are in native or introduced grasses.

If this soil is used for dryland farming, it is poorly suited to corn, grain sorghum, small grain, and alfalfa (fig. 9). It is better suited to close-sown crops because they tend to hold the soil better than row crops. Erosion by water is the principal hazard. Conservation of water is an important concern of management because of the slope and potential for runoff. Conservation tillage practices keep crop residue on the surface and help save moisture for use by crops, increase the content of organic matter, and control erosion. Terraces help prevent water erosion and conserve surface water. Farming on the contour and use of grassed waterways also help control erosion.

Irrigation is not generally suited to this soil because of the moderately steep slopes, severe hazard of erosion, and difficulty in properly managing the water.

This soil is suited to introduced grasses for pasture. These are generally smooth brome or a mixture of smooth brome and alfalfa. Proper stocking, rotation

Figure 9.—Landscape of Monona silt loam, 11 to 17 percent slopes. This soil is used extensively for cultivated crops, such as corn, alfalfa, and introduced grasses.

grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Weeds can be controlled by rototilling and hand hoeing in the row and cultivating between the rows, or by careful use of appropriate herbicides. Erosion is a hazard on this moderately steep soil and can be controlled by planting a cover crop between the rows or by planting trees on the contour in combination with terraces. Newly planted trees need supplemental watering during times of insufficient moisture.

Slope limits the use of this soil for sanitary facilities and building sites. Extensive grading is needed for septic tank absorption fields or sewage lagoons. Septic tank absorption fields can be constructed on the contour after grading. Sewage lagoon areas require grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. Dwellings and small commercial buildings should be designed to accommodate the slope, or the site should be graded to accommodate the structure. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength of this soil is important to the design of roads and streets. Use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Construction of adequate side ditches and crowning the road by grading help provide the needed surface drainage.

This soil is in capability unit IVe-1 dryland. It is in windbreak suitability group 3.

MnE2—Monona silt loam, 11 to 17 percent slopes, eroded. This soil is deep, well drained, and moderately steep. It is on side slopes of uplands. This soil formed in loess. Rills and small gullies are common after heavy rains. Areas range from 10 to 100 acres.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. Material from the upper part of the subsoil is commonly mixed with the surface layer in tillage. The subsoil is friable silt loam about 26 inches thick. The upper part is brown, and the lower part is dark yellowish brown. The underlying material is yellowish brown silt loam to a depth of 60 inches. Reddish, loamy material of the Loveland Formation is present in many small areas.

Included with this soil in mapping and in landscapes similar to this Monona soil are small areas of uneroded Monona soils and eroded Ida soils. The included soils make up 5 to 10 percent of this map unit.

This Monona soil has moderate permeability and high available water capacity. Runoff is rapid or very rapid, depending upon the kind and amount of vegetative cover. Moisture is readily released to plants. Content of organic matter is moderately low, and natural fertility is medium. Shrink-swell potential is moderate. The rate of water intake is moderate. Tilth is fair.

Nearly all areas of this soil are used for dryland farming. Very few areas are irrigated. A small acreage is in introduced grasses for pasture.

If this soil is used for dryland farming, it is poorly suited to corn, grain sorghum, small grain, introduced grasses, and alfalfa. Close-sown crops are better suited than row crops. Erosion by water is the principal hazard. Conservation of water and soil is an important concern of management. Terraces help conserve surface water and prevent erosion. Conservation tillage methods, such as tillage with a disc or chisel and no-till plant, help conserve moisture and control erosion. Contour farming and grassed waterways help prevent additional erosion. Improving fertility is important on this eroded soil, and this can be accomplished by using commercial fertilizers, incorporating barnyard manure, and conserving all crop residue.

Irrigation is generally not suited to this soil because of the moderately steep slopes, the hazard of soil erosion by the additional water, and the difficulty of managing the water efficiently.

This soil is suited to introduced grasses for pasture. Generally, pasture is smooth brome; a mixture of smooth brome and alfalfa; or smooth brome, orchardgrass, and alfalfa. Rotation grazing, proper stocking, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Weeds and undersirable grasses can be controlled by rototilling or hand hoeing within the row or by cultivation with a disc or other similar equipment between the rows. Erosion and loss of moisture by runoff can be controlled by planting a cover crop between the rows or by planting trees on the contour in combination with terraces. Newly planted trees need watering when moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. Extensive grading is generally needed for septic tank absorption fields or sewage lagoons. Septic tank absorption fields can be constructed on the contour after grading. Sewage lagoon areas require grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. Dwellings and small commercial buildings should be designed to accommodate the slope, or the slope should be graded to accommodate the structure. The moderate shrink-swell potential is a limitation for building sites. Foundations for buildings need to be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of the soil. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage. Erosion of ditchbanks and side slopes along roads can be severe. An adequate cover of grass helps prevent this erosion.

This soil is in capability unit IVe-8 dryland. It is in suitability group 3.

Mo—Moody silty clay loam, 0 to 2 percent slopes. This soil is deep, well drained, and nearly level. It is on broad divides on uplands. Areas range from 40 acres to 120 acres.

Typically, the surface layer is friable silty clay loam about 15 inches thick. The upper part of the surface layer is very dark brown, and the lower part is very dark grayish brown. The subsoil is friable silty clay loam about 35 inches thick. The upper part of the subsoil is very dark brown, the middle part is dark yellowish brown, and the lower part is light yellowish brown. The underlying material is light yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping and in a similar landscape as this Moody soil are small areas of the more clayey Belfore soils. The included soils make up 3 to 8 percent of this map unit.

This Moody soil has moderately slow permeability and high available water capacity. Moisture is readily released to plants. Runoff is medium. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate, and possibility of frost action is high. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming, but some areas are irrigated. A few areas are in native grass.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Conservation of water is an important concern of management. Conservation tillage practices that keep crop residue on the surface help save moisture, increase content of organic matter, and control soil blowing.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses for pasture, and small grain. This soil forms hard clods upon drying, if it is tilled when wet. Furrow irrigation is well suited. Border irrigation can be used for alfalfa and close-sown crops. Land leveling and the use of water reuse pits increase efficiency of water in furrow irrigation. The center-pivot sprinkler irrigation is particularly well suited. The application rate of water needs to be adjusted so that it does not exceed the intake rate of this moderately fine textured soil.

This soil is suited to introduced grasses for pasture. The most common pasture grasses are smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. The ability of adapted species to survive is good. Weeds can be controlled by cultivation between the rows and by hand hoeing or careful use of appropriate herbicides in the row. Newly planted trees may need supplemental watering when rainfall is insufficient.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage.

This soil is in capability unit I-1 dryland and capability unit I-3 irrigated. It is in windbreak suitability group 3.

MoC—Moody silty clay loam, 2 to 6 percent slopes. This soil is deep, well drained, and gently sloping. It is on ridgetops on uplands. This soil formed in loess. Areas range from 5 to 120 acres.

Typically, the surface layer is friable, very dark grayish brown and very dark brown silty clay loam about 11 inches thick. The subsoil is friable silty clay loam about 42 inches thick. The upper part of the subsoil is dark brown, the middle part is brown, and the lower part is yellowish brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping and in landscapes similar to this Moody soil are small areas of eroded Moody silty clay loam. The included soils make up less than 5 percent of this map unit.

This Moody soil has moderately slow permeability and high available water capacity. Runoff is medium. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming. Only a few areas are irrigated. A small acreage is used for tame grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Water erosion is the principal hazard. Conservation of water is an important concern of management. Terraces help prevent erosion and loss of surface water. Conservation tillage practices that keep crop residue on the surface help conserve moisture for use by crops, maintain the content of organic matter, and control erosion.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, tame grasses for pasture, and small grain. Erosion by water is the principal hazard. Keeping crop residue on the surface by conservation tillage practices helps slow erosion and conserve moisture. Terraces or bench leveling help conserve surface water and control erosion. Contour furrows can be used with row crops. Gravity and sprinkler irrigation are suited. The center-pivot sprinkler irrigation is particularly well suited, if the application rate of water is controlled so that it does not exceed the intake rate of the soil.

This soil is suited to introduced grasses for pasture. The most common pasture grasses are smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. The ability of adapted species to survive is good. Competition for moisture from weeds and undesirable grasses is a concern of management. Weeds can be controlled by cultivation between the rows, by hand hoeing in the rows, or by careful use of appropriate herbicides. Newly planted trees need supplemental watering when moisture is insufficient. Planting on the contour in combination with terraces helps conserve water and control erosion.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Sewage lagoon areas require grading to modify the slope and to shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. Grading is generally needed for small commercial buildings. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help provide the needed surface drainage.

This soil is in capability unit IIe-1 dryland and capability unit IIIe-3 irrigated. It is in windbreak suitability group 3.

MoC2—Moody silty clay loam, 2 to 6 percent slopes, eroded. This soil is deep, well drained, and gently sloping. It is mainly on ridgetops and side slopes on uplands. This soil formed in loess. Rills and gullies are common after heavy rains. Areas range from 5 to 30 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. Material from the upper part of the subsoil has been mixed with the surface layer by tillage. The subsoil is friable silty clay loam about 39 inches thick. The upper part of the subsoil is brown, the middle part is dark yellowish brown, and the lower part is yellowish brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the uneroded Moody silty clay loam. The included soils make up 5 to 10 percent of this map unit.

This Moody soil has moderately slow permeability and high available water capacity. Runoff is medium. Moisture is readily released to plants. Content of organic matter is moderately low, and natural fertility is medium. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is fair.

Nearly all areas of this soil are used for dryland farming. Only a small acreage is irrigated. A few areas are used for introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Loss of soil and surface water by erosion is serious on this soil. Erosion is the principal hazard. Contour farming, terraces, and grassed waterways help conserve water and control erosion. Conservation of water is an important concern of management. Conservation tillage practices that keep crop residue on the surface help conserve moisture for use by crops, maintain the content of organic matter, and control erosion.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses for pasture, and small grain. Erosion by water is the principal hazard. Conservation tillage practices, such as no-till plant and disc-plant, help control erosion, conserve soil moisture, and increase content of organic matter. Terraces or bench leveling conserves water and controls erosion. Application of barnyard manure is especially helpful in improving tilth and fertility on the light colored soil areas. Sprinkler irrigation is suited. The rate of water application should be adjusted so that it does not exceed the intake rate on this moderately fine textured soil.

This soil is suited to introduced grasses for pasture and native grasses for range. Pasture generally consists of smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. The ability of adapted species to survive is good. Competition for moisture from weeds and grasses is a problem. Weeds can be controlled by cultivation between the rows, by hand hoeing or rototilling in the row, or by careful use of appropriate herbicides. Runoff and erosion can be reduced by planting the trees on the contour and using terraces. Newly planted trees may need supplemental watering when rainfall is insufficient.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Sewage lagoon areas require grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can be backfilled with sand or gravel. Grading is generally needed for small commercial buildings. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Maintaining adequate side ditches and crowning the road by grading help provide the needed surface drainage.

This soil is in capability unit IIe-8 dryland and capability unit IIIe-3 irrigated. It is in windbreak suitability group 3.

MoD—Moody silty clay loam, 6 to 11 percent slopes. This soil is deep, well drained, and strongly sloping. It is on side slopes on loess uplands and on concave slopes in the upper reaches of drainageways. Areas range from 5 to 30 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 12 inches thick. The subsoil is friable silty clay loam about 33 inches thick. The upper part of the subsoil is dark brown, the middle part is brown, and the lower part is yellowish brown. The underlying material is light yellowish brown silty clay loam to a depth of 50 inches.

Included with this soil in mapping are small areas of the eroded Moody silty clay loam and the uneroded Nora silty clay loam. These soils have lime nearer the surface than this Moody soil, but are on landscapes similar to this soil. The included soils make up 5 to 12 percent of this map unit.

This Moody soil has moderately slow permeability and high available water capacity. Runoff is medium or rapid, depending on the vegetative cover. Moisture is readily released to plants. Erosion is the principal hazard. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate, and the hazard of frost action is high. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming. Very few areas are irrigated. A few areas are in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, grain sorghum, small grain, and alfalfa. It is better suited to close-sown crops than to row crops. Conservation of water is an important concern of management, because of the slope and potential runoff. Conservation tillage practices that keep crop residue on the surface help conserve moisture for use by crops, maintain content of organic matter, and control erosion. Water erosion is the principal hazard. Terraces help prevent erosion and conserve surface water. Farming on the contour and grassed waterways also help control erosion.

If this soil is irrigated, it is poorly suited to row crops, such as corn and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses for pasture, and small grain. This soil becomes cloddy upon drying if tilled when wet. Erosion by water is the principal hazard. Conservation tillage keeps crop residue on the surface, which in turn slows runoff and helps prevent erosion. Terraces and grassed waterways can be used to conserve water and control erosion. The center-pivot sprinkler irrigation is generally better suited than other methods for most crops.

This soil is suited to introduced grasses for pasture. Pasture generally is smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Moisture conservation is important on the slopes. Weeds and grasses can be controlled by hand hoeing or rototilling within the row, by careful use of appropriate herbicides, or by cultivating between the rows with a disc or harrow. Water erosion is a hazard on this strongly sloping soil and can be controlled by planting a cover crop between the rows of trees or by planting trees on the contour in combination with terraces. Newly planted trees may need supplemental watering when moisture is insufficient.

Slope limits use of this soil for sanitary facilities and building sites. For these uses, slopes need to be modified by grading. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Providing adequate side ditches and crowning the road by grading help furnish the needed surface drainage.

This soil is in capability unit IIIe-1 dryland and capability unit IVe-3 irrigated. It is in windbreak suitability group 3.

MoD2—Moody silty clay loam, 6 to 11 percent slopes, eroded. This soil is deep, well drained, and strongly sloping. It is on side slopes on uplands. This soil formed in loess. Rills and small gullies are common after heavy rains. Areas range from 20 to 60 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 6 inches thick. Plowing has mixed the surface layer with material from the upper part of the subsoil. The subsoil is friable silty clay loam about 30 inches thick. The upper part of the subsoil is brown, and the lower part is olive brown. The underlying material is light yellowish brown and calcareous. It is silty clay loam in the upper part and silt loam in the lower part to a depth of 60 inches.

Included with this soil in mapping are small areas of Moody silty clay loam and Nora silty clay loam that are not eroded and of Nora silty clay loam that is eroded. The Nora soils have a thinner subsoil and lime nearer to the surface than this Moody soil. The included soils make up 8 to 12 percent of this map unit.

This Moody soil has moderately slow permeability and high available water capacity. Runoff is medium or rapid, depending on the kind and amount of vegetative cover. Moisture is released readily to plants. Content of organic matter is moderately low, and natural fertility is medium. Shrink-swell potential is moderate, and frost action is high. The rate of water intake is low. Tilth is fair.

Nearly all areas of this soil are used for dryland farming. Very few areas are irrigated. A few areas are in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, grain sorghum, small grain, grasses, and alfalfa. Because of the slope, close-sown crops are better suited than row crops. Erosion by water is the principal hazard. Conservation of water is an important concern of management because of the slope and runoff. Terraces help conserve surface water and prevent erosion. Conservation tillage keeps crop residue on the surface and helps conserve moisture and control water erosion. Terracing, contour farming, and grassed waterways also help prevent erosion. Improving fertility is important on this eroded soil, and this can be accomplished by incorporating barnyard manure, conserving crop residue, and applying commercial fertilizers.

If this soil is irrigated, it is poorly suited to row crops, such as corn and grain sorghum, but is suited to close-sown crops, such as alfalfa, introduced grasses for pasture, and small grain. Erosion is the principal hazard. Conservation tillage practices that keep crop residue on the surface help slow erosion and improve intake of water. Terraces and grassed waterways conserve surface water and help control erosion. Sprinkler irrigation is generally better suited than other methods. The rate of water intake needs to be carefully adjusted to prevent runoff from this moderately fine textured soil. Phosphorus and nitrogen fertilizers are particularly needed in areas where the soil is lightest in color.

This soil is suited to introduced grasses for pasture. Generally, pasture is smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and applying nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Competition for moisture from weeds and undesirable grasses is an important limitation. Weeds and grasses can be controlled by cultivation with a disc between rows, by hand hoeing or rototilling in the row, or by careful use of appropriate herbicides. Erosion and loss of moisture by runoff can be controlled by planting a cover crop between the rows of trees or by planting trees on the contour in combination with terraces. Newly planted trees may need supplemental watering when moisture is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. For these uses, the slope needs to be modified by grading. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Maintaining adequate side ditches and crowning the road by grading help furnish the needed surface drainage.

This soil is in capability unit IIIe-8 dryland and capability unit IVe-3 irrigated. It is in windbreak suitability group 3.

Mt—Moody silty clay loam, terrace, 0 to 2 percent slopes. This soil is deep, well drained, and nearly level. It is on loess-covered stream terraces in Logan Creek Valley. Areas range from 10 to 100 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 15 inches thick. The subsoil is friable silty clay loam about 31 inches thick. The upper part of the subsoil is brown, and the lower part is yellowish brown. The underlying material is yellowish brown silty clay loam to a depth of 60 inches. In small areas, the surface layer is darker and thicker than 15 inches, or the surface layer is silt loam.

Included with this soil in mapping are small areas of the poorly drained Fillmore soils in shallow depressions. The included soils make up 0 to 5 percent of this map unit.

This Moody soil has moderately slow permeability and high available water capacity. Runoff is medium. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is high. Shrink-swell potential is moderate, and potential for frost action is high. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming. A small acreage is irrigated. Only a few areas are in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Conservation of water is an important concern of management. Conservation tillage methods, such as disc-plant or no-till plant, help conserve moisture for use by crops and build up the content of organic matter. Lime is generally needed for production of alfalfa. Tilling this soil when wet causes surface compaction and poor tilth.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and small grain. This soil becomes cloddy upon drying if tilled when wet. Diversions and terraces on the adjacent, higher lying soils help control runoff from those soils. Land leveling is generally needed for the most efficient use of water in gravity irrigation. The center-pivot sprinklers are well suited. The application rate of water needs to be adjusted so that it does not exceed the intake rate of the soil.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Capability of adapted species to survive is good. Competition for moisture from weeds and grasses can be controlled by cultivation between the rows, by hand hoeing or rototilling in the rows, or by careful use of appropriate herbicides. Newly planted trees may need supplemental water during periods of insufficient rainfall.

The moderately slow permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Sewage lagoons need to be sealed or lined to prevent seepage. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings need to be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. Crowning the road by grading and maintaining adequate side ditches help furnish the needed surface drainage.

This soil is in capability unit I-1 dryland and in capability unit I-3 irrigated. It is in windbreak suitability group 3.

NoD—Nora silty clay loam, 6 to 11 percent slopes. This soil is deep, well drained, and strongly sloping. It is on the lower parts of side slopes on the loess uplands. Areas range from 5 to 30 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable and about 20 inches thick. The upper part of the subsoil is very dark grayish brown silty clay loam, the middle part is dark yellowish brown silty clay loam, and the lower part is olive brown, calcareous silt loam. The underlying material is silt loam. It is light olive brown in the upper part and grayish brown in the lower part to a depth of 60 inches.

Included with this soil in mapping are small areas of eroded Nora silty clay loam and the finer textured Moody soils. Also included are a few areas of Judson soils on foot slopes. The included soils make up less than 10 percent of this map unit.

This Nora soil has moderate permeability and high available water capacity. Runoff is medium or rapid, depending upon the amount and kind of vegetative cover. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is good.

Nearly all areas of this soil are used for dryland farming. A few small areas are used for tame pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Because of the strong slopes and the hazard of erosion, this soil is better suited to close-sown crops than to row crops. Conservation of water is an important concern of management. Terraces help conserve surface water and prevent erosion. Conservation tillage practices that keep residue on the surface help conserve moisture for use by crops and control erosion. Erosion by water is the principal hazard. Contour farming, crop rotation, and grassed waterways help control erosion.

If this soil is irrigated, it is poorly suited to corn, alfalfa, sorghum, introduced grasses, and small grain. Erosion by water is the principal hazard. Maintaining a large amount of crop residue on the surface, contour farming, grassed waterways, and terraces help prevent further erosion. Sprinkler irrigation is generally better suited than other methods. The center-pivot sprinklers are particularly well suited.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition and maintain high production.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Cultivation between the rows, careful application of appropriate herbicides, and hoeing between the trees in the row helps conserve moisture and kill weeds. Runoff can be prevented and erosion can be controlled by planting a cover crop between the rows or by planting trees on the contour in combination with terraces. Newly planted trees may need supplemental watering when rainfall is insufficient.

Slope limits the use of this soil for sanitary facilities and building sites. For these uses, the slope needs to be modified by grading. Septic tank absorption fields can be constructed on the contour after grading. The size of the septic tank absorption field needs to be increased to overcome the moderate permeability of this soil. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. Buildings should be properly designed and located to accommodate the slope. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings need to be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Maintaining adequate side ditches and crowning the road by grading help furnish the needed surface drainage.

This soil is in capability unit IIIe-1 dryland and capability unit IVe-3 irrigated. It is in windbreak suitability group 3.

NoD2—Nora silty clay loam, 6 to 11 percent slopes, eroded. This soil is deep, well drained, and strongly sloping. It is on convex side slopes and ridges on uplands. This soil formed in loess. Rills and small gullies are common after heavy rains. Areas range from 10 to 50 acres.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is friable and about 18 inches thick. The upper part of the subsoil is dark brown silty clay loam, the middle part is brown silty clay loam, and the lower part is pale brown silt loam. The underlying material is pale brown, calcareous silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of the more weakly developed, calcareous Crofton soils. Also included are small areas of the more strongly developed Moody soils on lower side slopes. The included soils make up 5 to 12 percent of this map unit.

This Nora soil has moderate permeability and high available water capacity. Runoff is medium or rapid, depending on the amount and kind of vegetative cover. Moisture is readily released to plants. Content of organic mater is moderately low, and natural fertility is low. Shrink-swell potential is moderate. The rate of water intake is low. Tilth is fair.

Nearly all areas of this soil are used for dryland farming. A small acreage is in tame grasses.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain and alfalfa. Close-sown crops are better suited than row crops. Areas in row crops need a high level of management to prevent erosion. Erosion by water is the principal hazard, and conservation of water is an important concern of management. Terraces help control erosion and conserve moisture. Conservation tillage practices that keep crop residue on the surface help conserve moisture for use by crops and prevent erosion. Contour farming and grassed waterways help prevent further erosion. Incorporation of barnyard manure into the light colored areas helps improve fertility.

If this soil is irrigated, it is poorly suited to crops, such as corn, alfalfa, sorghum, introduced grasses for pasture, and small grain. Erosion by water is a serious hazard. Conservation tillage practices that maintain a large amount of crop residue on the surface, farming on the contour, grassed waterways, and terraces help prevent further erosion. Sprinkler irrigation is generally better suited than other methods. The center-pivot sprinklers are particularly well suited. Incorporation of barnyard manure into the light colored areas helps maintain high fertility and improve tilth.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and applying nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is fair. Competition for moisture from weeds and grasses is a problem. Weeds and grasses can be controlled by hand hoeing or rototilling within the row of trees, or by careful use of appropriate herbicides. Cultivation between the rows with equipment, such as a disc or harrow, controls weeds and grass. Erosion and runoff can be controlled by planting a cover crop between the rows or by terracing and planting trees on the contour. Newly planted trees need supplemental watering during times of insufficient moisture.

Slope limits the use of this soil for sanitary facilities and building sites. For these uses, the slope needs to be modified by grading. Septic tank absorption fields can be constructed on the contour after grading. Septic tank absorption fields need to be increased in size to overcome the moderate permeability of this soil. Sewage lagoon areas require extensive grading to modify the slope and shape the lagoon. Sewage lagoons need to be sealed or lined to prevent seepage. Buildings should be properly designed and located to accommodate the slope. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings need to be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. The low strength and moderate shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage. Maintaining adequate side ditches and crowning the road by grading help provide the needed surface drainage.

This soil is in capability unit IIIe-8 dryland and capability unit IVe-3 irrigated. It is in windbreak suitability group 3.

NoE—Nora silty clay loam, 11 to 15 percent slopes. This soil is deep, well drained, and moderately steep. It is on ridgetops and side slopes on loess uplands. Areas range from 10 to 60 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable and about 22 inches thick. The upper part of the subsoil is dark brown silty clay loam, and the lower part is yellowish brown silt loam. The underlying material is silt loam. It is yellowish brown in the upper part, and pale brown in the lower part to a depth of 60 inches. In a few small areas are Nora soils that are not so steep.

Included with this soil in mapping and in landscapes similar to this Nora soil are small areas of finer textured Moody silty clay loam and weakly developed, calcareous Crofton silt loam. Also included are small areas that have outcrops of glacial till and reddish, clayey material of the Loveland Formation. The included soils make up 5 to 10 percent of this map unit.

This Nora soil has moderate permeability and high available water capacity. Runoff is rapid. Moisture is readily released to plants. Content of organic matter is moderate, and natural fertility is low. Shrink-swell potential is moderate. Tilth is good.

Most areas of this soil are used for dryland farming. A few areas are in native or introduced grasses.

This soil is poorly suited to dryland corn, grain sorghum, small grain, and alfalfa. It is better suited to close-sown crops, but row crops can be grown under a high level of management that adequately controls erosion. Erosion by water is a severe hazard. Conservation of water is an important concern of management. Terraces and conservation tillage practices that keep crop residue on the surface help control erosion and conserve surface water. Contour farming and grassed waterways also help control erosion.

Irrigation is generally not suited to this moderately steep soil, because management of water is difficult and the hazard of erosion is severe.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome; a mixture of smooth brome and alfalfa; a mixture of smooth brome, orchardgrass, and alfalfa; or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Competition for moisture from weeds and grasses is a common problem. This can be corrected by cultivation between the rows with a disc or other farm equipment. Careful use of appropriate herbicides in the row or hand hoeing or rototilling between the trees and in the row help destroy grass and weeds. Erosion and runoff can be controlled by planting a cover crop or by terracing and planting the trees on the contour. Newly planted trees and shrubs may need supplemental watering during times of insufficient rainfall.

Slope limits the use of this soil for sanitary facilities and building sites. Grading is required for many uses. Septic tank absorption fields can be constructed on the contour after grading. Septic tank absorption fields need to be increased in size to overcome the moderate permeability of this soil. Sewage lagoons are not suited to this soil because of the slope; therefore, alternate sites on other soils that are suited to this use should be considered. Dwellings and small commercial buildings need to be designed to accommodate the slope, or the site needs to be graded to accommodate the structure. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. Cuts and fills are generally needed to provide a suitable grade for roads. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads should be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. The needed surface drainage can be provided by crowning the road by grading and by maintaining adequate side ditches.

This soil is in capability unit IVe-1 dryland. It is in windbreak suitability group 3.

NoE2—Nora silty clay loam, 11 to 15 percent slopes, eroded. This soil is deep, well drained, and moderately steep. It is on ridgetops and side slopes on uplands. This soil formed in loess. Rills and small gullies are common after rains. Areas range from 7 to 20 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is friable and about 17 inches thick. The upper part of the subsoil is pale brown, and the lower part is light yellowish brown to a depth of 60 inches. In a few small areas are Nora soils that have a slightly greater or lesser slope.

Included with this soil in mapping are small areas of the more strongly developed Moody silty clay loam and the more weakly developed, calcareous Crofton silt loam. These soils are in landscapes similar to this Nora soil. Also included are small areas of outcrops of reddish, loamy material of the Loveland Formation and small areas of soils that have concretions on the surface. The included soils and outcrops make up 5 to 12 percent of this map unit.

This Nora soil has moderate permeability and high available water capacity. Runoff is rapid. Moisture is readily released to plants. Content of organic matter is moderately low, and natural fertility is low. Shrink-swell potential is moderate. Tilth is fair.

Most areas of this soil are used for dryland farming. A few areas are in native grasses or introduced grasses.

This soil is poorly suited to dryland corn, grain sorghum, small grain, and alfalfa. It is better suited to close-sown crops than to row crops, but row crops can be grown if management adequately controls erosion. Erosion by water is a severe hazard. Conservation of water is an important concern of management. Terraces help control erosion and conserve surface water. Conservation tillage practices, such as disc-plant, that keep crop residue on the surface help control erosion and conserve moisture for use by crops. Contour farming and grassed waterways also help control erosion.

Irrigation is generally not suited to this moderately steep soil because the hazard of erosion is severe and water management is difficult.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep pasture grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good. Competition for moisture from weeds and grasses is a common problem. The weeds and grasses can be controlled by careful use of appropriate herbicides in the row or by rototilling or hand hoeing between the trees in the row. Cultivation between the rows with equipment, such as a disc, can also be used. Erosion and runoff can be controlled by planting a cover crop between the rows of trees or by terracing and planting the trees on the contour. Newly planted trees and shrubs need watering during seasons of insufficient natural moisture.

Slope limits the use of this soil for sanitary facilities and building sites. Grading is required for many uses. Septic tank absorption fields can be constructed on the contour after grading. Septic tank absorption fields need to be increased in size to overcome the moderate permeability of this soil. Sewage lagoons are not suited to this soil because of the slope; therefore, alternate sites on other soils that are suited to this use should be considered. Dwellings and small commercial buildings need to be designed to accommodate the slope, or the site needs to be graded to accommodate the structure. The moderate shrink-swell potential is a limitation for building sites. Foundations of buildings should be designed for sufficient strength to withstand the shrinking and swelling. Foundations can also be backfilled with sand or gravel. Cuts and fills are generally needed to provide a suitable grade for roads. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads should be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage. The needed surface drainage can be provided by crowning the road, by grading, and by maintaining adequate side ditches.

This soil is in capability unit IVe-8 dryland. It is in windbreak suitability group 3.

Om—Omadi silt loam, 0 to 1 percent slopes. This soil is deep, nearly level, and moderately well drained. It is on bottom lands in the Missouri River Valley and adjoins bluffs where streams deposited silt at flood stage. This soil formed in alluvium. Areas of this soil are rarely flooded. Areas are long and narrow and range from 10 to 60 acres.

Typically, the surface layer is friable silt loam about 22 inches thick. The upper part of the surface layer is very dark gray, and the lower part is black. The underlying material is stratified, very dark gray and dark grayish brown silt loam in the upper part and very dark gray in the lower part to a depth of 60 inches.

Included with this soil in mapping are small areas of the poorly drained Calco soils and somewhat poorly drained Colo soils at a lower elevation than this Omadi soil. Also included are small areas of moderately well drained Kennebec soils at a slightly higher elevation. The included soils make up less than 10 percent of this map unit.

This Omadi soil has moderate permeability and high available water capacity. Runoff is slow. Moisture is readily released to plants. Content of organic matter is moderately low, and natural fertility is high. The rate of water intake is moderate. Tilth is good. The seasonal high water table is at a depth of about 5 feet in most wet years and at a depth of about 8 feet in most dry years. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. A small acreage is irrigated. A few small areas are in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if fertility is maintained and weeds and insects are controlled. Conservation tillage practices, such as no-till plant and disc-plant, help conserve moisture for use by crops.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, small grain, and introduced grasses. Row crops can be grown in consecutive years if the fertility is maintained and weeds and insects are controlled. This soil tends to form clods upon drying if tilled when wet. Some land leveling is generally needed for gravity irrigation. Sprinklers are well suited to this soil.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are well suited to this soil. The ability of adapted species to survive is good. Competition for moisture from grasses and weeds is a common concern in establishment and management of trees. Weeds can be controlled by careful use of appropriate herbicides or rototilling in the row and by cultivation with a disc or similar equipment between the rows.

The hazard of rare flooding should be considered if this soil is to be used for building sites and sanitary facilities. Dwellings and buildings need to be constructed on elevated, well compacted fill to protect them from flooding. Septic tank absorption fields and sewage lagoons need to be protected from flooding by dikes. The absorption fields and lagoons need to be constructed on raised fill to a height above flood level. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit I-1 dryland and capability unit I-6 irrigated. It is in windbreak suitability group 1.

On—Onawa silty clay, 0 to 2 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It is on bottom lands in the Missouri River Valley. In places it is in old abandoned river channels. Areas of this soil are occasionally flooded. Areas range from 40 to 250 acres.

Typically, the surface layer is very dark grayish brown, very firm silty clay about 8 inches thick. The underlying material to a depth of 24 inches is dark grayish brown, mottled silty clay. Beneath this to a depth of 60 inches it is stratified, grayish brown, mottled silt loam and very fine sandy loam. In areas, thin lenses of fine sandy loam, silty clay loam, and silty clay are below a depth of 24 inches.

Included with this soil in mapping are small areas of poorly drained Albaton silty clay at a slightly lower elevation and moderately well drained Haynie silt loam in slightly higher parts of the landscape. The included soils make up about 5 to 10 percent of this map unit.

This Onawa soil has slow permeability in the upper part of the profile and moderate permeability in the lower part. The available water capacity is high. Runoff is slow. Moisture is released slowly to plants. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 4 feet in most dry years. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is high in the clayey upper part of the profile and low in the lower part. The rate of water intake is very low. Tilth is poor.

Most areas of this soil are used for dryland farming. A small acreage is irrigated. Only a few areas are used for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Soil wetness and the firm consistence of this soil are important in management. Surface water stands in low areas for several days after heavy rains and delays tillage operations. Upon drying, the soil cracks. Land leveling and V-shaped ditches are needed for good drainage. Most areas of this soil are plowed late in fall to improve tilth over the winter. Without adequate snow cover or other kind of protection, soil blowing is a hazard during winter. Soil workability is generally poor because the soil is very sticky when wet and very hard when dry. The surface layer should be tilled at the proper moisture content.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and winter wheat. Because of the water table, wetness is the main limitation. The soil is difficult to till because it is sticky when moist and very hard and cloddy when dry. It should be tilled at the proper moisture content. This soil generally needs leveling for gravity irrigation. Tailwater recovery systems can be installed at the lower ends of fields to recycle runoff of irrigation water. Irrigation by sprinklers is suitable, but the very low intake rate of this soil requires a slow application rate. Growing legumes, such as alfalfa, tends to increase the permeability of this soil. Sprinklers should be adjusted to provide the proper application rate.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking rates, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good if species are selected that tolerate the moderately high water table. Competition for moisture from grasses and weeds is a concern. Weeds and grasses can be controlled by cultivating between the rows with a disc or other suitable equipment. Hand hoeing, rototilling, or appropriate herbicides can be used in the tree row. In dry weather, this soil cracks and exposes roots to drying. A shallow cultivation and supplemental watering may be needed to close the cracks.

This soil is not suitable for building sites because of the hazard of flooding. It is not suited to septic tank absorption fields because of flooding and wetness. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or constructed on raised fill to raise the bottom of the lagoon several feet above the water table. Sewage lagoons need to be sealed or lined to prevent seepage. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-1 dryland and capability unit IIw-1 irrigated. It is in windbreak suitability group 2s.

Ow—Owego silty clay, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is on bottom lands between old abandoned river channels in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 20 to 100 acres.

Typically, the surface layer is very dark gray, very firm silty clay about 6 inches thick. The upper part of the underlying material is dark gray silty clay; the middle part is dark grayish brown silty clay loam and olive silt loam about 11 inches thick; and the lower part is stratified, dark gray, black, and very dark gray silty clay to a depth of 60 inches.

Included with this soil in mapping are small areas of Blencoe soils that have silty underlying material, Blyburg soils that are silty and at a slightly higher elevation, and poorly drained Albaton soils at a slightly lower elevation. The included soils make up less than 8 percent of this map unit.

This Owego soil has very slow permeability and high available water capacity. Runoff is very slow. Moisture is released slowly to plants. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 3 feet in most dry years. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is high. The rate of water intake is very low.

Most areas of this soil are used for dryland farming. A few areas are irrigated. Only a small acreage is in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. The control of wetness and the very firm consistence of this soil are concerns of management. Surface water stands in low areas for several days after rains and delays tillage operations. Upon drying, the soil cracks. This can damage plant roots. Land leveling and V-shaped ditches improve drainage. This soil can be tilled late in fall so that freezing and thawing in winter improves tilth. Without adequate snow cover or other kind of protection, soil blowing is a hazard during the winter. Soil workability is generally poor because the soil is very sticky when wet and very hard when dry.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, tame grasses, and small grain. Wetness caused by the seasonal high water table is the main limitation. This soil is difficult to till because it is very firm when moist and very hard and cloddy when dry. It should be tilled at the proper moisture content. This soil generally needs leveling for irrigation. Tailwater recovery systems can be installed at the lower end of fields to recycle the runoff of irrigation water. Irrigation by sprinklers is suitable, but the low intake rate of the soil requires a slow application rate. Growing legumes, such as alfalfa, tends to improve the permeability.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome, a mixture of smooth brome and alfalfa, or a mixture of orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive is good if species are selected that tolerate the moderately high water table. Competition for moisture from grasses and weeds can be controlled by timely cultivation between the rows and by careful use of appropriate herbicides in the rows. During dry weather the soil may crack, thus exposing the roots to drying. Shallow cultivation and supplemental watering are needed to close the cracks.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and very slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or need to be constructed on raised fill to raise the bottom of the lagoon several feet above the water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIIw-1 dryland and capability unit IIIw-1 irrigated. It is in windbreak suitability group 2s.

Pe—Percival silty clay, 0 to 2 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It formed in alluvium on bottom lands in the Missouri River Valley. Areas of this soil are occasionally flooded. Areas range from 10 to 30 acres.

Typically, the surface layer is very dark gray, firm silty clay about 8 inches thick. The underlying material is dark gray, mottled silty clay in the upper part to a depth of 19 inches and stratified light gray and grayish brown fine sand in the lower part to a depth of 60 inches. In small areas, the clayey material is only 12 to 14 inches thick.

Included with this soil in mapping are small areas of poorly drained Albaton silty clay that has clayey material throughout the profile. These areas are at a slightly lower elevation than this Percival soil. Also included are areas of excessively drained Sarpy soils that are sandy and are at a higher elevation. A few small areas of Percival soils that have been leveled for irrigation and have sand from the adjoining Sarpy soils deposited over their surface are also included. The included soils make up 0 to 8 percent of this map unit.

This Percival soil has slow permeability in the upper part of the profile and rapid permeability in the lower part. The available water capacity is low. Runoff is slow. Moisture is released slowly to plants. The seasonal high water table is at a depth of about 1.5 feet in most wet years and at a depth of about 3 feet in most dry years. Late in summer the water table recedes. Content of organic matter is moderately low, and natural fertility is low. The rate of water intake is very slow. Tilth is poor because of the high clay content in the surface layer. Shrink-swell potential is high in the clayey upper part of the profile and is low in the sandy lower part.

Most areas of this soil are used for dryland farming. A few areas are in tame grasses.

If this soil is used for dryland farming, it is suited to corn, grain sorghum, and small grain and to grasses and legumes for hay and pasture. Because this soil warms up slowly in spring, tillage operations are delayed. This soil is droughty, however, during summer when the water table is lowest. Conservation tillage practices that keep crop residue on the surface help conserve moisture, increase content of organic matter, and prevent soil blowing. Flooding can be controlled by dikes and levees on the adjacent, higher lying soils. Drainage ditches help remove water early in spring and allow the soil to be tilled sooner. Many areas of this soil are tilled in fall to improve tilth by freezing and thawing during winter.

If this soil is irrigated, it is suited to corn, grain sorghum, and close-sown crops, such as alfalfa, introduced grasses, and small grain. Wetness, caused mainly by the seasonal high water table, is the main limitation. Tillage operations in spring are commonly delayed by wetness. This soil is flooded about once every 3 to 10 years, but crop losses are normally slight. Sprinkler and gravity irrigation are suited. Because the underlying material is sandy, the length of runs should be short for gravity irrigation. Also for gravity irrigation, some land leveling is generally needed to provide an even distribution of water and uniform drainage. Conservation tillage practices that leave crop residue on the surface help control soil blowing and improve tilth.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome, a mixture of smooth brome and alfalfa, or reed canarygrass. Grazing when the soil is wet should be avoided. Proper stocking, rotation grazing, and application of nitrogen fertilizers keep the grasses in good condition.

Trees and shrubs in windbreaks and plantings for recreational and wildlife areas are suited to this soil. The ability of adapted species to survive is fair. Only species of trees and shrubs that tolerate the moderately high water table and occasional flooding are suited. Cultivation with a disc between the rows or hand hoeing and rototilling within the rows can control weeds and grasses. Supplemental watering is necessary when natural rainfall is insufficient.

This soil is not suitable for building sites and sanitary facilities because of flooding and wetness; also, the hazard of contamination of ground water by sanitary facilities is possible. Therefore, alternate sites on other soils that are suited to these uses should be considered. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted till and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Roads need to be designed so that the pavement is thick enough to compensate for the low strength of this soil. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-1 dryland and capability unit IIw-1 irrigated. It is in windbreak suitability group 2s.

Pg—Pits, gravel. This miscellaneous area consists of pits and the adjacent mounds of gravel, sand, and overburden. The pits are in uplands and are generally dry. Sand and gravel are stockpiled for use in construction of roads and as fill material. Areas range from 5 to 40 acres.

Typically, this material consists of a mixture of fine, medium, and coarse sand and varying amounts of gravel. A soil profile has not developed.

Included with this miscellaneous area in mapping are small areas of Steinauer clay loam and Boone soils. The included soils make up about 3 to 6 percent of this map unit.

Permeability is very rapid, and available water capacity is low. Content of organic matter is very low, and natural fertility is low. Runoff is slow or very slow.

About one-third of the areas of this map unit is used for commercial mining of sand and gravel. The rest is abandoned and has little value for farming. Areas are generally not suited to cultivated crops because of the coarse texture, low available water capacity, and steepness of slope. Areas of sand are generally devoid of vegetation, except where they are no longer being actively used as a source of sand and gravel. Where areas are no longer being actively mined, vegetation gradually becomes established.

In places, this miscellaneous area has value as wildlife habitat. Trees and shrubs can be hand planted. Species that tolerate droughty conditions are preferred. Cedar, pine, cottonwood, and green ash are better suited than most other species for individual or scattered plantings. Trees require special care after planting to survive. Native grass cover or wood barriers help protect plantings from blowing sand. Supplemental watering is needed at times to keep small, newly-planted trees alive.

This miscellaneous area is generally not suited to septic tanks or sewage lagoons. The areas need to be reshaped for buildings or roads.

This map unit is in capability unit VIIIs-8 dryland. It is in windbreak suitability group 10.

Sa—Salix silty clay loam, 0 to 1 percent slopes. This soil is deep, nearly level, and moderately well drained. It is on the highest elevation of the second bottom lands in the Missouri River Valley. This soil formed in alluvium. Areas of this soil are rarely flooded. Areas are generally long and narrow and range from 10 to 40 acres.

Typically, the surface layer is friable silty clay loam about 19 inches thick. The upper part of the surface layer is black, and the lower part is very dark grayish brown. The friable subsoil is about 15 inches thick. The upper part of the subsoil is dark grayish brown silty clay loam, and the lower part is very dark grayish brown silty loam. The underlying material is dark grayish brown silt loam to a depth of 60 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Blencoe and Woodbury soils at a slightly lower elevation than this Salix soil. The included soils make up less than 5 percent of this map unit.

This Salix soil has moderate permeability and high available water capacity. Moisture is readily released to plants. The seasonal high water table is at a depth of about 4 feet in most wet years and at a depth of about 5 feet in most dry years. Content of organic matter is moderate, and natural fertility is medium. Runoff is slow. The rate of water intake is slow. Tilth is generally good. Shrink-swell potential is low.

Most areas of this soil are used for dryland farming. A small acreage is irrigated. A few small areas are in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Conservation of water is an important concern of management. Conservation tillage practices that keep crop residue on the surface, such as no-till plant and disc-plant, help conserve moisture.

If this soil is irrigated, it is suited to corn, soybeans, grain sorghum, alfalfa, and small grain and introduced grasses for pasture. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. This soil forms clods upon drying if tilled when wet. Land leveling for gravity irrigation is generally needed for efficient water use. Conservation tillage keeps crop residue on the surface, and this reduces soil blowing and helps prevent loss of soil moisture. Sprinkler irrigation is suited to this soil.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. The ability of adapted species to survive and grow is good. Competition for moisture from grasses and weeds is a common concern of management. Weeds can be controlled by cultivation with a disc or other equipment between the rows and by rototilling or hand hoeing in the row.

The hazard of rare flooding needs to be considered if this soil is to be used for building sites and sanitary facilities. Dwellings and buildings need to be constructed on elevated, well compacted fill to protect them from flooding. Septic tank absorption fields and sewage lagoons can be protected from flooding by dikes. Septic tank absorption fields need to be placed in fill raised to a sufficient height above the seasonal high water table so that they will function adequately. Sewage lagoons need to be constructed on compacted fill to raise the bottom of the lagoon several feet above the water table, and they need to be sealed or lined to prevent seepage. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit I-1 dryland and capability unit I-4 irrigated. It is in windbreak suitability group 1.

SbC—Sarpy fine sand, 0 to 6 percent slopes. This soil is deep and excessively drained. It is on bottom lands in the Missouri River Valley, commonly adjacent to the Missouri River or old river channels. Areas of this soil are occasionally flooded. Areas range from 7 to 75 acres, and most areas are hummocky.

Typically, the surface layer is very dark grayish brown, loose fine sand about 4 inches thick. The upper part of the underlying material is dark grayish brown, calcareous fine sand, and the lower part is grayish brown, calcareous fine sand that has yellowish brown mottles. In small areas, loamy material is below a depth of 40 inches, or a seasonal high water table is at a depth of about 6 feet early in spring. In places, the hummocks have been leveled for sprinkler irrigation.

Included with this soil in mapping are small areas of well drained Carr fine sandy loam and Grable silt loam at a slightly lower elevation than this Sarpy soil. The included soils make up 5 to 8 percent of this map unit.

Permeability is rapid, and available water capacity is low. Moisture is released readily to plants. Organic matter content and natural fertility are low. Runoff is slow. The rate of water intake is very high. Tilth is poor in this loose sandy soil. Shrink-swell potential is low.

About half the areas of this soil are used for farming, and the rest are used for grazing of native grasses.

If this soil is used for dryland farming, it generally is not suited to common crops. Because of the low available water capacity this soil is droughty, especially during summer, and, as a result, crop production under dryland conditions is poor. Furthermore, if this soil is tilled, it is subject to severe soil blowing.

If this soil is irrigated, it is poorly suited to corn and grain sorghum but better suited to close-sown crops, such as alfalfa, introduced grasses, and small grain. Soil blowing and low moisture retention are the main concerns of management. Sprinkler irrigation is the only system suited to this soil. The application rate of water can be high because the soil absorbs the water rapidly. Applications of water need to be frequent because of the low moisture retention. Conservation tillage practices, such as no-till plant and keeping crop residue on the surface, help reduce soil blowing. Barnyard manure helps improve tilth and increases fertility.

This soil is suited to introduced grasses for pasture. Pasture generally consists of smooth brome and some areas of switchgrass or sand lovegrass. Overgrazing can easily result in soil blowing. Proper stocking and rotation grazing help keep the grasses in good condition, and application of nitrogen fertilizer helps increase production.

This Sarpy soil is suited to trees and shrubs in windbreaks. Only those species that tolerate coarse textured, somewhat droughty soils are suited. The ability of adapted species to survive and grow is fair. Soil blowing is the principal hazard. This can be controlled by maintaining strips of sod or a cover crop between the rows. Supplemental watering is needed when rainfall is not sufficient.

This soil is not suitable for building sites or septic tank absorption fields because of the hazard of flooding. Contamination of ground water from sanitary facilities is possible. Sewage lagoons need to be protected from flooding by dikes or levees and should be sealed or lined to prevent seepage. Roads also need to be protected from flooding. They should be constructed on suitable compacted fill material and have adequate side ditches and culverts. Temporary shoring helps prevent sloughing or caving of sidewalls of shallow excavations.

This soil is in capability unit VIs-7 dryland and capability unit IVs-12 irrigated. It is in windbreak suitability group 7.

SgC—Sarpy-Grable Variant complex, 0 to 6 percent slopes. This complex consists of nearly level to gently sloping Sarpy soils and nearly level Grable Variant soils. These soils are on low bottom lands in the Missouri River Valley. They are mainly in abandoned channels of the river and on the slightly higher, uneven ridges. Areas of the Sarpy soil are occasionally flooded, and areas of the Grable Variant soil are frequently flooded. Areas range from 10 to 100 acres.

Sarpy soils make up about 50 to 60 percent of this complex and are on the highest parts of the landscape. Grable Variant soils make up about 30 to 40 percent and are on the lowest parts of the landscape.

Typically, the surface layer of the Sarpy soils is grayish brown, loose fine sand about 6 inches thick. The underlying material to a depth of 60 inches is grayish brown, mottled fine sand.

Typically, the surface layer of the Grable Variant soils is very dark grayish brown, mottled, very friable silt loam about 6 inches thick. The upper part of the underlying material is dark grayish brown, mottled, very fine sandy loam; the middle part is dark grayish brown and grayish brown, stratified very fine sandy loam and fine sand; and the lower part to a depth of 60 inches is grayish brown fine sand.

Included with these soils in mapping are small areas of Albaton silty clay, depressional, on landscape positions similar to those of the Grable Variant soils. Also included are small areas of Carr soils at a slightly lower elevation than the Sarpy soils. The included soils make up less than 10 percent of this complex.

In the Sarpy soils, permeability is rapid. Available water capacity, organic matter content, and natural fertility are low. The seasonal high water table is at a depth of about 6 feet in most wet years. In the Grable Variant soils, permeability is moderate in the upper part of the soil and rapid in the lower part. The available water capacity is moderate, organic matter content is moderately low, and natural fertility is low. The seasonal high water table is at a depth of about 1 foot in most wet years and at a depth of about 3 feet in most dry years. These Sarpy and Grable Variant soils release water readily to plants and have low shrink-swell potential. On both soils, runoff is slow.

Most areas of this map unit are used for rangeland and native woodland. Only a small acreage is used for dryland farming, and yields are generally low.

The soils in this unit are generally not suited to dryland or irrigated cultivated crops. Flooding and wetness in the Grable Variant soils and droughtiness and soil blowing in the Sarpy soils are the principal hazards.

These soils are suited to introduced grasses for pasture. Native pasture commonly consists of reed canarygrass, switchgrass, redtop, and sedges. Proper stocking and rotation grazing help keep the grasses in good condition.

The Sarpy soils in this unit are suited to trees and shrubs for windbreaks, provided the species selected tolerate droughty, sandy soils. Supplemental watering is needed if rainfall is deficient for growth of the trees. Permanent grasses in areas between the tree rows help prevent blowing and sand blasting of the trees. The Grable Variant soils are not suited to windbreaks because of the excessive wetness.

The soils in this complex are not suited to building sites and sanitary facilities because of the hazard of flooding and wetness; therefore, alternate sites on other soils that are suited to these uses should be considered. Roads need to be protected from flooding. They should be constructed on suitable compacted fill material and have adequate side ditches and culverts. The Grable Variant soil is susceptible to frost action. Damage to roads by frost action can be reduced by the use of a gravel moisture barrier in the subgrade, and by good surface drainage. Crowning the road by grading helps provide the needed surface drainage.

This complex is in capability unit VIs-7 dryland. The Sarpy soils are in windbreak suitability group 7, and the Grable Variant soils are in windbreak suitability group 10.

So—Solomon silty clay, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is on bottom lands in the Missouri River and Logan Creek Valleys. It is in old swales, generally in the lowest part of the landscape. Areas of this soil are occasionally flooded. Areas range from 40 to 400 acres.

Typically, the surface layer is black, very firm, calcareous silty clay about 20 inches thick. The subsoil is very dark gray, mottled, firm silty clay about 20 inches thick. The underlying material is dark gray silty clay to a depth of 60 inches. Fragments of snail shells and carbonate concretions are in most parts of the profile. In some areas, the surface layer is a lighter color.

Included with this soil in mapping are small areas of the less clayey Holly Springs silty clay loam at a slightly higher elevation than this Solomon soil. The included soils make up less than 8 percent of this map unit.

This Solomon soil has very slow permeability and high available water capacity. Runoff is very slow. Moisture is released slowly to plants. The seasonal high water table ranges from a depth of about 1 foot in most wet years to a depth of about 2 feet in most dry years. It is lower during the growing season. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is high. The rate of water intake is very low. Tilth is poor, mainly because of the high clay content.

Most areas of this soil are used for dryland farming, but some areas are irrigated. A few areas are in introduced grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Wetness and the very firm consistence of this soil strongly influence use and management. Surface water stands in low areas for several days after rains, and this delays tillage. Upon drying, the soil cracks. Land leveling and V-shaped ditches are needed for good drainage. Tillage late in fall improves tilth by exposing this soil to freezing and thawing during winter. Without adequate snow cover or other kinds of protection, soil blowing can be a hazard during winter. Workability is generally poor because this soil is very sticky when wet and very hard when dry. Tillage operations should be done when the surface layer has the proper soil moisture content to prevent forming large, hard clods. Conservation tillage practices that keep crop residue on the surface help prevent soil blowing and improve tilth.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and wheat. Wetness from the water table is the main limitation. Tillage is difficult because this soil is extremely firm if moist and very hard and cloddy if dry. Tillage should be done under the proper soil moisture content. Land leveling is generally needed for gravity irrigation. A reuse system can be installed at the lower ends of fields to recycle runoff of irrigation water. Irrigation by sprinklers is suitable, but the very low intake rate of the soil requires a slow application rate. Growing legumes, such as alfalfa, tends to improve permeability. Sprinklers that operate in sets at one location should be adjusted to provide the proper application rate. Conservation tillage practices that keep crop residue on the surface help improve tilth.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is wet causes poor tilth. Proper stocking, rotation grazing, and applications of nitrogen fertilizers help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. The ability of adapted species to survive is fair. Species should be used that tolerate the moderately high water table. Competition for moisture from grasses and weeds is a concern of management. Weeds and grasses can be controlled by cultivating between the rows with standard cultivation equipment and by hand hoeing, rototilling, or the application of appropriate herbicides in the rows. During dry weather, the soil commonly cracks. This exposes the roots to drying. A shallow cultivation is needed to close the cracks.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of the flooding, wetness, and very slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or need to be constructed on raised fill to raise the bottom of the lagoon several feet above the seasonal high water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. This soil is suitable for pond reservoir areas.

This soil is in capability unit IIIw-1 dryland and capability unit IIIw-1 irrigated. It is in windbreak suitability group 2w.

StF2—Steinauer clay loam, 11 to 30 percent slopes, eroded. This soil is deep, somewhat excessively drained, and moderately steep and steep. It is on uplands on side slopes, commonly in a band along the middle or upper part of the slope, and also on narrow ridgetops and points of ridges. Rills and small gullies are common after rains. Areas range from 10 to 25 acres.

Typically, the surface layer is dark grayish brown, firm clay loam about 7 inches thick. Beneath this is clay loam underlying material. The upper part of the underlying material is pale brown and has reddish brown mottles and soft masses of lime; the lower part to a depth of 60 inches is pale brown and has concretions of lime. This soil contains a few stones and pebbles. In a few areas, sand or gravel is at a depth of 30 to 40 inches or reddish brown loam and clay loam are on the surface.

Included with this soil in mapping are small areas where unweathered glacial till crops out at the surface. Also included are small areas of Burchard soils and a few small sand and gravel pits. The included soils and miscellaneous areas make up about 5 to 12 percent of this map unit.

This Steinauer soil has moderately slow permeability and moderate available water capacity. Runoff is medium or rapid, depending on slope and the amount and kind of cover. Workability is poor because of the scattered stones and pebbles. Moisture is released slowly to plants. Content of organic matter and natural fertility are low. Shrink-swell potential is moderate. Tilth is poor.

About 40 percent of the acreage of this soil is used for cultivated crops. A large part of the remaining acreage is in introduced grasses, and the rest is in mixed native trees, shrubs, and grasses. A few areas are in native grasses.

This soil is generally not suited to cultivated crops because of the moderately steep and steep slopes and the corresponding severe hazard of erosion by water.

This soil is suited to grasses for pasture or range. A good cover needs to be maintained. Controlled grazing that leaves one-half to one-third of the forage production for the following year enables the grasses to store carbohydrates in the root system and insures a healthy stand. Overgrazing reduces the protective cover and causes deterioration of the plant community. Rotation grazing, proper grazing use, and a planned grazing system of use and rest help maintain or improve the range condition.

The less steep parts of this map unit, or the soils that have 11 to 20 percent slopes, are suited to windbreak plantings for farmsteads and feedlots and to plantings for wildlife habitat. The steeper parts, or those soils that have more than 20 percent slopes, are generally not suited to plantings of trees and shrubs in windbreaks. Only those species that tolerate a high content of calcium and are resistant to drought should be used. The hazard of water erosion is very severe, and trees need to be planted on the contour and a cover crop used to prevent erosion.

Slope limits the use of this soil for sanitary facilities and building sites. Because of the excessively steep slope, this soil is generally not suited to septic tank absorption fields or sewage lagoons. Therefore, alternate sites on other soils that are suited to these uses need to be considered. Buildings should be designed and located to accommodate the slope, or the site should be graded to accommodate the structure. Road construction requires extensive cutting and filling to lessen the grade. The low strength of this soil needs to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance.

This soil is in capability unit VIe-8 dryland. It is in windbreak suitability group 10 if slopes are more than 20 percent and in windbreak suitability group 8 if slopes are 11 to 20 percent.

Wo—Woodbury silty clay, 0 to 2 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It is on bottom lands in the Missouri River Valley, and, in places, it is in low swales of old meandering channels. Areas of this soil are occasionally flooded. Areas are long and narrow and range from 10 to 80 acres.

Typically, the surface layer is very firm silty clay about 22 inches thick. The upper part of the surface layer is very dark gray, and the lower part is black. The subsoil is about 20 inches thick. The upper part of the subsoil is very dark grayish brown, very firm silty clay, and the lower part is dark grayish brown, friable silty clay loam that has mottles. The underlying material is grayish brown silty loam to a depth of 60 inches. In a few places, thin lenses of loamy fine sand and fine sand are below a depth of 48 inches.

Included with this soil in mapping are small areas of the less clayey, better drained Salix silty clay loam and small areas of Blencoe soils. These soils are at a slightly higher elevation than this Woodbury soil. Also included are areas of fine textured Luton soils at a similar elevation or a slightly lower elevation than the Woodbury soil. The included soils make up 5 to 10 percent of this map unit.

This Woodbury soil has slow permeability in the surface layer and the upper part of subsoil and moderate permeability in the lower part of the subsoil and in the underlying material. The available water capacity is moderate. Moisture is released slowly to plants. The seasonal high water table ranges from a depth of about 2 feet in most wet years to a depth of about 3 feet in most dry years. Content of organic matter is moderate, and natural fertility is medium. Runoff is very slow. This soil has high shrink-swell potential. The rate of water intake is very low. Tilth is poor because of the very firm consistence of the clayey surface layer.

Most areas of this soil are used for dryland farming, but some areas are irrigated. A few areas are in tame grasses for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, wheat, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds and insects are controlled. Wetness and the very firm consistence of this soil make tillage difficult. Surface water remains in low areas for several days after rains, and this delays tillage operations. Upon drying, the soil cracks, and this allows air to enter and desiccate plant roots. Land leveling and surface V-shaped ditches help improve drainage. Most areas of this soil are tilled late in fall to improve tilth. Without adequate snow cover or other kinds of protection, soil blowing can be a hazard in winter. Conservation tillage practices, such as disc-plant, that keep crop residue on the surface help control blowing and conserve moisture. Tillage should be done when the surface layer has the proper moisture content.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as alfalfa, introduced grasses, and winter wheat. Wetness, caused by the moderately high water table, is the main limitation. This soil is difficult to till because it is extremely firm when moist and very hard and cloddy when dry. It should be tilled only at the proper moisture content. Conservation tillage practices, such as disc-plant, that keep crop residue on the surface help control soil blowing and conserve moisture. This soil generally needs land leveling for gravity irrigation. A tailwater recovery system can be installed at the lower end of the field to recycle runoff water. Irrigation by sprinklers is suitable, but the very low intake rate of this soil requires a slow application rate. Growing legumes, such as alfalfa, tends to increase the permeability. Sprinklers that operate in sets at one location should be adjusted to provide the proper application rate.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Rotation grazing, proper stocking, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Species should be used that tolerate the moderately high water table. The ability of adapted species to survive and grow is good. Competition for moisture from grasses and weeds is a concern of management. Cultivation with a disc or other similar equipment between the rows and hand hoeing or rototilling in the rows can be used to control weeds. During dry weather, the soil cracks. This exposes the roots to drying. A shallow cultivation can be used to close the cracks.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or need to be constructed on compacted fill to raise the bottom of the lagoon several feet above the seasonal high water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIIw-1 dryland and capability unit IIIw-1 irrigated. It is in windbreak suitability group 2s.

Zn—Zook silt loam, overwash, 0 to 2 percent slopes. This soil is deep, nearly level, and poorly drained. It is on bottom lands adjacent to the dredged channels of Logan Creek. Areas of this soil are occasionally flooded. Areas range from 10 to 100 acres.

Typically, the surface layer is friable and about 22 inches thick. The upper part of the surface layer is very dark grayish brown, calcareous silt loam, and the lower part is silty clay loam. The subsoil is firm silty clay. It is black in the upper part and dark gray in the lower part to a depth of 60 inches.

Included with this soil in mapping are small areas of the less clayey Colo silty clay loam at a slightly higher elevation than this Zook soil and the more clayey Zook silty clay at a similar or slightly lower elevation. Also included are small areas of soils that have a loam surface layer. The included soils make up 3 to 10 percent of this map unit.

This Zook soil has slow permeability and moderate available water capacity. Runoff is slow. Moisture is released slowly to plants. The seasonal high water table is at a depth of about 1 foot in most wet years and at a depth of about 3 feet in most dry years. Content of organic matter is moderate, and natural fertility is medium. Shrink-swell potential is high in the subsoil. The rate of water intake is low. Tilth is good.

Most areas of this soil are used for dryland farming, but some areas are irrigated.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Wetness early in spring, when rainfall is highest, is the major hazard. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds, diseases, and insects are controlled. Water stands on the surface of low areas for short periods after heavy rains, and this delays tillage operations. Surface V-shaped ditches help improve drainage. This soil is commonly tilled late in fall. Without snow cover or other kinds of surface protection, soil blowing can be a hazard during winter. Conservation tillage practices, such as disc-plant and no-till plant, that leave crop residue on the surface help prevent soil blowing and conserve moisture.

If this soil is irrigated, it is suited to row crops, such as corn, soybeans, and grain sorghum, and to close-sown crops, such as introduced grasses and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Soil wetness is the main limitation. Tillage is commonly delayed early in spring. The soil is occasionally flooded, but damage to crops is not generally serious. Conservation tillage practices that keep crop residue on the surface help prevent soil blowing and loss of moisture by evaporation. Land leveling helps improve surface drainage and increases efficiency of irrigation. Surface ditches and perforated tile can be installed where a suitable outlet is available. Furrow, border, and sprinkler irrigation are generally suited.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Species should be selected that tolerate the moderately high water table and occasional flooding. The ability of adapted species to survive and grow is good. Competition for moisture from grasses and weeds can be controlled by cultivating between the tree rows and by applying appropriate herbicides in the tree row. Areas near the trees and between the trees can be hand hoed or rototilled. This soil commonly shrinks during dry weather, allowing air to enter and dry out the roots of newly established plants. When this occurs, shallow cultivation with a rototiller or disc helps close the cracks.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or need to be constructed on fill to raise the bottom of the lagoon several feet above the seasonal high water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable, compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-2 dryland and capability IIw-2 irrigated. It is in windbreak suitability group 2w.

Zo—Zook silty clay loam, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is mainly on bottom lands along Bell and Logan Creeks, but in places it is in old abandoned channels of the Missouri River. Areas of this soil are occasionally flooded. Areas range from 10 to 250 acres.

Typically, the surface soil is black, firm silty clay loam about 29 inches thick. The subsoil is very dark gray, firm silty clay about 15 inches thick. The underlying material to a depth of 60 inches is dark gray silty clay.

Included with this soil in mapping are small areas of Zook silty clay at an elevation similar to this Zook soil. Also included are small areas of Zook silt loam, Colo silty clay loam, and Holly Springs silty clay loam at a slightly higher elevation. The included soils make up 5 to 10 percent of this map unit.

This Zook soil has slow permeability and moderate available water capacity. Runoff is slow. Moisture is released slowly to plants. The seasonal high water table is at a depth of about 1 foot in most wet years and at a depth of about 3 feet in most dry years. Content of organic matter is high, and natural fertility is medium. Shrink-swell potential is high. The rate of water intake is very low. Tilth is fair.

Most areas of this soil are used for dryland farming, but some areas are irrigated. A few areas are in introduced grasses and used for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Soil wetness and flooding in spring are the major hazards. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds, diseases, and insects are controlled. Surface water commonly stands in low areas for several days after rains, and this delays tillage operations. Land leveling and shallow surface ditches help improve surface drainage. In places, perforated tile drains lower the water table and help control wetness. Most areas of this soil are tilled in fall. Without snow cover or other kinds of protection, soil blowing is a hazard in winter. Conservation tillage practices that keep crop residue on the surface help reduce soil blowing, conserve soil moisture, and improve tilth. Terraces, dams, and other kinds of land treatment on the drainage area above this soil are beneficial in reducing flood damage.

Corn is the principal irrigated crop. Small areas of soybeans, grain sorghum, and introduced grasses mixed with alfalfa are also irrigated. Soil wetness from the water table is the main limitation. Flooding is common. Land leveling improves surface drainage and increases efficiency of irrigation. Shallow surface ditches and perforated tile can be installed where a suitable outlet is available. Gravity and sprinkler irrigation are suited. Conservation tillage practices that leave crop residue on the surface, such as disc-plant, conserve soil moisture and improve tilth.

This soil is suited to introduced grasses for pasture. Pasture commonly consists of smooth brome or a mixture of smooth brome and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that tolerate the moderately high water table and occasional flooding. The ability of adapted species to grow and survive is good. Competition for moisture from grasses and weeds are a concern of management. Cultivation between the rows and proper use of appropriate herbicides in the rows help control grasses and weeds. Areas near the trees can be hoed by hand. In dry weather, cracks form in this soil. When this occurs, care should be taken to keep plant roots from drying. Shallow cultivation and supplemental watering help close the cracks.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or need to be constructed on fill to raise the bottom of the lagoon several feet above the seasonal high water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIw-4 dryland and capability unit IIw-1 irrigated. It is in windbreak suitability group 2w.

Zw—Zook silty clay, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It is in the lowest part of the landscape on bottom lands in the valleys of Bell and Logan Creeks. Areas of this soil are occasionally flooded. Areas range from 10 to 200 acres.

Typically, the surface soil is very firm silty clay about 40 inches thick. The upper part of the surface soil is very dark gray, and the lower part is black. The subsoil is very dark gray, very firm silty clay about 8 inches thick. The underlying material to a depth of 60 inches is gray silty clay. In some areas, lime concretions are in the lower part of the profile.

Included with this soil in mapping are small areas of the less clayey Colo soils and poorly drained Holly Springs soils. Both of these soils are at a slightly higher elevation than this Zook soil. Also included are small areas of Zook silty clay loam at a similar or slightly higher elevation. The included soils make up 3 to 10 percent of this map unit.

This Zook soil has slow permeability and moderate available water capacity. Runoff is slow. Moisture is absorbed slowly and released slowly to plants. The seasonal high water table is at a depth of about 1 foot in most wet years and at a depth of about 3 feet in most dry years. Content of organic matter is high, and natural fertility is medium. Shrink-swell potential is high. The rate of water intake is very low. Tilth in this clayey soil is poor.

Most areas of this soil are used for dryland farming. A few areas are in introduced grasses and are used for pasture.

If this soil is used for dryland farming, it is suited to corn, soybeans, grain sorghum, small grain, and alfalfa. Row crops can be grown in consecutive years if proper amounts and kinds of fertilizers are applied and weeds, diseases, and insects are controlled. Soil wetness early in spring, when rainfall is the highest, is the major hazard. The soil floods occasionally, but damage to crops is seldom severe. Surface water stands in low areas for several days after rains, and this delays tillage. Land leveling, perforated tile drains, and shallow surface ditches are effective in providing improved drainage. Most areas of this soil are tilled in fall when moisture conditions are most favorable. Without snow cover or other kinds of surface protection, soil blowing is a hazard in winter. Avoiding the use of machinery on this soil in wet periods helps reduce compaction. Workability is poor, and the soil should be tilled only at the proper moisture content. Keeping crop residue on the surface and using conservation tillage practices improve tilth and conserve moisture.

If this soil is irrigated, it is suited to corn, soybeans, and grain sorghum and to close-sown crops, such as introduced grasses and alfalfa. Row crops can be grown in consecutive years if a high level of management is used. Soil wetness is the principal limitation, and, because of this, tillage is delayed early in spring. Land leveling, perforated tile drains, and shallow ditches can be used to improve drainage. Surface ditches and tile drains need a suitable outlet. Gravity and sprinkler irrigation are suited. Returning crop residue and incorporating barnyard manure into the soil help make this soil more friable and easy to work. Conservation tillage practices that keep crop residue on the surface help improve tilth and conserve moisture.

Introduced grasses for pasture are suited to this soil. Pasture commonly consists of smooth brome, a mixture of smooth brome and alfalfa, or orchardgrass and alfalfa. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, and application of nitrogen fertilizers help keep the grasses in good condition.

Trees and shrubs in windbreaks are suited to this soil. Species selected should tolerate the moderately high water table and occasional flooding. The ability of adapted species to survive and grow is fair. Competition for moisture from grasses and weeds is a concern. Weeds and grasses can be controlled by cultivation or by use of appropriate herbicides. Establishing seedlings may be difficult in wet periods in some years. During summer when the weather is dry, this soil shrinks, and cracks appear. If this occurs, shallow cultivation and supplemental irrigation help close the cracks.

This soil is not suitable for building sites because of the hazard of flooding, wetness, and high shrink-swell potential. It is not suitable for septic tank absorption fields because of flooding, wetness, and slow permeability. Therefore, alternate sites on other soils that are suited to these uses should be considered. Sewage lagoons need to be protected from flooding by dikes or need to be constructed on fill to raise the bottom of the lagoon several feet above the seasonal high water table. Roads need to be protected from flooding and wetness. They should be constructed on suitable compacted fill and have adequate side ditches and culverts. The low strength and high shrink-swell potential of this soil need to be considered in the design of roads and streets. The use of coarse-grained material for subgrade or base material insures better performance. Mixing the base material with hydrated lime increases strength and helps prevent excessive shrinking and swelling. Damage to roads by frost action can be reduced by good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading helps provide the needed surface drainage.

This soil is in capability unit IIIw-1 dryland and capability unit IIIw-1 irrigated. It is in windbreak suitability group 2w.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and windbreaks; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

By William E. Reinsch, conservation agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Most of the farmland in Burt County is used for cultivated crops. According to the Nebraska Agriculture Statistics, 87 percent of the total acreage in the county is planted to crops. The largest acreage is in corn and soybeans, followed by alfalfa and small grain. Minor crops are sorghum and rye. About 71 percent of the cropland is dryfarmed.

The potential of soils in Burt County for increased production of food is good. About 291,700 acres is suited to cropland and, of this, 153,700 acres is suited to irrigation if an adequate supply of water is available. An additional 34,800 acres could be developed for irrigation, providing water is available and erosion problems are controlled.

Dryland crops. Good management practices on dryland crops are those that reduce runoff, reduce erosion, conserve moisture, and improve tilth. Most of the soils in Burt County are suitable for crop production. In many places, however, the erosion hazard is severe and needs to be reduced or corrected by suitable conservation practices.

Terraces, contour farming, grassed waterways, and conservation tillage practices that keep crop residue on the surface help reduce water erosion. Keeping crop residue on the surface or growing a protective plant cover reduces sealing and crusting of the soil during and after heavy rains. In winter, stubble catches drifting snow that can provide additional moisture.

The hazard of soil blowing in Burt County is minor, but the same management practices that control water erosion can be used to control erosion by wind. Examples of these practices are use of crop residue, conservation tillage, contour stripcropping, and narrow field windbreaks. The overall hazard of erosion can be reduced if areas of the more productive soils are used for row crops and the steeper, more erodible soils are used for close-sown crops, such as small grain, alfalfa, or grasses for hay and pasture. Proper land use alone can reduce the potential for erosion in many places.

In Burt County, rainfall is the limiting factor for crop production. If wind and water are acting as erosive forces to the soil, a cropping system needs to be planned to fit the needs of the soils in each field.

The sequence of crops grown in a field, in combination with the practices needed for the management and conservation of the soil, is known as a cropping system. On dryland soils, the cropping system should preserve tilth and fertility, maintain a plant cover that protects the soil from erosion, and control weeds, insects, and diseases. Cropping systems vary according to the soils on which they are used. For example, the crop sequence on Ida silt loam, 11 to 17 percent slopes, eroded, should include a high percentage of grass and legume crops. However, on Colo silty clay loam, 0 to 1 percent slopes, a higher percentage of row crops can be grown in the cropping sequence and the fertility and tilth of the soil can still be maintained.

For dryland farming, soils need to be worked to prepare a seedbed, to control weeds, and to provide a favorable place for plants to grow. Excessive tillage, however, breaks down the granular structure in the surface layer that is needed for good tilth. Steps in the cultivation process should be limited to those that are essential. Various methods of conservation tillage are used in Burt County. The conservation tillage systems of no-till plant, disc-plant, or chisel-plant are well suited to row crops. Grasses can be established by drilling into a cover of stubble without further seedbed preparation.

All soils that are used for cultivated crops or for pasture should be tested to determine the need for additional nutrients. Under dryland management, the kinds and amounts of fertilizers to be applied should be based on results of soil tests and on the content of the moisture in the soil at time of application. Where the subsoil is dry and rainfall is low, the rate at which fertilizer is applied should be slightly lower than the rate applied if the soil is moist. For non-legume crops, nitrogen fertilizer is beneficial for all soils. Fertilizers containing phosphorus and zinc are needed on the more eroded soils or on cut areas after construction of terraces or diversions. Dryfarmed soil requires smaller amounts of fertilizer because the plant population is generally lower than on irrigated soil.

The best management practices to protect the soil and reduce erosion on soils in capability class I and capability subclasses IIw and IIIw are crop residue use, addition of nutrients in fertilizers or barnyard manure, and a good cropping system. On soils in subclasses IIe and IIs, good management includes leaving the stand of crop residue on the soil over winter, contour farming, and grassed waterways. It also includes a conservation tillage system that leaves 3,000 pounds per acre of corn or sorghum residue on the soil surface after planting the crop, or 1,500 pounds per acre of small grain residue. On soils in subclasses IIIe and IVe, good practices are leaving the stand of crop residue on the soil over winter, contour farming, terraces, grassed waterways, and a conservation tillage system that leaves 3,000 pounds per acre of corn or sorghum residue or 1,500 pounds per acre of small grain residue on the soil surface after planting the crops. On slopes of more than 10 percent, grasses and legumes are needed in the cropping sequence to reduce water erosion to an acceptable limit.

Some soils in Burt County are somewhat poorly drained and poorly drained because of the moderately high water table. Open drainage ditches and underground tile systems can be used to help lower the water table if suitable outlets at low elevations are available. Where the water table cannot be lowered sufficiently for good crop growth, crops can be planted that tolerate wet conditions.

Use of herbicides is an excellent way to control weeds; however, care should be taken to apply the correct kind of herbicides at the proper rate to correspond with soil conditions. The colloidal clay and humus fraction of the soil are responsible for most of the chemical activity in the soil. Therefore, crop damage from herbicides can occur on sandy soils that are low in colloidal clay and on soils in which the content of organic matter is moderately low to low. Consequently, application rates of herbicides need to be correspondingly lowered on these soils. Keeping field boundaries on the contour helps maintain the content of organic matter in the field, thereby lessening the danger of damage from herbicides.

Irrigated crops. About 17 percent of all cropland in Burt County is irrigated. The largest acreage is in corn and soybeans, and a smaller acreage is in alfalfa hay and small grain.

The irrigated soils are mainly in the Missouri River Valley. A smaller acreage is in Logan Creek Valley. The irrigation water is derived almost entirely from wells.

Either furrow or sprinkler irrigation is suited to corn and soybeans. Alfalfa can be irrigated by border, contour ditch, corrugations, or sprinklers.

The cropping system on soils well suited to irrigation consists mostly of row crops. A cropping sequence that includes row crops and alfalfa or grasses helps control diseases and insects that are commonly present if the same crop is grown year after year. Gently sloping soils, such as Moody silty clay loam, 2 to 6 percent slopes, are subject to water erosion if they are furrow irrigated down the slope. If irrigated by furrow, these soils can be contour benched, leveled, or irrigated with contour furrows in combination with parallel terraces.

Land leveling increases the efficiency of irrigation because an even distribution of water can be obtained. The efficiency of furrow irrigation can be improved by the addition of a tailwater recovery system. Sprinkler irrigation is better suited to the coarser textured soils, providing adequate water is available. Terraces, contour farming, and contour bench leveling can be used on irrigated land, in addition to contour furrows with terraces. Grassed waterways and conservation tillage systems that keep crop residue on the surface help control water erosion on soils irrigated with sprinklers.

Where sprinkler irrigation is developed on soils such as Nora silty clay loam, 6 to 11 percent slopes, the same conservation practices that control water erosion on nonirrigated cropland should be applied. These practices include terraces, contour farming, and conservation tillage practices that leave a protective cover of crop residue on the soil after the row crop is planted. These practices are important in conserving the supply of surface water and in protecting soil from erosion.

In sprinkler irrigation, water is applied by sprinklers at a rate the soil can absorb without runoff. Sprinklers can be used on the more sloping soils as well as the nearly level soils. Some soils, such as Moody silty clay loam, 2 to 6 percent slopes, are suited to sprinkler irrigation if conservation practices are applied that control the erosion. Because the water can be carefully controlled, sprinklers have special use in conservation, such as establishing new pasture on moderately steep slopes. In summer, however, much water is lost through evaporation. Wind drift can cause uneven application of water in some sprinkler systems.

Sprinkler systems are of two general kinds: those that operate in sets, which means they are set at a certain location and operate there until a specified amount of water is applied; and the center-pivot type, which is a moving system that revolves about a central pivot point.

Soil holds only a limited amount of water. Irrigation water, therefore, is applied at regular intervals to keep the soil profile moist at all times. The interval varies according to the crop and the time of year. The water should be applied only as fast as the soil can absorb it.

Irrigated silt loam and silty clay loam soils in Burt County hold about 2 inches of available water per foot of soil depth. A soil that is 4 feet deep and planted to a crop that sends its roots to that depth can hold about 8 inches of available water for that crop.

Maximum efficiency is obtained if the irrigation process is started when about one-half of the stored water has been used by the plants. Thus, if a soil holds 8 inches of available water, irrigation should be started when about 4 inches have been removed by the crop. Irrigation sets or systems should be planned to replace the amount that is used by the crop.

A tailwater recovery pit can be installed at the end of a furrow irrigated field to trap runoff of excess irrigation tailwater. This water can then be pumped to the upper ends of the field and used again. This practice increases the efficiency of the irrigation system and helps conserve the supply of underground water.

All of the soil series in Nebraska are placed in irrigation design groups. These design groups are described in the Nebraska Irrigation Guide (*7*), which is part of the technical specifications for conservation in Nebraska. Arabic numbers of the irrigation capability unit indicate the irrigation design group to which the soils belong.

Assistance in planning and designing an irrigation system is available through the local office of the Soil Conservation Service or the county agricultural agent. Estimates concerning cost of equipment can be obtained from local dealers and manufacturers of irrigation equipment.

Pasture and hay. Areas that are in hay or pasture should be managed for maximum production. Once the pasture is established, the grasses need to be kept productive. A rotation grazing system that meets the needs of the plants and promotes uniform utilization of forage is important if high returns are expected. Many forages are a good source of minerals, vitamins, proteins, and other nutrients. A well managed pasture can thus provide a balanced ration throughout the growing season. Irrigated pasture requires a high level of management to produce maximum returns.

A mixture of grasses and legumes can be grown on many kinds of soil and, if properly managed, is profitable. Grasses and legumes are compatible with grain crops in a crop rotation and have beneficial soil building effects. This is because they improve tilth, add organic matter, and reduce erosion. The mixture is ideal in a conservation cropping system.

Grasses and legumes used for pasture and hayland, both dryland and irrigated, require additional plant nutrients to obtain maximum production. The kinds and amounts of fertilizers needed should be determined by a soil test.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIw-4 or IIIe-3.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

prime farmland

Prime farmland, one of the several kinds of important farmlands, is of major importance in providing short and long range needs of the United States for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that government and individuals together must encourage and facilitate intelligent and prudent use of the prime farmland of the Nation.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to produce food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to most economically produce and sustain a high yield of crops. If this land is properly treated and high level management and acceptable farming methods are used, it produces the highest yields with the least inputs of energy and economic resources, and results in the least damage to the environment.

At the present time, prime farmland in Burt County may be used for cropland, pastureland, or woodland, or it may have other land uses. It is not used for urbanland, built-up land, or water areas. This land should continue to be used for the production of food or fiber or be made available for these uses.

Prime farmland generally has an adequate and dependable supply of moisture from precipitation or for irrigation. The temperature is favorable and the growing season is adequate. The soils have an acceptable level of acidity or alkalinity, are permeable to water and air, and have few or no rocks. They are not excessively erodible or saturated with water for long periods, and are not flooded during the growing season. The slope ranges mainly from 0 to 6 percent. About 153,940 acres or nearly 50 percent of Burt County meets the soil requirements for prime farmland. The local staff of the Soil Conservation Service can supply more detailed information on the criteria for prime farmland.

A recent trend in land use in parts of Burt County has been the conversion of some areas of prime farmland to industrial and urban uses. The loss of prime farmland to other uses tends to result in the conversion of marginal lands to farming use. These soils are generally more erodible, more droughty, more difficult to cultivate, and are usually less productive.

Soil map units that make up the prime farmlands in Burt County are listed in this section. This list, however, does not recommend a particular land use for these soils. The extent of each listed map unit is shown in Table 4, and the location of each unit is shown on the detailed soil maps at the back of this publication. Soil qualities that affect use and management are described in the section "Detailed soil map units."

Soils that have such limitations as a high water table or inadequate rainfall, or are frequently flooded can qualify as prime farmland if these limitations are overcome by drainage or flood control measures or by irrigation. Onsite investigation is needed to determine if limitations have been overcome by corrective measures.

The map units in Burt County that meet the soil requirements for prime farmland are:

Be—Belfore silty clay loam, 0 to 2 percent slopes
Bf—Belfore silty clay loam, terrace, 0 to 2 percent slopes
Bn—Blencoe silty clay loam, 0 to 1 percent slopes
Bo—Blencoe silty clay, 0 to 1 percent slopes
Bs—Blyburg silt loam, 0 to 2 percent slopes
Ca—Calco silty clay loam, 0 to 2 percent slopes
Cd—Carr silt loam, 0 to 2 percent slopes
Cf—Colo silt loam, overwash, 0 to 1 percent slopes
Cg—Colo silty clay loam, 0 to 1 percent slopes
Gb—Grable silt loam, 0 to 2 percent slopes
He—Haynie silt loam, 0 to 2 percent slopes
Hg—Haynie Variant silt loam, 0 to 1 percent slopes
Hp—Holly Springs silty clay loam, 0 to 1 percent slopes
JuC—Judson silty clay loam, 2 to 6 percent slopes
Ko—Kennebec silt loam, occasionally flooded, 0 to 2 percent slopes
Ma—Marshall silty clay loam, 0 to 2 percent slopes
MaC—Marshall silty clay loam, 2 to 6 percent slopes
MaC2—Marshall silty clay loam, 2 to 6 percent slopes, eroded
Mb—Marshall silty clay loam, terrace, 0 to 2 percent slopes
Mk—Modale silt loam, 0 to 2 percent slopes
Mo—Moody silty clay loam, 0 to 2 percent slopes
MoC—Moody silty clay loam, 2 to 6 percent slopes
MoC2—Moody silty clay loam, 2 to 6 percent slopes, eroded
Mt—Moody silty clay loam, terrace, 0 to 2 percent slopes
Om—Omadi silt loam, 0 to 1 percent slopes
On—Onawa silty clay, 0 to 2 percent slopes
Ow—Owego silty clay, 0 to 1 percent slopes
Sa—Salix silty clay loam, 0 to 1 percent slopes
Zn—Zook silt loam, overwash, 0 to 2 percent slopes
Zo—Zook silty clay loam, 0 to 1 percent slopes
Zw—Zook silty clay, 0 to 1 percent slopes

rangeland

By Peter N. Jensen, range conservationist, Soil Conservation Service.

Rangeland or native pasture makes up approximately 1 percent of the agricultural land in Burt County. It is largely in the eastern part of the county, along creeks in the Missouri River Valley, and is mainly in the Ida-Monona-Judson association. Most rangeland is in the Silty and Limy Upland range sites. The average livestock farm is about 400 acres.

The general livestock program is mainly small operations of cow and calf herds. Calves are sold in the fall as feeders. The rangeland is generally grazed late in spring through the early part of fall. In other parts of the year, the livestock graze smooth brome in spring and corn or grain sorghum stalks in fall and early in winter. They are fed alfalfa-hay or silage, or both of these the rest of the winter.

In Burt County, approximately 2,500 acres of cropland has been planted to a mixture of adapted native grasses and is used for summer pasture. Some areas of the rangeland have been depleted by overuse and support low forage producing plants. Commonly, overused range has an abundance of broadleaf weeds, and some migration of shrubs occurs on the steeper slopes and trees in the drainageways. The productivity of the range can be increased by proper management, namely proper grazing use, deferred grazing, planned grazing systems of use and rest, and brush or weed control. In addition, range seeding can be applied in cropland areas where soil losses exceed tolerable limits.

Farmers can obtain technical help with reseeding presently cropped land to grass, setting up a planned grazing system, or other aspects of a range program from the local office of the Soil Conservation Service.

woodland

By Keith A. Ticknor, forester, Soil Conservation Service.

Approximately 2 percent, or 6,300 acres, of the land in Burt County is forested. Woodland areas occur mostly on the steep bluffs adjacent to the Missouri River Valley and on the bottom lands of streams, including the low bottom lands of the Missouri River. Woodland in Burt County has declined 41 percent since 1955, chiefly because native woodland is being cleared and converted to cropland.

Most of the soils in Burt County have potential for production of wood products, including Christmas trees.

However, it is expected that crop production will continue to limit or decrease the use of the land for wood products.

Of the sawtimber in Burt County, approximately 40 percent is eastern cottonwood, 24 percent is bur oak, 10 percent is American basswood, 4 percent is green ash, 3 percent is black walnut, and 19 percent is made up of minor species of hardwood and softwood trees. All of these species of sawtimber have commercial value.

windbreaks and environmental plantings

By Keith A. Ticknor, forester, Soil Conservation Service.

Most farmsteads in Burt County are surrounded by trees. Some of the trees are native and were established before the farmstead was built. Others have been planted since that time. Windbreaks are planted for protection and for esthetic value.

Many windbreaks in the county are deteriorating because of insect and disease infestations, or because the trees and shrubs have passed maturity. Renovation measures are needed to restore the effectiveness of these windbreaks.

For windbreaks to fulfill their intended purpose, the selected species of tree or shrub needs to be adapted to the soils in which it is to be planted. Matching the proper tree with the soil is the first step toward insuring survival. It also helps to insure that a maximum rate of growth is obtained in the windbreaks. Permeability, available water capacity, and fertility greatly affect the rate of growth for trees and shrubs in windbreaks.

Because competing weeds and grasses are the most limiting factor, proper site preparation prior to planting and control of weeds and other competition after planting are especially important for establishing and managing a windbreak in Burt County.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low and high growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

By Robert O. Koerner, biologist, Soil Conservation Service.

Burt County has many important recreation facilities and places of historical significance. Results of a study concerning recreation potential are published in An Appraisal of Potentials for Outdoor Recreational Development, Burt County, Soil Conservation Service, 1967. In this publication, 12 kinds of recreation activities were evaluated and appraised by representatives of county, State, and Federal agencies, and local private organizations.

Rated high in Burt County were areas for small game hunting and areas for picnicking, and camping.

Public recreation facilities maintained by the Nebraska Game and Parks Commission are: Mid-Decatur Bend Special Use Area, a 45-acre hunting area for big game, small game, and waterfowl; and Blackbird State Wayside Area, which maintains 10 acres with picnic tables, tent and trailer sites, and hiking facilities.

Burt County also has many scenic and historical sites. Hills and valleys have a wide variety of trees, and shrubs, and vines grow along roadsides and fence rows. The Lewis and Clark Trail along the Missouri River bottom is of historical importance. Other historical sites include the Decatur Town and Ferry Company, which was established in 1856 and became a famous ferry crossing; and the Decatur Trail, on State Highway 51, which was a route for Indians traveling to and from their hunting grounds.

Other interesting places in Burt County include Golden Springs on U.S. Highway 73 in Decatur Township, which is an unusual natural spring near the foothills of the Missouri River, and Reservoir Hill near Tekamah, which is a historic Indian lookout and observation point. In 1962 an ancient Indian village was discovered on U.S. Highway 77 south of Oakland. It is estimated to be over 7,000 years old.

Fishing in Burt County is mainly in the Missouri River and Logan Creek. Catfish, carp, bass, and bluegills are the main species. Bass, bluegills, and catfish are also found in privately owned ponds throughout the county.

The principal species of wildlife are white-tailed deer, bobwhite quail, pheasants, mourning doves, cottontail rabbits, squirrels, and waterfowl (fig 10).

Technical assistance for designing installations to improve habitat for wildlife and facilities for recreation within Burt County are available at the Soil Conservation Service field office in Lyons.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for

Figure 10.—A shallow pond in an area of Albaton silty clay, depressional. This area provides wildlife habitat for waterfowl.

recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

By Robert O. Koerner, biologist, Soil Conservation Service.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, smooth brome, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, green ash, honeylocust, hawthorn, dogwood, hickory, eastern cottonwood, and willow. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are sumac, common chokecherry, Russian-olive, autumn-olive, and wild plum.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cordgrass, rushes, sedges, and reedgrass.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasants, meadowlarks, field sparrows, cottontail rabbits, skunks, and red foxes.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include cottontail rabbits, bobwhite quail, woodcocks, thrushes, woodpeckers, squirrels, red foxes, raccoons, deer, and coyotes.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrats, mink, and beaver.

The soil associations on the general soil map of Burt County are discussed in relation to wildlife in the following paragraphs.

The Zook-Colo association contains the major upland drainageways of the county, including Logan and Bell Creeks. Stream channels and banks make good wildlife habitat for deer, squirrels, cottontail rabbits, pheasants, and bobwhite quail. Most of the adjacent bottom lands are cultivated and provide waste grain as supplementary food. The drainageways also provide escape cover and travel lanes for wildlife.

The Moody-Nora-Judson association is an area of rolling loess uplands where corn, grain, sorghum, alfalfa, and soybeans are commonly grown in rotation. Scattered trees and shrubs, such as plum and dogwood, are in the narrow drainageways and along roadsides. Farmstead windbreaks also provide good woody cover. The main species of wildlife in this association are pheasants, bobwhite quail, and songbirds.

The Ida-Monona-Judson association and the Ida-Burchard-Steinauer association are areas of loess uplands, glacial till uplands, and the adjacent foot slopes. These associations offer a wide variety of cover types (fig. 11). They are mainly in cultivated cropland. However, in most places, the narrow drainageways and the bluffs to the Missouri River Valley are heavily wooded with basswood, ash, bur oak, and boxelder. Along the roadsides are thickets of plum, dogwood, sumac, Virginia creeper, wild grape, and elderberry. The wooded bluffs and drainageways provide good escape cover and travel lanes for deer and other species as they travel to the uplands from the Missouri River bottom lands.

The Luton-Solomon-Forney association is on the high bottom lands adjacent to and slightly higher than the Haynie-Albaton-Sarpy association. Scattered trees are in most drainageways that cross these areas. Openland wildlife in this association are pheasants, bobwhite quail, and many songbirds. Farmstead windbreaks provide added woody cover. Some wet areas provide habitat for wetland species, such as shore birds, mink, muskrats, and beaver.

The Haynie-Albaton-Sarpy association includes islands in the Missouri River and low bottom lands adjacent to the river. A few of the islands have heavy stands of trees, mainly eastern cottonwood and willows. Many wooded areas, which have been cleared of trees and planted to cultivated crops, provide diversity in both food and cover for wildlife species, such as white-tailed deer, bobwhite quail, and pheasants. Most of the bottom lands adjacent to the river are cultivated and provide additional food for wildlife. Many marshy areas are adjacent to the river where the channel course has changed. Oxbows have created lakes that provide good areas for waterfowl. Other wetland wildlife species using this association are mink, muskrats, beaver, and shore birds.

The Belfore-Moody-Marshall association consists of stream terraces in parts of the Logan Creek and Missouri River Valleys. These nearly level areas are used mainly as openland wildlife habitat. Fields of corn, soybeans, and grain sorghum are common, along with some areas planted to alfalfa. The main species of wildlife in this association are pheasants, doves, songbirds, and cottontail rabbits. Farmstead windbreaks are common and provide small areas of woody cover. Deer commonly feed in the fields where the areas are adjacent to woody drainageways of nearby associations. Mourning doves are in all parts of Burt County.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Figure 11.—Most upland areas provide food, cover, and habitat for many kinds of wildlife. The kind of area shown is especially valuable as habitat for deer and quail.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate, or high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

physical and chemical analyses of selected soils

Samples from soil profiles were collected for physical and chemical analyses by the Soil Conservation Service, Soil Survey Laboratory in Lincoln, Nebraska. Soils of the Belfore, Burchard, Crofton, Luton, Marshall, Monona, Moody, and Nora series were sampled in nearby counties. These data are recorded in Soil Survey Investigations Report Number 5 (*6*). Soils of the Ida and Monona series were sampled in nearby counties in Iowa. These data are recorded in Soil Survey Investigations Report Number 3 (*5*).

This information is useful to soil scientists in classifying soils and developing concepts of soil genesis. It is also helpful in estimating available water capacity, susceptibility to soil blowing, fertility, tilth, and other practical aspects of soil management.

engineering index test data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity, T—100 (AASHTO).

The group index number that is part of the AASHTO Classification is computed using the Nebraska modified system.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*8*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludolls (*Hapl*, meaning minimal horizonation, plus *udoll*, the suborder of the Mollisols that have a humid moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Hapludolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*8*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Albaton series

The Albaton series consists of deep, poorly drained and very poorly drained soils. These soils are on bottom lands in the Missouri River Valley and, in places, are in swales and depressions. These soils formed in calcareous, clayey alluvium and have very slow permeability. Slope is 0 to 1 percent.

Albaton soils are commonly adjacent to Onawa, Modale, Sarpy, and Haynie soils. Onawa soils are silt loam in the lower part of the C horizon. Modale soils are silt loam in the upper part of the C horizon. Sarpy soils are sandy. Typically, Haynie soils are silt loam throughout the profile. Typically, Modale, Sarpy, and Haynie soils are at a slightly higher elevation.

Typical pedon of Albaton silty clay, 0 to 1 percent slopes, 1,980 feet west and 300 feet south of northeast corner sec. 13, T. 20 N., R. 11 E.

Ap—0 to 8 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate fine and very fine blocky structure; very hard, very firm, very sticky; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1g—8 to 40 inches; stratified dark grayish brown (2.5Y 4/2) and dark gray (N 4/0) silty clay, light brownish gray (2.5Y 6/2) and gray (N 6/0) dry; common fine distinct yellowish brown (10YR 5/6) mottles; massive; horizontal cleavage planes between strata; very hard, very firm, very sticky; slight effervescence; mildly alkaline; clear smooth boundary.

C2g—40 to 60 inches; stratified dark gray (2.5Y 4/0) and olive gray (5Y 5/2) silty clay, gray (2.5Y 5/0) and light olive gray (5Y 6/2) dry; many medium prominent reddish brown (5YR 4/4) and yellowish brown (10YR 5/6) mottles; massive; horizontal cleavage planes between strata; very hard, very firm, very sticky; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 6 to 10 inches and corresponds to the thickness of the A horizon.

The A horizon has hue of 10YR or 2.5Y, value of 3 moist and 4 through 6 dry, and chroma of 1 or 2. The Cg horizon has strata of various colors and textures. It has hue of 10YR or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 0 through 2. The Cg horizon dominantly is silty clay, but in some pedons it has strata that are less than 6 inches thick and are slightly lower in clay content. In some pedons, this horizon is silty clay loam or silt loam below a depth of 40 inches. The Cg horizon has common to many yellowish brown, reddish brown, or strong brown mottles.

Belfore series

The Belfore series consists of deep, well drained soils. These soils are on uplands and stream terraces. They formed in silty, calcareous loess and have moderately slow permeability. Slope ranges from 0 to 2 percent.

Belfore soils are commonly adjacent to Fillmore, Judson, Moody, and Nora soils. Fillmore soils have an A2 horizon and are in shallow depressions. Judson soils are on foot slopes and colluvial fans. They have a thicker A horizon and less clay in the B horizon than Belfore soils. Moody and Nora soils have less clay in the B horizon, have carbonates higher in the profile, and are on side slopes below the Belfore soils.

Typical pedon of Belfore silty clay loam, 0 to 2 percent slopes, 1,600 feet north and 800 feet west of the southeast corner sec. 6, T. 21 N., R. 9 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—8 to 14 inches; very dark grayish brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine and medium granular; hard, friable; slightly acid; clear wavy boundary.

B21t—14 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; hard, firm; slightly acid; clear wavy boundary.

B22t—20 to 26 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm; shiny surfaces on peds; slightly acid; clear smooth boundary.

B23—26 to 36 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; few fine faint yellowish brown (10YR 5/6) relict mottles; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; shiny surfaces on peds; hard, firm; slightly acid; clear smooth boundary.

B3—36 to 48 inches; olive brown (2.5Y 4/4) silty clay loam, light olive brown (2.5Y 5/4) dry; few fine faint yellowish brown (10YR 5/6) relict mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable; slightly acid; clear smooth boundary.

C1—48 to 56 inches; light olive brown (2.5Y 5/4) silty clay loam, light yellowish brown (2.5Y 6/4) dry; common medium distinct yellowish brown (10YR 5/6) relict mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable; slightly acid; gradual wavy boundary.

C2—56 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam, light yellowish brown (2.5Y 6/4) dry; common medium distinct yellowish brown (10YR 5/6) relict mottles; massive; slightly hard, friable; slightly acid.

The thickness of the solum ranges from 36 to 60 inches. Free carbonates are leached to a depth of 50 inches or more. Most pedons contain mottles below a depth of 25 inches, and some contain small very dark brown or black concretions.

The A horizon ranges from 10 to 18 inches in thickness. It has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. It is slightly acid or medium acid. The B2t horizon has value of 3 through 5 moist and 4 through 6 dry and has chroma of 2 or 3. It is silty clay loam or silty clay and ranges from 38 to 42 percent clay. The B23 and B3 horizons have hue of 10YR or 2.5Y, value of 3 through 5 moist and 4 through 6 dry, and chroma of 3 or 4. These horizons are slightly acid or medium acid. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 6 or 7 dry, and chroma of 2 through 4. It is slightly acid through mildly alkaline.

Blencoe series

The Blencoe series consists of deep, somewhat poorly drained soils. These soils are on bottom lands in the Missouri River Valley. Typically, they have slow permeability in the upper part of the profile and moderate permeability in the lower part. Slope is 0 to 1 percent.

Blencoe soils are commonly adjacent to Blyburg, Forney, and Luton soils. Blyburg soils have less clay and more silt in the upper part of the profile than the Blencoe soils, have carbonates higher in the profile, and are at a higher elevation. Forney and Luton soils have more clay in the B and C horizons and are at a slightly lower elevation.

Typical pedon of Blencoe silty clay, 0 to 1 percent slopes, 2,565 feet north and 250 feet east of southwest corner sec. 12, T. 20 N., R. 11 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine and medium granular structure; very hard, very firm; slightly acid; abrupt smooth boundary.

A12—8 to 15 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; very hard, very firm; slightly acid; gradual smooth boundary.

B1—15 to 25 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; very hard, very firm; neutral; gradual smooth boundary.

B2—25 to 30 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine faint reddish brown (5YR 4/4) mottles; weak medium and fine subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

B3—30 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

IIC1—36 to 44 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 5/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable; strong effervescence; mildly alkaline; gradual smooth boundary.

IIC2—44 to 52 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; strong effervescence; mildly alkaline; gradual wavy boundary.

IIC3—52 to 60 inches; light olive brown (2.5Y 5/4) silt loam, light gray (2.5Y 7/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; few soft accumulations of lime; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 40 inches. The thickness of the mollic epipedon ranges from 20 to 30 inches. Typically, the soil is silty clay to a depth of 20 to 30 inches. Silt loam begins at a depth of 20 to 40 inches and extends to a depth of 60 inches or more. In some pedons, a recent deposit of silty clay loam is on the surface.

The A horizon ranges from 12 to 20 inches in thickness. It has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. The A horizon is dominantly silty clay but ranges to silty clay loam. Typically, the A horizon is slightly acid, but it is neutral in some pedons. The B horizon has hue of 10YR and 2.5Y, value of 3 or 4 moist and 4 or 5 dry, and chroma of 1 or 2. It is silty clay or heavy silty clay loam in the upper part and silty clay loam or silty loam in the lower part. Typically, the B horizon is neutral, but it is mildly alkaline in some pedons. The C horizon has hue of 2.5Y or 10YR, value of 4 or 5 moist and 5 to 7 dry, and chroma of 2 to 4.

Blyburg series

The Blyburg series consists of deep, well drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in calcareous, silty alluvium and have moderate permeability. Slope ranges from 0 to 2 percent.

The Blyburg soils are similar to Salix soils and are commonly adjacent to Blencoe, Forney, and Luton soils. Salix soils are silty clay loam in the upper part of the control section and silty loam in the lower part. Blencoe soils are silty clay in the upper part of the control section. Forney and Luton soils are poorly drained, are silty clay throughout the profile, and are at a lower elevation than Blyburg soils.

Typical pedon of Blyburg silt loam, 0 to 2 percent slopes, 300 feet south and 200 feet east of northwest corner sec. 11, T. 21 N., R. 11 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak medium and fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A12—8 to 16 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium and fine subangular blocky structure parting to weak medium and fine granular; slightly hard, very friable; neutral; clear wavy boundary.

A13—16 to 19 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak medium and fine subangular blocky structure parting to weak fine granular; slightly hard, very friable; slight effervescence; mildly alkaline; clear wavy boundary.

C1—19 to 30 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak medium and fine subangular blocky structure; slightly hard, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C2—30 to 60 inches; brown (10YR 5/3) stratified silt loam and very fine sandy loam, very pale brown (10YR 7/3) dry; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 20 inches and corresponds to the thickness of the A horizon. Depth to free carbonates ranges from 8 to 20 inches.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. It is neutral or mildly alkaline. The C horizon has hue or 10YR or 2.5Y, value of 4 or 5 moist and 5 through 7 dry, and chroma of 2 or 3. The C horizon is silt loam or very fine sandy loam and is stratified. It is mildly alkaline or moderately alkaline.

Boone series

The Boone series consists of moderately deep, excessively drained soils. These soils are on bluffs adjacent to the Missouri River Valley. They formed in material weathered from weakly cemented sandstone. Slope ranges from 20 to 60 percent.

Boone soils are commonly adjacent to Judson and Ida soils. Judson soils contain much less sand than Boone soils and are on foot slopes. Ida soils are silty and at a higher elevation.

Typical pedon of Boone loamy fine sand in an area of Boone-Rock outcrop complex, 20 to 60 percent slopes, 1,250 feet east and 800 feet north of southwest corner sec. 31, T, 23 N., R. 11 E.

A1—0 to 8 inches; very dark gray (10YR 3/1) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; many weathered sandstone fragments; medium acid; gradual wavy boundary.

C—8 to 21 inches; brown (10YR 4/3) loamy fine sand, brown (10YR 5/3) dry; single grain; loose; slightly acid; clear irregular boundary.

Cr—21 to 60 inches; grayish brown (10YR 5/2) weakly cemented sandstone, light gray (10YR 7/2) dry.

The depth to cemented sandstone ranges from 20 to 40 inches. In some areas, small and medium fragments of strongly indurated sandstone are scattered throughout the pedon. Reaction is medium acid or slightly acid throughout.

The A horizon has hue of 10YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 1 or 2. It is dominantly loamy fine sand but ranges to sandy loam and fine sand. The C horizon has hue of 10YR, value of 5 or 6 moist and 6 or 7 dry, and chroma of 2 through 6. The Cr horizon is reworked or weakly cemented sandstone.

Burchard series

The Burchard series consists of deep, well drained soils on uplands. These soils formed in glacial till and have moderately slow permeability. Slope ranges from 6 to 17 percent.

The Burchard soils in Burt County have a thinner A horizon than that defined as the range for the series, and carbonates are higher in the profile. These differences, however, do not alter the usefulness or behavior of these soils.

Burchard soils are commonly adjacent to Ida, Monona, and Steinauer soils. Ida and Monona soils have less clay in the profile than Burchard soils and formed in silty loess. Steinauer soils have a thinner A horizon, are not so well developed, and typically have steep slopes.

Typical pedon of Burchard clay loam, 11 to 17 percent slopes, eroded, 2,350 feet south and 800 feet east of northwest corner sec. 11, T. 23 N., R. 9 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; hard, firm; neutral; abrupt smooth boundary.

B21t—8 to 18 inches; dark yellowish brown (10YR 4/4) clay loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; hard, firm; thin films on ped faces; strong effervescence; moderately alkaline; clear wavy boundary.

B22t—18 to 30 inches; light olive brown (2.5Y 5/4) clay loam, light yellowish brown (2.5Y 6/4) dry; moderate medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; hard, firm; thin films on ped faces; many small masses of lime; strong effervescence; moderately alkaline; clear wavy boundary.

C—30 to 60 inches; light olive brown (2.5Y 5/2) clay loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct yellowish brown (10YR 5/4) mottles; massive; hard, firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from about 24 to 50 inches. The depth to carbonates ranges from 7 to 30 inches. Small stones are scattered throughout the pedon.

The A horizon has value of 3 or 4 moist and 4 or 5 dry and chroma of 2. It is dominantly clay loam, but is loam or silty clay loam in some pedons. The A horizon is neutral to medium acid. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 4 through 6. The B horizon is clay loam ranging from 26 to 35 percent clay content. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 6 or 7 dry, and chroma of 2 through 4. The B and C horizons are mildly alkaline or moderately alkaline.

Calco series

The Calco series consists of deep, poorly drained and very poorly drained soils. These soils are on bottom lands along upland drainageways and major stream valleys. They formed in silty calcareous alluvium and have moderately slow permeability. Slope ranges from 0 to 2 percent.

Calco soils are near Colo, Zook, and Judson soils. Colo soils are noncalcareous. Zook soils have more clay in the control section than Calco soils and are noncalcareous. Judson soils are well drained, noncalcareous, more strongly developed, and are on foot slopes.

Typical pedon of Calco silty clay loam, 0 to 2 percent slopes, 2,200 feet west and 200 feet north of southeast corner sec. 8, T. 22 N., R. 9 E.

A11—0 to 5 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; hard, firm; slight effervescence; moderately alkaline; abrupt smooth boundary.

A12—5 to 39 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine and medium subangular blocky structure; hard, firm; few fragments of snail shells; violent effervescence; moderately alkaline; gradual smooth boundary.

Bg—39 to 48 inches; very dark gray (N 3/0) silty clay loam, dark gray (N 4/0) dry; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; hard, firm; few fragments of snail shells; violent effervescence; moderately alkaline; gradual smooth boundary.

Cg—48 to 60 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; hard, firm; few fragments of snail shells; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 36 to 52 inches. Average clay content of the control section ranges from 30 to 35 percent, but the percent of clay content in some layers is higher or lower than this. Reaction is mildly alkaline or moderately alkaline throughout the pedon.

The A horizon has hue of 10YR or is neutral, has value of 2 or 3 moist and 3 or 4 dry, and chroma of 0 or 1. This horizon is dominantly silty clay loam but ranges to silt loam. The Bg horizon is neutral or has hue of 10YR, value of 3 moist and 3 or 4 dry, and chroma of 0 or 1. The C horizon has value of 3 or 4 moist and 4 or 5 dry and chroma of 0 or 1.

Carr series

The Carr series consists of deep, well drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in calcareous, loamy alluvium and have moderately rapid permeability. Slope ranges from 0 to 2 percent.

Carr soils are adjacent to Sarpy, Haynie, and Grable soils. Sarpy soils are coarse textured throughout the profile and typically are at a slightly higher elevation than Carr soils. Haynie soils are coarse-silty. Grable soils have contrasting textures of fine material over sandy material.

Typical pedon of Carr silt loam, 0 to 2 percent slopes, 1,800 feet south and 50 feet east of center sec. 7, T. 20 N., R. 12 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; soft, very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 40 inches; grayish brown (10YR 5/2) stratified fine sandy loam, very fine sandy loam, and silt loam, light brownish gray (10YR 6/2) dry; single grain; loose; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2—40 to 60 inches; dark grayish brown (10YR 4/2) stratified fine sandy loam, very fine sandy loam, and silt loam with thin lenses of silty clay loam, light brownish gray (10YR 6/2) dry; few fine distinct reddish brown (5YR 4/4) mottles; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 3 to 14 inches and corresponds to the thickness of the the A horizon. The depth to free carbonates is less the 10 inches. Reaction is mildly alkaline throughout the pedon.

The A horizon has hue of 10YR, value of 3 through 5 moist and 5 through 7 dry, and chroma of 1 or 2. Typically, the A horizon is fine sandy loam but ranges to loamy fine sand, sandy loam, or silt loam. The C horizon is dominantly fine sandy loam but ranges to very fine sandy loam, loamy fine sand, silt loam, or sandy loam. The C horizon has few to common mottles below a depth of 20 inches. In some pedons, the C horizon has strata that are slightly higher in content of sand and clay than is dominant. These strata are less than 6 inches thick.

Colo series

The Colo series consists of deep, somewhat poorly drained soils. These soils are on bottom lands in valleys of the major streams. They formed in silty, noncalcareous alluvium and have moderately slow permeability (fig. 12). Slope is 0 to 1 percent.

Colo soils are similar to Calco soils and are commonly adjacent to Calco, Judson, and Kennebec soils. Calco soils are calcareous throughout the profile. Judson soils are better drained than Colo soils and are on foot slopes. Also, Judson soils have chroma of 3 within a depth of 30 inches, have a B horizon, and formed in colluvium. Kennebec soils are better drained and are at a slightly higher elevation.

Typical profile of Colo silty clay loam, 0 to 1 percent slopes, 1,600 feet north and 520 feet west of southeast corner sec. 14, T. 21 N., R. 9 E.

Figure 12.—Profile of Colo silty clay loam. This deep soil is dark colored and somewhat poorly drained. The arrow indicates the upper boundary of the underlying material. The scale is in feet.

A11—0 to 6 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; moderate medium and fine granular structure; slightly hard, firm; slightly acid; abrupt smooth boundary.

A12—6 to 22 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine and medium granular; slightly hard, firm; slightly acid; clear wavy boundary.

A13—22 to 30 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine faint yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure parting to moderate medium granular; hard, firm; neutral; clear wavy boundary.

AC—30 to 38 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine faint dark brown (7.5YR 4/4) and yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; hard, firm; neutral; diffuse smooth boundary.

C1g—38 to 50 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine distinct brown (7.5YR 4/4) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; diffuse smooth boundary.

C2g—50 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (2.5Y 7/2) dry; many medium distinct yellowish brown (10YR 5/8) mottles; massive; slightly hard, friable; neutral.

The thickness of the solum ranges from 36 to 48 inches. The thickness of the mollic epipedon is 36 inches or more. Reaction in the solum ranges from neutral to medium acid.

The A horizon is neutral or has hue of 10YR, value of 2 or 3 moist and 3 or 4 dry, and chroma of 0 or 1. It is silty clay loam or silt loam. The C horizon has value of 3 to 5 moist and 4 to 7 dry and chroma of 0 to 2. Typically, it is silty clay loam ranging from 32 and 36 percent content of clay. In some pedons, a layer in the lower part of the C horizon ranges to 40 percent content of clay. The C horizon is neutral to slightly acid.

Crofton series

The Crofton series consists of deep, well drained soils. These soils are on uplands. They formed in silty, calcareous loess and are moderately permeable. Slope ranges from 6 to 15 percent.

Crofton soils are near Judson, Moody, and Nora soils. These soils have a mollic epipedon, are more strongly developed, and have carbonates lower in the profile than Crofton soils. Judson soils are on concave foot slopes and on colluvial fans. Moody soils are generally above Crofton soils or are in the concave area adjacent to the upland drainageways. Nora soils are in positions similar to Crofton soils.

Typical pedon of Crofton silt loam, 11 to 15 percent slopes, eroded, 1,400 feet west and 1,300 feet south of northeast corner sec. 1, T. 21 N., R. 8 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—6 to 12 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; few fine distinct reddish brown (5YR 4/4) relict mottles; massive; slightly hard, friable; many small concretions of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C2—12 to 60 inches; brown (10YR 5/4) silt loam, very pale brown (10YR 7/4) dry; common fine distinct reddish brown (5YR 4/4) relict mottles; massive; slightly hard, friable; few small concretions of lime; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 12 inches. The depth to free carbonates ranges from 0 to 8 inches. Reaction is mildly alkaline or moderately alkaline throughout the pedon.

The A horizon has value of 3 or 4 moist and 4 through 6 dry and chroma of 2 or 3. The C horizon has hue of 10YR and 2.5Y, value of 4 through 6 moist and 5 through 7 dry, and chroma of 2 through 4.

Fillmore series

The Fillmore series consists of deep, poorly drained soils. These soils are in shallow depressions on loess-covered stream terraces. They have very slow permeability. Slope is 0 to 1 percent.

Fillmore soils are near Belfore and Moody soils. Belfore and Moody soils do not have an A2 horizon. They contain less clay in the control section than Fillmore soils, are better drained, and are at a slightly higher elevation.

Typical pedon of Fillmore silt loam, 0 to 1 percent slopes, 1,500 feet east and 1,000 feet south of northwest corner sec. 4, T., 23 N., R. 8 E.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; slightly hard; very friable; medium acid; abrupt smooth boundary.

A2—11 to 18 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 7/1) dry; weak medium platy structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

B21t—18 to 22 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; strong medium prismatic structure parting to strong medium blocky; very hard, very firm, very sticky; shiny faces on peds; slightly acid; clear smooth boundary.

B22t—22 to 36 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; few fine faint reddish brown (5YR 4/4) mottles; strong medium blocky structure; very hard, very firm, very sticky; slightly acid; clear smooth boundary.

B23t—36 to 48 inches; very dark grayish brown (10YR 3/2) silty clay, grayish brown (10YR 5/2) dry; many faint reddish brown (5YR 4/4) mottles; strong medium blocky structure; very hard, firm, very sticky; neutral; gradual smooth boundary.

C—48 to 60 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; many coarse prominent reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; hard, sticky; few fine faint iron and manganese stains; neutral.

The thickness of the solum ranges from 30 to 60 inches. The depth to free carbonates is 36 to more than 60 inches.

The A1 or Ap horizon has hue of 10YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 1 or 2. The A2 horizon has hue of 10YR and value of 3 through 5 moist and 5 through 7 dry. The A horizon is commonly silt loam, but in some pedons the A2 horizon is silt. The A horizon is medium acid or slightly acid. The B2t horizon has hue of 10YR, value of 2 or 3 moist and 3 through 5 dry, and chroma of 1 or 2. It is 45 to 50 percent content of clay. Throughout, the B horizon is slightly acid to mildly alkaline. The C horizon has hue of 10YR and 2.5Y, value of 4 through 6 moist and 5 through 7 dry, and chroma of 2 through 4. It is neutral or slightly alkaline.

Forney series

The Forney series consists of deep, poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in clayey alluvium and have very slow permeability. Slope is 0 to 1 percent.

Forney soils in Burt County are calcareous between depths of 9 and 38 inches and moderately alkaline between depths of 52 and 60 inches. These characteristics are outside the range defined for the series. These differences, however, do not alter the usefulness or behavior of the soils.

Forney soils are near Blyburg, Blencoe, Luton, and Solomon soils. Blyburg and Blencoe soils are coarser textured in the C horizon than Forney soils and are at a slightly higher elevation. Luton soils do not have a buried horizon. Solomon soils are calcareous within a depth of 10 inches.

Typical pedon of Forney silty clay, 0 to 1 percent slopes, 1,360 feet north and 50 feet east of southwest corner of sec. 25, T. 22 N., R. 11 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay, grayish brown (2.5Y 5/2) dry; moderately fine and medium granular structure; hard, very firm; neutral; abrupt smooth boundary.

C1g—9 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few fine faint brown (10YR 5/3) and yellowish brown (10YR 5/6) mottles; moderate medium fine and very fine subangular blocky structure; very hard, very firm; slight effervescence; mildly alkaline; clear smooth boundary.

C2g—18 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; many fine distinct reddish brown (5YR 4/4) mottles; moderate medium and fine subangular blocky structure; very hard, very firm; slight effervescence; mildly alkaline; clear smooth boundary.

A1b—22 to 28 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; few fine distinct brown (10YR

5/3) and yellowish brown (10YR 6/6) mottles; moderate medium subangular blocky structure; very hard, very firm, neutral; clear smooth boundary.

B2gb—28 to 44 inches; dark olive gray (5Y 3/2) silty clay, dark gray (5Y 4/1) dry; few fine faint brown (10YR 5/3) mottles; moderate fine prismatic structure parting to moderate medium and fine subangular blocky; very hard, very firm; mildly alkaline; clear smooth boundary.

A1b2—44 to 52 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; few fine faint brown (10YR 5/3) mottles; moderate fine subangular blocky structure; very hard, very firm; mildly alkaline; gradual smooth boundary.

Bgb2—52 to 60 inches; very dark grayish brown (2.5Y 3/2) silty, clay, grayish brown (2.5Y 5/2) dry; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine and medium subangular blocky structure; very hard, very firm; small soft accumulations of lime; strong effervescence; moderately alkaline.

The thickness of the solum corresponds to the thickness of the A horizon. The depth to free carbonates ranges from 9 to 36 inches. Reaction is neutral or mildly alkaline in the control section.

The A horizon has hue of 10YR or 2.5Y, value of 3 moist and 4 dry, and chroma of 1 or 2. It is dominantly silty clay but is silty clay loam in some pedons. The Cg horizon has hue of 2.5Y or 5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 1 or 2. It is silty clay or clay. The A1b horizon is neutral or has hue of 2.5Y, 5Y, or 10YR and value of 2 or 3 moist and 3 or 4 dry. It is silty clay or clay. The B2gb horizon has hue of 2.5Y or 5Y, value of 3 through 5 moist and 4 or 5 dry, and chroma of 1 or 2. The A1b2 and Bgb2 horizons have characteristics similar to the uppermost buried horizon.

Grable series

The Grable series consists of deep, well drained soils. These soils are on bottom lands in the Missouri River Valley. They have moderate permeability in the upper part of the profile and rapid permeability in the lower part. They formed in calcareous, silty and sandy alluvium. Slope ranges from 0 to 2 percent.

Grable soils are near Carr, Haynie, and Sarpy soils. Carr soils are coarse-loamy and are at a slighty lower elevation than Grable soils. Typically, Haynie soils are silt loam throughout the profile and are at a slightly lower elevation. Sarpy soils are sandy and at a similar elevation, but typically are nearer to the Missouri River.

Typical pedon of Grable silt loam, 0 to 2 percent slopes, 1,320 feet south and 75 feet east of northwest corner sec. 21, T. 23 N., R. 11 E.

Ap—0 to 8 inches; very dark grayish brown (2.5Y 3/2) silt loam, dark grayish brown (2.5Y 4/2) dry; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—8 to 21 inches; dark grayish brown (2.5Y 4/2) stratified very fine sandy loam and silt loam, grayish brown (2.5Y 5/2) dry; weak horizontal cleavage; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—21 to 60 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the A horizon. Reaction is mildly alkaline or moderately alkaline throughout the pedon.

The A horizon has hue of 10YR or 2.5Y, value of 3 moist and 4 or 5 dry, and chroma of 1 or 2. It is commonly silt loam but is loam or very fine sandy loam in some pedons. The C1 and IIC2 horizons have hue of 10YR or 2.5Y and value of 4 or 5 moist and 5 or 6 dry. The C1 horizon is silt loam or very fine sandy loam, ranging from 12 to 16 percent content of clay. In some pedons, thin strata of finer or coarser material are in this horizon. Typically, the IIC horizon is fine sand, but it is loamy sand in some pedons.

Grable Variant

The Grable Variant consists of deep, somewhat poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They have moderate permeability in the upper part of the profile and rapid permeability in the lower part. These soils formed in calcareous, silty and sandy alluvium. Slope ranges from 0 to 2 percent.

Grable Variant soils are near Albaton, Carr, and Sarpy soils and are somewhat similar to Grable soils. Albaton soils are clayey thoughout the profile and are at a similar elevation. Carr soils are coarse-loamy in the control section, and Sarpy soils are sandy thoughout the profile. Carr and Sarpy soils are at a slightly higher elevation. Grable soils do not have a seasonal high water table such as that in Grable Variant soils.

Typical pedon of Grable Variant silt loam in an area of Sarpy-Grable Variant complex, 0 to 6 percent slopes, 500 feet west and 100 feet south of northeast corner sec. 13, T. 82 N., R. 46 E.

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; soft, very friable; strong effervescence, moderately alkaline; abrupt smooth boundary.

C1—6 to 14 inches; dark grayish brown (10YR 4/2) very fine sandy loam, grayish brown (10YR 5/2) dry; common medium distinct strong brown (7.5YR 5/8) mottles; weak fine bedding planes; massive; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—14 to 21 inches; dark grayish brown (2.5YR 4/2) stratified very fine sandy loam and fine sand, grayish brown (2.5YR 5/2) dry; few fine faint strong brown (7.5YR 5/8) mottles; weak fine bedding planes; massive; strong effervescence; moderately alkaline; gradual smooth boundary.
IIC3—21 to 60 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; single grain; loose; slight effervescence; mildly alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the A horizon. The depth to carbonates ranges from 0 to 10 inches. Reaction is moderately alkaline or mildly alkaline throughout the pedon.

The A horizon has hue of 10YR or 2.5Y, value of 3 moist and 4 or 5 dry, and chroma of 1 or 2. It is commonly silt loam but is very fine sandy loam in some pedons. The C1, C2, and IIC3 horizons have hue of 10YR or 2.5Y and value of 4 or 5 moist and 5 or 6 dry. The C1 horizon is silt loam or very fine sandy loam, and the C2 horizon is stratified very fine sandy loam and fine sand. The C2 horizon in some pedons contains thin strata of finer textured material. The IIC3 horizon commonly is fine sand but has thin strata of finer or coarser material in some pedons.

Haynie series

The Haynie series consists of deep, moderately well drained soils. These soils are on the highest parts of flood plains on bottom lands in the Missouri River Valley. They formed in silty, calcareous alluvium and have moderate permeability. Slope ranges from 0 to 2 percent.

Haynie soils are commonly adjacent to Carr, Grable, Onawa, and Sarpy soils. Those soils do not have a mollic epipedon. Onawa soils are silty clay in the upper part of the profile and are at a lower elevation than Haynie soils. Grable, Carr, and Sarpy soils are coarser textured in the lower part of the profile and are at a slightly higher elevation.

Typical pedon of Haynie silt loam, 0 to 2 percent slopes, 2,500 feet west and 400 feet north of southeast corner sec. 7, T. 20 N., R. 12 E.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; soft, very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.
C1—7 to 41 inches; dark grayish brown (2.5Y 4/2) stratified silt loam and very fine sandy loam, light brownish gray (2.5Y 6/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive with weak horizontal cleavage; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.
C2—41 to 60 inches; dark grayish brown (2.5Y 4/2) silt loam with thin strata of silty clay loam and silty clay, grayish brown (2.5Y 5/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive with weak horizontal cleavage; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 10 inches and corresponds to thickness of the A horizon. The depth to free carbonates ranges from 0 to 10 inches. Reaction is mildly alkaline or moderately alkaline thoughout the pedon.

The A horizon has hue of 10YR or 2.5Y and value of 3 or 4 moist and 4 through 6 dry. It is dominantly silt loam but ranges to very fine sandy loam. The C horizon has hue of 10YR or 2.5Y and value of 3 or 4 moist and 5 or 6 dry. Typically, the C horizon is silt loam or very fine sandy loam, but it contains thin strata of fine sandy loam, loamy fine sand, silty clay loam, or silty clay in some pedons. These strata are generally less than 2 inches in thickness.

Haynie Variant

The Haynie Variant consists of deep, moderately well drained soils. These soils are on bottom lands in the Missouri River Valley. They have moderate permeability in the upper part of the profile and slow permeability in the lower part. These soils formed in calcareous alluvium in areas that were formerly old settling basins for runoff from upland drainageways. Slope is from 0 to 1 percent.

Haynie Variant soils are similar to Haynie soils and are near Solomon, Holly Springs, and Luton soils. Haynie soils do not have clayey material between depths of 40 and 60 inches. Solomon, Holly Springs, and Luton soils are clayey throughout the profile and are at a lower elevation than Haynie Variant soils.

Typical pedon of Haynie Variant silt loam, 0 to 1 percent slopes, 1,900 feet west and 700 feet south of northeast corner sec. 7, T. 20 N., R. 11 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; soft, friable; slight effervescence; moderately alkaline; abrupt smooth boundary.
C1—9 to 50 inches; grayish brown (10YR 5/2) stratified silt loam and very fine sandy loam, light brownish gray (10YR 6/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; soft, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.
IIAb—50 to 60 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; hard, firm; slight effervescence; mildly alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the A horizon. Depth to free carbonates ranges from 0 to 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 or 4 moist and 4 through 6 dry, and chroma of 1 or 2 dry or moist. It is dominantly silt loam but ranges to very fine sandy loam. Typically, the C1 horizon is stratified silt loam and very fine sandy loam, but in some pedons it contains thin strata of silty clay loam. The IIAb horizon has hue of 10YR or 2.5Y, value of 2 or 3 moist and 3 or 4 dry, and chroma of 1 or 2 dry or moist. Typically, it is silty clay but ranges to silty clay loam. Depth to the IIb horizon ranges from 40 to 60 inches.

Holly Springs series

The Holly Springs series consists of deep, poorly drained soils. These soils are on bottom lands. They have moderately slow permeability in the upper part of the profile and very slow permeability in the lower part. They formed in calcareous, silty and clayey alluvium. Slope is 0 to 1 percent.

Holly Springs soils are near Colo, Luton, Solomon, and Zook soils. Colo and Zook soils have less clay in the B horizon than Holly Springs soils, are noncalcareous, and are at a slightly higher elevation. Luton and Solomon soils are clayey thoughout the control section and are at a slightly lower elevation.

Typical pedon of Holly Springs silty clay loam, 0 to 1 percent slopes, 1,100 feet west and 50 feet south of northeast corner sec. 18, T. 21 N., R. 11 E.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate medium and fine granular structure; hard, very firm; strong effervesence; moderately alkaline; abrupt smooth boundary.

A12—7 to 12 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate medium granular structure; hard, very firm; few fragments of snail shells; strong effervescence; moderately alkaline; clear smooth boundary.

A3—12 to 20 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to moderate fine granular; very hard, very firm; few fragments of snail shells; strong effervescence; moderately alkaline; clear smooth boundary.

B2g—20 to 28 inches; very dark gray (N 3/0) silty clay loam, very dark gray (5Y 3/1) dry; few fine faint gray (5Y 6/1) mottles; moderate medium subangular blocky structure; very hard, very firm; few fragments of snail shells; strong effervescence; moderately alkaline; gradual smooth boundary.

A1b—28 to 33 inches; very dark gray (N 3/0) silty clay, dark gray (5Y 4/1) dry; few fine faint light olive gray (5Y 6/1) mottles; weak fine subangular blocky structure; very hard, very firm; common fragments of snail shells; small soft masses of carbonates; strong effervescence; moderately alkaline; gradual smooth boundary.

A3b—33 to 40 inches; very dark gray (N 3/0) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very hard, very firm; common fragments of snail shells; small soft masses of carbonates; strong effervescence; moderately alkaline; gradual smooth boundary.

Bgb—40 to 60 inches; very dark gray (5Y 3/1) silty clay, gray (5Y 5/1) dry; moderate medium subangular blocky structure; very hard, very firm; common fragments of snail shells; small masses of soft carbonates; strong effervescence; moderately alkaline.

The thickness of the solum, including the buried soil, ranges from 40 to 60 inches or more. Typically, the thickness of the mollic epipedon is 24 to 30 inches, but in some pedons it is as much as 36 inches or more. Typically, the buried silty clay material is at a depth of 20 to 32 inches. Reaction is mildly alkaline or moderately alkaline in all parts of the pedon.

The A horizon is neutral or has hue of 10YR, value of 2 moist and 3 dry, and chroma of 0 or 1. Typically, it is silty clay loam, but it is silt loam in some pedons. The B2g horizon is neutral or has hue of 5Y, value of 3 moist and 4 or 5 dry, and chroma of 0 or 1. The buried A horizon is neutral or has hue of 5Y, value of 2 or 3 moist and 4 or 5 dry, and chroma of 0 or 1. The Bgb horizon has hue of 10YR or 5Y, value of 4 moist and 4 or 5 dry, and chroma of 0 or 1. The buried A and B horizons range from 50 to 60 percent in content of clay.

Ida series

The Ida series consists of deep, well drained soils on uplands. These soils formed in silty, calcareous loess and have moderate permeability (fig. 13). Slope ranges from 6 to 60 percent.

Ida soils are near Burchard, Monona, and Steinauer soils. Burchard soils formed in till and are more strongly developed than Ida soils. They also have a mollic epipedon and are at a lower elevation. Monona soils have a mollic epipedon, are more strongly developed, and are leached of lime to a greater depth. Steinauer soils formed in till and are below Ida soils.

Typical pedon of Ida silt loam, 11 to 17 percent slopes, eroded, 1,000 feet south and 50 feet west of center of sec. 34, T. 24 N., R. 10 E.

Ap—0 to 7 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine granular structure; slightly hard, very friable; few concretions of carbonate; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—7 to 24 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; many fine faint strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; weak medium prismatic structure; slightly hard, very

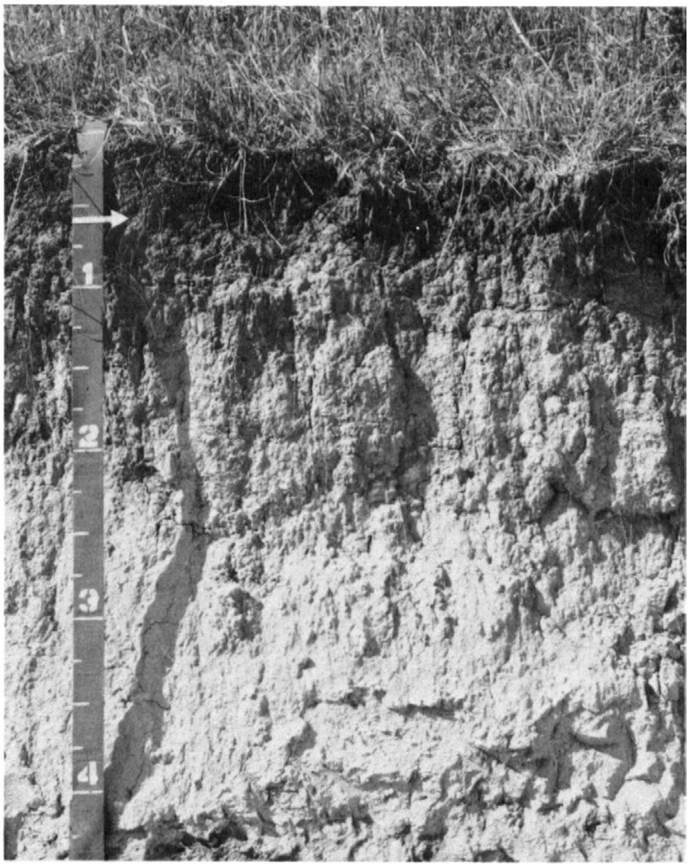

Figure 13.—Profile of Ida silt loam. The arrow indicates the thin surface layer of this deep soil. The scale is in feet.

friable; many small concretions of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—24 to 60 inches; yellowish brown (10YR 5/4) silt loam, light yellowish brown (10YR 6/4) dry; many fine distinct strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) mottles; massive; slightly hard, very friable; many small and medium concretions of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the A1 or Ap horizon. Reaction is slightly alkaline or moderately alkaline throughout the pedon. Typically, carbonates are throughout the profile, except in the A horizon in some pedons.

The A horizon has value of 3 or 4 moist and 4 or 5 dry and chroma of 2 through 6. The C horizon has hue of 10YR, value of 4 or 5 moist and 5 through 7 dry, and chroma of 3 through 6.

Judson series

The Judson series consists of deep, well drained soils. These soils are on colluvial-alluvial foot slopes. They have moderate permeability. They formed in noncalcareous, silty colluvium that eroded mostly from soils on the adjacent loess uplands. Slope ranges from 2 to 6 percent.

Judson soils are near Calco, Colo, and Kennebec soils on bottom lands and near Marshall, Monona, Moody, and Nora soils on uplands. Calco soils are more poorly drained than Judson soils, have lime throughout the profile, and are below Judson soils. Colo soils are not so well developed, are somewhat poorly drained, and are on bottom lands. Kennebec soils are not so well developed, are darker below a depth of 36 inches, and are on bottom lands. Monona, Moody, and Nora soils have a thinner A horizon, have lime higher in the profile, and are mainly on side slopes of the loess uplands above Judson soils.

Typical pedon of Judson silty clay loam, 2 to 6 percent slopes, 800 feet west and 200 feet north of southeast corner sec. 36, T. 21 N., R. 9 E.

Ap—0 to 10 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—10 to 19 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium granular; slightly hard, friable; slightly acid; gradual smooth boundary.

A13—19 to 27 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish (10YR 4/2) dry; weak fine subangular blocky structure parting to weak medium granular; hard, friable; slightly acid; gradual wavy boundary.

A3—27 to 34 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 4/3) dry; moderate medium subangular blocky structure parting to moderate medium granular; hard, friable; slightly acid; gradual smooth boundary.

B2—34 to 48 inches; brown (10YR 4/3) silty clay loam, yellowish brown (10YR 5/4) dry; moderate medium and fine subangular blocky structure; hard, friable; slightly acid; gradual smooth boundary.

B3—48 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/6) dry; few fine faint strong brown (7.5YR 5/8) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; hard, firm; slightly acid.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the A horizon ranges from 20 to 36 inches.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. The A horizon commonly is silty clay loam but is silt loam in some pedons. It is slightly acid or medium acid. The B horizon has value of 3 or 4 moist and 4 or 5 dry and chroma of 3 or 4. Where the C horizon is above a depth of 60 inches, it has value of 4 or 5 moist and 5 through 7 dry and chroma of 4 through 6. The C horizon ranges from medium acid to neutral.

Kennebec series

The Kennebec series consists of deep, moderately well drained soils. These soils are on bottom lands along upland drainageways. They formed in silty alluvium and have moderate permeability. Slope ranges from 0 to 2 percent.

Kennebec soils are associated with Calco, Colo, and Judson soils. Kennebec soils are better drained than Calco and Colo soils, contain less clay, and are at a slightly higher elevation. Kennebec soils do not have carbonates; Calco soils do. Kennebec soils are not so well developed as Judson soils, have chroma of 0 or 1 below a depth of 36 inches, and are at a lower elevation.

Typical pedon of Kennebec silt loam, occasionally flooded, 0 to 2 percent slopes, 2,150 feet north and 1,500 feet west of southeast corner sec. 27, T. 24 N., R. 10 E.

Ap—0 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A1b—12 to 46 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; slightly acid; diffuse smooth boundary.

AC—46 to 54 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; slightly hard, friable; slightly acid; diffuse smooth boundary.

C—54 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable; slightly acid.

The thickness of the solum ranges from 36 to 60 inches or more and corresponds to the thickness of the mollic epipedon. Typically, the A and C horizons are 24 to 30 percent clay. Some areas of this soil have 7 to 18 inches of very dark gray or dark grayish brown overwash.

The A horizon has value of 2 or 3 and chroma of 1 or 2 dry or moist. It is medium acid or slightly acid. The C horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2 dry or moist. The C horizon has a few dark grayish brown, strong brown, and dark yellowish brown mottles. It is slightly acid or neutral.

Luton series

The Luton series consists of deep, poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in clayey, alluvial sediment and have very slow permeability. Slope is 0 to 1 percent.

Luton soils are near Blencoe, Forney, and Solomon soils. Blencoe soils have less clay in the C horizon than Luton soils and are at a slightly higher elevation. Forney soils are more stratified, and Solomon soils are calcareous throughout the profile. Forney and Solomon soils are in positions similar to those of Luton soils.

Typical pedon of Luton silty clay, 0 to 1 percent slopes, 1,000 feet east and 200 feet north of southwest corner sec. 17, T. 23 N., R. 11 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate fine granular structure; very hard, very firm; neutral; abrupt smooth boundary.

A12—8 to 16 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium and fine subangular blocky structure; very hard, very firm; neutral; gradual smooth boundary.

A13—16 to 27 inches; black (10YR 2/1) silty clay; very dark gray (N 3/0) dry; moderate medium and fine subangular blocky structure; very hard, very firm; mildly alkaline; clear smooth boundary.

B21g—27 to 38 inches; dark olive gray (5Y 3/2) silty clay, gray (5Y 5/1) dry; common fine distinct olive brown (2.5Y 4/4 and 5/4) mottles; strong medium and fine subangular blocky structure; very hard, very firm; mildly alkaline; clear smooth boundary.

B3g—38 to 46 inches; olive gray (5Y 4/2) silty clay, light olive gray (5Y 6/2) dry; many medium distinct yellowish brown (10YR 5/6) mottles; strong medium and fine subangular blocky structure; very hard, very firm; moderately alkaline; clear smooth boundary.

C1g—46 to 60 inches; olive gray (5Y 4/2) clay, light olive gray (5Y 6/2) dry; many medium distinct yellowish brown (10YR 5/6) mottles; strong medium and fine subangular blocky structure; very hard, very firm; few small deposits of soft lime; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 48 inches. The matrix is not calcareous above a depth of 36 inches, but some secondary carbonates are common in the B horizon.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. It is dominantly silty clay but ranges to clay and silty clay loam. The A horizon is neutral or mildly alkaline. The B horizon has hue of 10YR and 5Y, value of 3 through 6, and chroma of 1 or 2. Typically, the B horizon is 46 to 60 percent content of clay, but in some pedons it contains subhorizons that are 60 to 70 percent content of clay. The C horizon has color and texture similar to those of the B horizon.

Marshall series

The Marshall series consists of deep, well drained soils. These soils are on uplands and stream terraces. They formed in silty loess and have moderate permeability. Slope ranges from 0 to 6 percent.

Marshall soils are commonly adjacent to Monona and Ida soils. Monona and Ida soils are not so well developed as Marshall soils. Ida soils are calcareous throughout the profile.

Typical pedon of Marshall silty clay loam, 0 to 2 percent slopes, 2,300 feet west and 200 feet north of southeast corner sec. 31, T. 24 N., R. 10 E.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—9 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable; slightly acid; gradual smooth boundary.

B1—15 to 18 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; slightly hard, friable; slightly acid; gradual smooth boundary.

B2t—18 to 33 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable; slightly acid; gradual smooth boundary.

B3—33 to 46 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; few fine faint strong brown (7.5YR 5/6) and few medium distinct grayish brown (2.5Y 5/2) relict mottles; weak medium subangular blocky structure; slightly hard, friable; brownish and blackish stains; neutral; gradual smooth boundary.

C—46 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; few medium distinct grayish brown (2.5Y 5/2) and strong brown (7.5Y 5/6) relict mottles; weak medium subangular blocky structure; soft friable; small brownish and blackish stains; neutral.

The thickness of the solum ranges from 40 to 60 inches. Typically, free carbonates are below a depth of 60 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2. It is dominantly silty clay loam but ranges to silt loam. The A horizon is medium acid or slightly acid. The B2 horizon has value of 4 or 5 moist and 5 or 6 dry and chroma of 3 or 4. The B3 and C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 through 6. These horizons are slightly acid or neutral.

The surface layer of map unit MaC2—Marshall silty clay loam, 2 to 6 percent slopes, eroded, is thinner than that defined in the range for the series, but this difference does not alter the usefulness or behavior of this soil.

Modale series

The Modale series consists of deep, somewhat poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They have moderate permeability in the upper part of the profile and slow permeability in the lower part. The upper part of the profile formed in silty, calcareous alluvium, and the lower part formed in clayey alluvium. Slope ranges from 0 to 2 percent.

Modale soils are near Albaton, Haynie, and Onawa soils. Albaton soils are clayey throughout the profile and are at a slightly lower elevation than Modale soils. Onawa soils have a clayey A horizon and a silty C horizon. Haynie soils are silt loam throughout the profile and are at a slightly higher elevation.

Typical pedon of Modale silt loam, 0 to 2 percent slopes, 2,010 feet east and 150 feet south of northwest corner sec. 29, T. 80 N., R. 45 W.

Ap—0 to 7 inches; very dark grayish brown (2.5Y 3/2) light silt loam, grayish brown (2.5Y 5/2) dry; weak fine granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—7 to 24 inches; stratified dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) silt loam, grayish brown (2.5Y 5/2) dry; many fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2g—24 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few fine distinct yellowish brown (10YR 5/6 and 6/6) mottles; moderate fine and medium blocky structure; hard, very firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 10 inches and is the same as the thickness of the A horizon. Typically, the pedon is calcareous throughout, but in some pedons the A horizon is noncalcareous. Reaction is mildly alkaline or moderately alkaline throughout the pedon.

The A horizon has value of 3 or 4 moist and 4 or 5 dry and chroma of 1 or 2. It generally is silt loam, but in some pedons it ranges to silty clay loam and very fine sandy loam. The C1 horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 2. Typically, it is silt loam or very fine sandy loam, but it has thin strata of fine sandy loam and silty clay in some pedons. The IIC horizon is dominantly silty clay but ranges to clay.

Monona series

The Monona series consists of deep, well drained soils. These soils are on uplands (fig. 14). They formed in silty loess and have moderate permeability. Slope ranges from 6 to 17 percent.

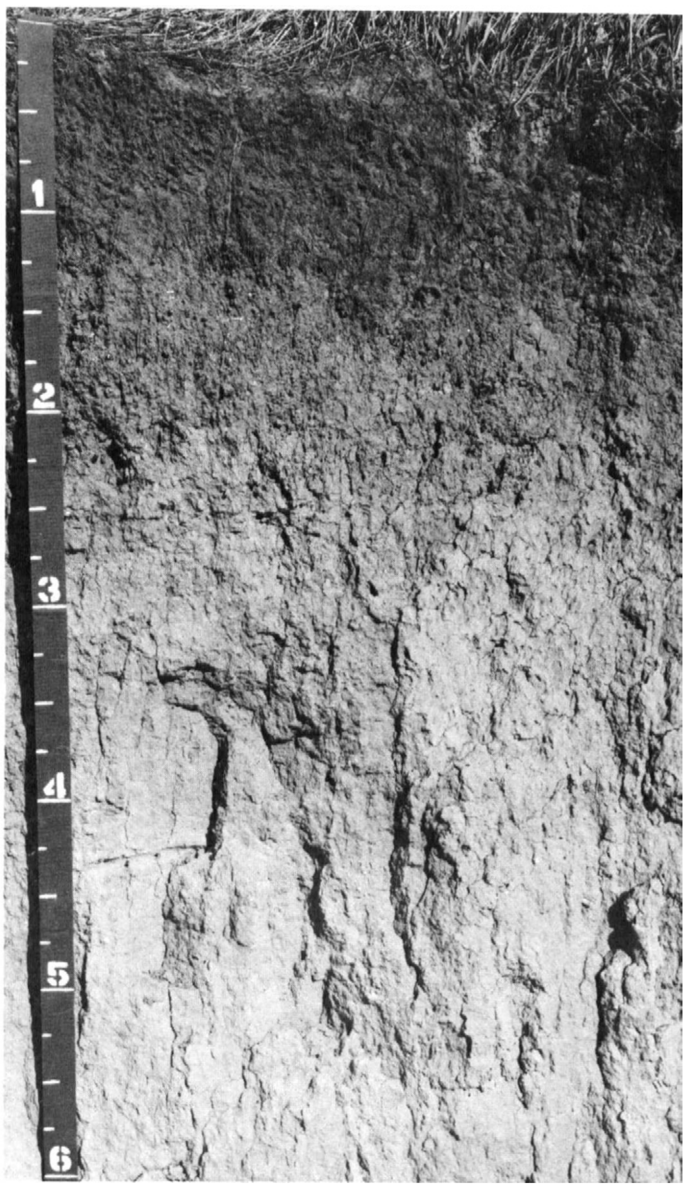

Figure 14.—Profile of Monona silt loam. This deep soil has a dark colored surface layer and a friable subsoil. It formed in loess. The scale is in feet.

Monona soils are near Marshall, Burchard, Ida, and Judson soils. Marshall soils have more clay throughout the pedon and are at a higher elevation than Monona soils. Judson soils have a thicker A horizon, have a darker colored control section, and are mainly on foot slopes. Typically, Ida soils have less clay, have a thinner A horizon, have carbonates at the surface, and are commonly at a lower elevation. Burchard soils formed in glacial till. They commonly have free carbonates higher in the profile than in Monona soils, have more clay throughout the profile, and generally are at a lower elevation.

Typical pedon of Monona silt loam, 6 to 11 percent slopes, 2,000 feet north and 200 feet east of southwest corner sec. 33, T. 23 N., R. 10 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—6 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B1—11 to 15 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable; neutral; gradual smooth boundary.

B2—15 to 30 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; slightly hard, friable; neutral; gradual smooth boundary.

C1—30 to 44 inches; brown (10YR 5/3) silt loam; pale brown (10YR 6/3) dry; few faint yellowish brown (10YR 5/6) mottles; weak fine prismatic structure; slightly hard, friable; neutral; gradual smooth boundary.

C2—44 to 60 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; few fine faint yellowish brown (10YR 5/6) and light gray (10YR 6/2) mottles; massive; slightly hard, friable; neutral.

Typically, the thickness of the solum is about 30 inches but ranges from 24 to 40 inches. The depth to free carbonates is commonly about 48 inches but ranges from 40 to 72 inches. The thickness of the mollic epipedon ranges from 10 to 16 inches.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. It has clay content of 25 to 28 percent in most pedons. The A horizon is slightly acid or medium acid. The B horizon is 12 to 24 inches thick. It has value of 4 or 5 moist and 5 or 6 dry and chroma of 3 or 4. The B horizon has clay content of 23 to 30 percent. It is slightly acid or neutral. The C horizon has value of 4 or 5 moist and 5 or 6 dry and chroma of 3 through 6. It is neutral to moderately alkaline.

The surface layers of map units MnD2—Monona silt loam, 6 to 11 percent slopes, eroded, and MnE2—

Monona silt loam, 11 to 17 percent slopes, eroded, are lighter colored and thinner than that defined in the range for the series. These differences, however, do not alter the usefulness or behavior of these soils.

Moody series

The Moody series consists of deep, well drained soils. These soils are on uplands and stream terraces (fig. 15). They formed in loess and have moderately slow permeability. Slope ranges from 0 to 11 percent.

Figure 15.—Profile of Moody silty clay loam. This deep soil has a granular surface layer and a subangular blocky subsoil. It formed in loess. The scale is in feet.

Moody soils are near Belfore, Nora, and Judson soils. Belfore soils have more clay in the B horizon and have carbonates deeper in the profile than Moody soils. Nora soils have less clay in the B horizon and have carbonates nearer the surface. Judson soils have a thicker mollic epipedon and are on foot slopes.

Typical pedon of Moody silty clay loam, 2 to 6 percent slopes, 1,000 feet north and 40 feet east of southwest corner sec. 10, T. 22 N., R. 8 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—7 to 11 inches; very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; slightly acid; clear wavy boundary.

B21—11 to 17 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; slightly acid; clear wavy boundary.

B22—17 to 34 inches; brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; gradual smooth boundary.

B23—34 to 46 inches; brown (10YR 5/3) silty clay loam, pale brown (10YR 6/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; gradual smooth boundary.

B3—46 to 53 inches; yellowish brown (10YR 4/4) silty clay loam, light yellowish brown (10YR 6/4) dry; few fine faint strong brown (7.5YR 5/6) relict mottles; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; gradual wavy boundary.

C—53 to 60 inches; yellowish brown (10YR 5/4) silty clay loam, very pale brown (10YR 7/4) dry; few fine faint strong brown (7.5YR 5/6) and gray (10YR 6/2) mottles; massive; slightly hard, friable; neutral.

The mollic epipedon ranges from 10 to 17 inches in thickness. It includes the A horizon and extends into the upper part of the B horizon. The solum ranges from 30 to 58 inches in thickness. Depth to carbonates ranges from 30 to 60 inches or more.

The A horizon has value of 2 or 3 moist and 3 or 4 dry. It is dominantly silty clay loam but ranges to silt loam. The A horizon ranges from medium acid to neutral. The B21 horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 2 or 3. The B2 horizon unlike the B21 subhorizon most commonly has hue of 10YR or 2.5Y, value of 3 through 5 moist and 5 or 6 dry, and chroma of 3 or 4. It is neutral or slightly acid. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 5 through 7 dry and chroma of 2 through 4. Typically, the C horizon is silty clay loam, but in some pedons it is silt loam. It is neutral or mildly alkaline.

In map units MoC2—Moody silty clay loam, 2 to 6 percent slopes, eroded, and MoD2—Moody silty clay loam, 6 to 11 percent slopes, eroded, the surface layers are thinner than that defined in the range for the series, but this difference does not alter the usefulness or behavior of these soils.

Nora series

The Nora series consists of deep, well drained soils. These soils are on uplands (fig. 16). They formed in calcareous loess and have moderate permeability. Slope ranges from 6 to 15 percent.

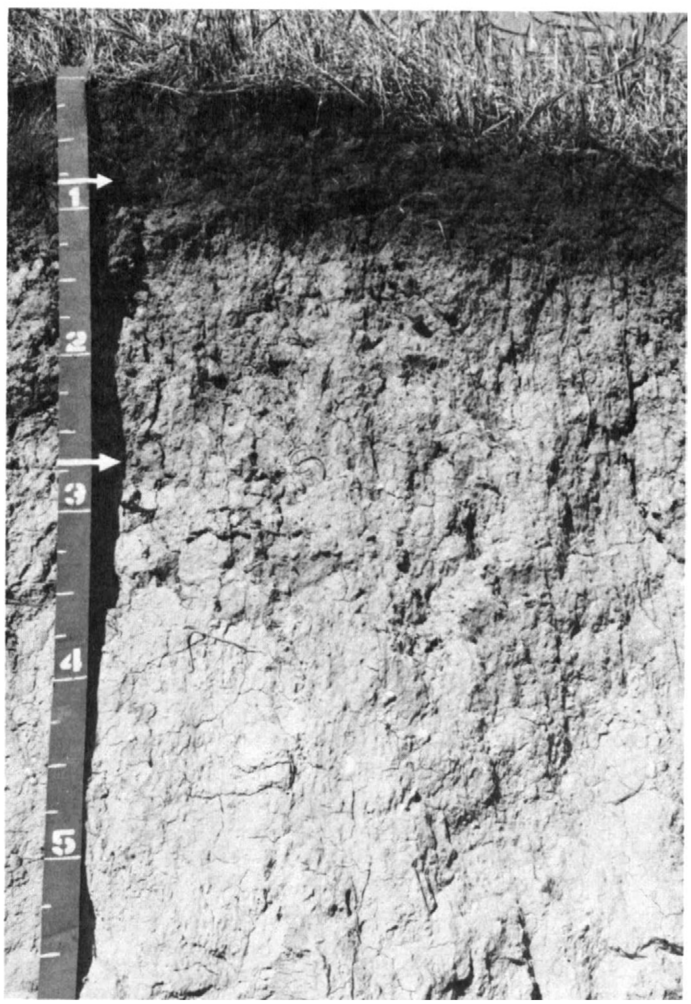

Figure 16.—Profile of Nora silty clay loam. Arrows indicate the lower boundaries of the surface layer and subsoil, respectively. The scale is in feet.

Nora soils are near Crofton, Moody, and Judson soils. Crofton soils do not have a mollic epipedon, are not so well developed as Nora soils, and have free carbonates at a shallower depth. Judson soils have a thicker mollic epipedon and are on foot slopes. Moody soils have a thicker solum, lime at a lower depth in the profile, and more clay is in the control section.

Typical pedon of Nora silty clay loam, 6 to 11 percent slopes, 2,525 feet west and 250 feet north of southeast corner sec. 8, T. 23 N., R. 8 E.

A11—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—7 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; neutral; clear wavy boundary.

B21—10 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

B22—14 to 20 inches; dark brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; mildly alkaline; clear wavy boundary.

B3ca—20 to 30 inches; olive brown (2.5Y 4/4) silt loam, light yellowish brown (2.5Y 6/4) dry; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, friable; few fine soft segregations of lime; strong effervescence; moderately alkaline; clear wavy boundary.

C1ca—30 to 38 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; common medium prominent yellowish brown (10YR 5/6) relict mottles; weak coarse subangular blocky structure; slightly hard, friable; few fine concretions of lime; strong effervescence; moderately alkaline; clear wavy boundary.

C2—38 to 60 inches; grayish brown (10YR 5/2) silt loam, pale yellow (2.5Y 7/3) dry; common medium prominent yellowish brown (10YR 5/6) relict mottles; weak medium subangular blocky structure; slightly hard, friable; common fine soft segregations of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 34 inches. Typically, the depth to carbonates is 20 to 24 inches but ranges from 12 to 30 inches. The mollic epipedon ranges from 7 to 15 inches in thickness and extends into the B horizon in some pedons.

The A horizon has value of 2 or 3 moist and 3 or 4 dry. It is typically silty clay loam but ranges to silt loam. The A horizon is slightly acid or neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 or 4. It is silty clay loam or silt loam ranging from 20 to 35 percent content of clay. The B2 horizon is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 through 6 moist and 5 through 7 dry, and chroma of 2 through 4.

In map units NoD2—Nora silty clay loam, 6 to 11 percent slopes, eroded, and NoE2—Nora silty clay loam, 11 to 15 percent slopes, eroded, the surface layers are thinner and lighter colored than that defined in the range for the series, but these differences do not alter the usefulness or behavior of these soils.

Omadi series

The Omadi series consists of deep, moderately well drained soils. These soils are on bottom lands in the Missouri River Valley, mainly near bluffs on uplands where the channels of creeks have been deepened or straightened. They formed in silty, calcareous, stratified alluvium and have moderate permeability. Slope is 0 to 1 percent.

Omadi soils are near Colo, Kennebec, and Holly Springs soils. Colo soils are somewhat poorly drained, are silty clay loam throughout the profile, and are noncalcareous. Kennebec soils are not stratified and are noncalcareous. Holly Springs soils are more poorly drained than Omadi soils and have a clayey control section.

Typical pedon of Omadi silt loam, 0 to 1 percent slopes, 1,400 feet west and 400 feet south of northeast corner sec. 6, T. 21 N., R. 11 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—8 to 15 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, friable; neutral; abrupt smooth boundary.

A13—15 to 22 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; slightly hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C1—22 to 46 inches; stratified very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) silt loam, dark gray (10YR 4/1) and light brownish gray (10YR 6/2) dry; few fine faint reddish brown (5YR 4/3) mottles; massive; slightly hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C2—46 to 60 inches; very dark gray (10YR 3/1) silt loam, dark grayish brown (10YR 4/2) dry; few fine faint reddish brown (5YR 5/4) mottles; massive; slightly hard, friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 22 inches. Typically, carbonates are at a depth of 15 inches, but they range in depth from 0 to 20 inches.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. It is dominantly silt loam, but is silty clay loam in some pedons. The A horizon is neutral to moderately alkaline. The C horizon has value of 2 or 3 moist and 3 through 6 dry and chroma of 1 or 2. It is mildly alkaline or moderately alkaline.

Onawa series

The Onawa series consists of deep, somewhat poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in calcareous, clayey and silty alluvium. They have slow permeability in the upper part of the profile and moderate permeability in the lower part. Slope ranges from 0 to 2 percent.

Onawa soils are commonly adjacent to Albaton, Haynie, and Percival soils. Albaton soils are clayey throughout the profile and are at a slightly lower elevation than Onawa soils. Haynie soils are silty and are at a slightly higher elevation. Percival soils are clayey in the upper part of the profile and sandy in the lower part.

Typical pedon of Onawa silty clay, 0 to 2 percent slopes, 800 feet north and 200 feet west of center of sec. 29, T. 80 N., R. 45 W.

Ap—0 to 8 inches; very dark grayish brown (2.5Y 3/2) silty clay, dark grayish brown (2.5Y 4/2) dry; moderate fine granular structure; very hard, very firm; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—8 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few fine faint yellowish brown (10YR 5/6) and reddish brown (5YR 4/4) mottles; moderate medium and fine blocky structure; very hard, very firm; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—24 to 60 inches; stratified grayish brown (2.5Y 5/2) silt loam and very fine sandy loam, light brownish gray (2.5Y 6/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 9 inches and corresponds to the thickness of the A1 or Ap horizon. Reaction is mildly alkaline or moderately alkaline throughout the pedon.

The A horizon has hue of 10YR or 2.5Y and chroma of 1 or 2. It is dominantly silty clay, but in some pedons it is silty clay loam. The C1 horizon has hue of 2.5Y or 5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 1 or 2. The IIC2 horizon has colors similar to the C1 horizon. The C1 and IIC2 horizons are typically silt loam and very fine sandy loam, but they commonly have thin lenses less than 4 inches thick of loamy fine sand, silty clay loam, and silty clay.

Owego series

The Owego series consists of deep, somewhat poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in clayey and silty alluvium and have very slow permeability. Slope is 0 to 1 percent.

Owego soils are near Albaton, Blyburg, Luton, and Modale soils. Albaton and Luton soils are clayey throughout the profile. Blyburg soils are coarse-silty and are at a slightly higher elevation than Owego soils. Modale soils are coarse-silty over clayey and are at a slightly lower elevation.

Typical pedon of Owego silty clay, 0 to 1 percent slopes, 1,000 feet south and 100 feet west of northeast corner sec. 32, T. 23 N., R. 11 E.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure parting to moderate medium granular; very hard, very firm; mildly alkaline; abrupt smooth boundary.

C1—6 to 14 inches; dark gray (5Y 4/1) silty clay, gray (5Y 5/1) dry; moderate medium subangular blocky structure; hard, very firm; mildly alkaline; clear wavy boundary.

C2—14 to 16 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; hard, friable; mildly alkaline; abrupt smooth boundary.

C3—16 to 25 inches; olive (5Y 4/3) silt loam, pale olive (5Y 6/3) dry; common medium distinct brown (7.5YR 4/4) mottles; massive; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ab1—25 to 30 inches; dark gray (5Y 4/1) silty clay, gray (5Y 5/1) dry; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; very hard, very firm; slight effervescence; moderately alkaline; abrupt smooth boundary.

Ab2—30 to 44 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; very hard, very firm; slight effervescence; mildly alkaline; clear wavy boundary.

Ab3—44 to 60 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine faint strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very hard, very firm; mildly alkaline.

The thickness of the solum is less than 20 inches and in many pedons corresponds to the thickness of the Ap or A1 horizon.

The A1 or Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. Typically, it is silty clay, but it ranges to silty clay loam. The A1 horizon is neutral or mildly alkaline. The C3 horizon has hue of 2.5Y or 5Y, value of 4, and chroma of 2 or 3. Typically, it is silt loam, but it is silty clay loam in some pedons and has clay content of 15 to 30 percent. The C3 horizon ranges from 6 and 14 inches in thickness. The underlying clayey horizon is commonly gleyed, mottled, and 48 to 56 percent clay. It is mildly alkaline or moderately alkaline. In some pedons, the buried A horizon is absent.

Percival series

The Percival series consists of deep, somewhat poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in calcareous, clayey and sandy alluvium. These soils have slow permeability in the upper part of the profile and rapid permeability in the lower part. Slope ranges from 0 to 2 percent.

Percival soils are near Albaton, Haynie, and Onawa soils. Albaton soils are clayey throughout the control section and are at a slightly lower elevation than Percival soils. Haynie soils contain less clay in the upper part of the control section and are silty in the lower part; also, they are at a slightly higher elevation. Onawa soils are similar to Percival soils in the upper part of the control section but are not sandy in the lower part and are at about the same elevation.

Typical pedon of Percival silty clay, 0 to 2 percent slopes, 2,320 feet north and 60 feet east of southwest corner sec. 24, T. 20 N., R. 11 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine and medium granular structure; very hard, very firm; slight effervescence; moderately alkaline; abrupt smooth boundary.

C1g—8 to 19 inches; dark gray (5Y 4/1) silty clay, gray (5Y 5/1) dry; few fine faint strong brown (7.5Y 5/6) mottles; moderate fine and medium subangular blocky structure; very hard, very firm; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC2—19 to 48 inches; stratified 50 percent gray (2.5Y 6/0) and dark grayish brown (2.5Y 4/2) and 50 percent light gray (2.5Y 7/0) fine sand, grayish brown (2.5Y 5/2) dry; few fine faint strong brown (7.5YR 5/6) mottles; single grain; loose; strong effervescence; moderately alkaline; clear smooth boundary.

IIC3—48 to 60 inches; stratified 70 percent gray (2.5Y 6/0) and grayish brown (2.5Y 5/2) and 30 percent light gray (2.5Y 7/0) fine sand, grayish brown (2.5Y 6/2) dry; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the A1 or Ap horizon. Free carbonates are at or near the surface. Reaction is mildly alkaline or moderately alkaline throughout the pedon.

The A horizon has hue of 10YR or 2.5Y, value of 3 moist and 4 or 5 dry, and chroma of 1 or 2. Typically, it is silty clay, but it ranges to silty clay loam. The C1g horizon has hue of 5Y or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 1 or 2. The IIC horizon has hue of 2.5Y, value of 4 or 5 moist and 5 through 7 dry, and chroma of 0 through 2. The lower part of the control section below a depth of 18 to 24 inches is stratified loamy fine sand or fine sand.

Salix series

The Salix series consists of deep, moderately well drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in calcareous, silty alluvium and have moderate permeability. Slope is 0 to 1 percent.

Salix soils are commonly adjacent to Blencoe, Blyburg, Owego, and Woodbury soils. Blencoe soils are finer textured in the upper part of the profile than Salix soils and similar in the lower part. Blyburg soils are coarse-silty and contain more very fine sand throughout the profile. Owego and Woodbury soils are finer textured throughout the profile. Typically, Blencoe, Owego, and Woodbury soils are at a lower elevation, and Blyburg soils are at about the same elevation.

Typical pedon of Salix silty clay loam, 0 to 1 percent slopes, 300 feet north and 75 feet west of southeast corner sec. 34, T. 22 N., R. 11 E.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—7 to 14 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; slightly hard, friable; neutral; gradual smooth boundary.

A3—14 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; slightly hard, friable; neutral; gradual smooth boundary.

B21—19 to 26 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak medium subangular blocky structure; slightly hard, friable; many very fine tubular pores and wormcasts; strong effervescence; moderately alkaline; gradual smooth boundary.

B22—26 to 30 inches; very dark grayish brown (2.5Y 3/2) silt loam, grayish brown (2.5Y 5/2) dry; weak medium subangular blocky structure; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

B3—30 to 34 inches; very dark grayish brown (2.5Y 3/2) silt loam, grayish brown (2.5Y 5/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—34 to 48 inches; dark grayish brown (2.5Y 4/2) silt loam, grayish brown (2.5Y 5/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; massive; slightly hard, friable; few small soft masses of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—48 to 60 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; few fine faint yellowish brown (10YR 5/4) mottles; massive; slightly hard, friable; few small soft masses of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 36 inches. The thickness of the mollic epipedon ranges from 16 to 23 inches. Free carbonates are below a depth of 18 to 36 inches.

The A horizon has hue of 10YR, value of 2 or 3 moist and 3 or 4 dry, and chroma of 1 or 2. Typically, the A horizon is silty clay loam, but it is silt loam in some pedons. It is slightly acid or neutral. The B horizon has hue of 10YR in the upper part and grades to 2.5Y in the lower part. It has value of 3 or 4 moist and 5 or 6 dry and chroma 2 or 3. The B horizon is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 2 or 3. It is predominantly silt loam but is very fine sandy loam or loam in some pedons. The C horizon is mildly alkaline or moderately alkaline.

Sarpy series

The Sarpy series consists of deep, excessively drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in calcareous, sandy alluvium and have rapid permeability. Slope ranges from 0 to 6 percent.

Sarpy soils are commonly adjacent to Albaton, Carr, Grable, and Haynie soils. Albaton soils are clayey. Carr soils contain more silt and clay and less sand than Sarpy soils. Grable soils have silt loam or very fine sandy loam in the A horizon and upper part of the C horizon. Typically, Haynie soils are silt loam throughout the profile. Typically, Sarpy soils are at a slightly higher elevation than the associated soils and are commonly adjacent to channels of the Missouri River.

Typical pedon of Sarpy fine sand, 0 to 6 percent slopes, 1,500 feet north and 1,400 feet west of southeast corner sec. 7, T. 20 N., R. 12 E.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) fine sand, grayish brown (10YR 5/2) dry; single grain; loose; slight effervescence; moderately alkaline; abrupt smooth boundary.

C1—4 to 36 inches; grayish brown (10YR 5/2) fine sand, light brownish gray (10YR 6/2) dry; single grain;

loose; strong effervescence; moderately alkaline; clear wavy boundary.

C2—36 to 60 inches; grayish brown (10YR 5/2) fine sand, light brownish gray (10YR 6/2) dry; few fine faint yellowish brown (10YR 5/6) mottles; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 4 to 10 inches and corresponds to the thickness of the A1 or Ap horizon.

The A horizon has hue of 10YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 1 through 3. It is loamy fine sand or fine sand. In some pedons, this horizon does not have free carbonates. The A horizon is neutral to moderately alkaline. The C horizon has hue of 10YR or 2.5Y, value of 4 through 6 moist and 5 or 6 dry, and chroma of 2 through 4. Typically, it is fine sand, but it ranges to loamy fine sand. This horizon contains thin strata of finer textured material in some pedons. The C horizon is mildly alkaline or moderately alkaline.

Solomon series

The Solomon series consists of deep, poorly drained soils. These soils are on bottom lands in the Missouri River Valley. They formed in calcareous, clayey alluvium and have very slow permeability. Slope is 0 to 1 percent.

Solomon soils are commonly adjacent to Luton and Holly Springs soils. Luton soils are similar to Solomon soils in texture but are noncalcareous. Holly Springs soils are similar to Solomon soils, except they are silty in the upper part of the control section. Solomon soils are at a slightly lower elevation than the associated soils.

Typical pedon of Solomon silty clay, 0 to 1 percent slopes, 200 feet south and 20 feet east of northwest corner sec. 17, T. 21 N., R. 11 E.

Ap—0 to 6 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong fine and medium granular structure; very hard, very firm; strong effervescence; moderately alkaline; abrupt smooth boundary.

A12—6 to 14 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine blocky structure; very hard, very firm; strong effervescence; moderately alkaline; gradual smooth boundary.

A13—14 to 20 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium and fine subangular blocky structure; very hard, very firm; many small concretions of carbonate; many small snail shells; strong effervescence; moderately alkaline; diffuse smooth boundary.

B2g—20 to 40 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine faint brown (10YR 5/3) mottles; moderate medium and fine subangular blocky structure; very hard, very firm; many small concretions of carbonate; many small snail shells; strong effervescence; moderately alkaline; diffuse smooth boundary.

C1g—40 to 60 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; few fine faint brown (10YR 5/3) mottles; massive; very hard, very firm; many small concretions of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the mollic epipedon ranges from 15 to 40 inches. Depth to free carbonates is less than 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 moist and 3 or 4 dry, and chroma of 1 or 2. It is dominantly silty clay but ranges from silty clay loam to clay. The A horizon is mildly alkaline or moderately alkaline. The Bg horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 through 4 moist and 3 through 5 dry, and chroma of 1 or 2. it is dominantly silty clay, but it is clay in some pedons. The Bg horizon is moderately alkaline or strongly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 3 through 5 moist and 4 through 6 dry, and chroma of 1 or 2. It is silty clay or clay and is mildly alkaline or strongly alkaline.

Steinauer series

The Steinauer series consists of deep, somewhat excessively drained soils. These soils are on uplands (fig. 17). They formed in calcareous, glacial till and have moderately slow permeability. Slope ranges from 11 to 30 percent.

Steinauer soils are near Ida, Monona, and Burchard soils. Ida and Monona soils have less sand than Steinauer soils, do not have pebbles and stones in the control section, and formed in loess. In addition, Monona soils have a thicker solum. Burchard soils have a thicker solum, are more strongly developed, and are leached of carbonates to a greater depth.

Typical pedon of Steinauer clay loam, 11 to 30 percent slopes, eroded, 350 feet west and 75 feet south of northeast corner sec. 33, T. 23 N., R. 10 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; hard, firm; violent effervescence; mildly alkaline; abrupt smooth boundary.

C1—7 to 25 inches; pale brown (10YR 6/3) clay loam, very pale brown (10YR 7/3) dry; few fine faint reddish brown (5YR 5/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; soft masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C2—25 to 60 inches; light yellowish brown (10YR 6/4) clay loam, very pale brown (10YR 7/4) dry; common medium distinct reddish brown (5YR 5/4) mottles; weak coarse prismatic structure; common

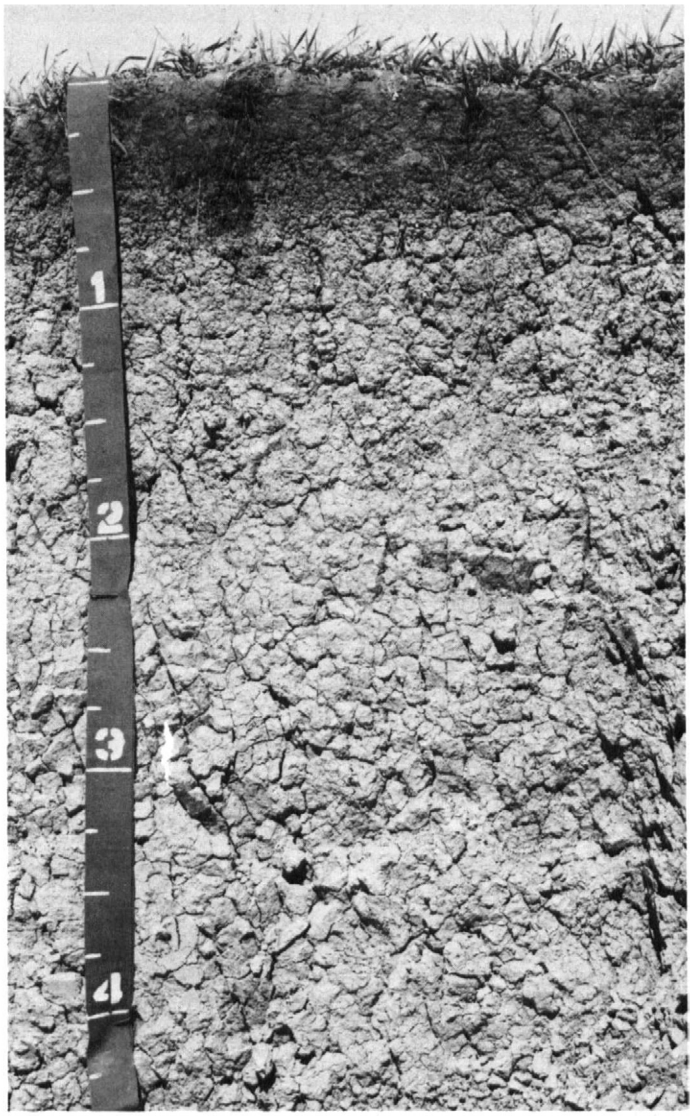

Figure 17.—Profile of Steinauer clay loam. This deep soil is weakly developed and formed in calcareous glacial till. The scale is in feet.

concretions of lime; few medium stones; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 8 to 15 inches, depending mainly on steepness of the slope and the vegetative cover. The content of pebbles and stones on the surface and in the profile ranges from less than 1 percent to 10 percent, by volume. Free carbonates are near the surface and range to a depth of about 14 inches. Reaction is mildly alkaline or moderately alkaline throughout the pedon.

The A horizon has value of 4 or 5 moist and 5 or 6 dry and chroma of 2. In some pedons, this horizon is thin, dark colored, and less than 6 inches thick. The A horizon is dominantly clay loam but ranges from loam to gravelly clay loam. The AC horizon, if present, has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 through 4. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 moist and 6 or 7 dry, and chroma of 2 through 4. The C horizon dominantly is clay loam but is loam in some pedons. This horizon contains thin layers of clay and seams or pockets of sand and gravel. In the C horizon, the stones, pebbles, lime concretions, and iron concretions vary in size and amount from pedon to pedon.

Woodbury series

The Woodbury series consists of deep, somewhat poorly drained soils. These soils are on bottom lands in the Missouri River Valley. The upper part of the profile formed in clayey, alluvial sediment, and the lower part formed in silty, alluvial sediment. These soils have slow permeability in the upper part of the profile and moderate permeability in the lower part. Slope ranges from 0 to 2 percent.

Woodbury soils are near Blencoe, Blyburg, and Salix soils. Blencoe soils have less clay in the upper part of the B horizon than Woodbury soils and are at a slightly higher elevation. Blyburg soils are better drained, have less clay in the profile, and are at a higher elevation. Salix soils are better drained and have less clay in the B horizon.

Typical pedon of Woodbury silty clay, 0 to 2 percent slopes, 750 feet south and 100 feet west of northeast corner sec. 3, T. 21 N., R. 11 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium granular structure; very hard, very firm; neutral; abrupt smooth boundary.

A12—9 to 17 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak subangular blocky structure; very hard, very firm; neutral; clear wavy boundary.

A3—17 to 22 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine distinct brown (7.5YR 5/4) mottles; weak medium subangular blocky structure; very hard, very firm; neutral; clear wavy boundary.

B21—22 to 26 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; very hard, very firm; neutral; clear wavy boundary.

B22g—26 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; very hard, very firm; neutral; clear wavy boundary.

B3—36 to 42 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light olive brown (2.5Y 5/4) dry; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable; neutral; clear wavy boundary.

C—42 to 60 inches; grayish brown (2.5Y 5/2) silt loam, light brownish gray (2.5Y 6/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; massive; few thin lenses of loamy fine sand and fine sand below a depth of 48 inches; slightly hard, very friable; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 36 to 48 inches. The thickness of the mollic epipedon ranges from 16 to 30 inches in most pedons.

The A horizon has value of 2 or 3 moist and 3 or 4 dry and chroma of 1 or 2. It is dominantly silty clay but is silty clay loam in some pedons. The A horizon is slightly acid or neutral. The B2 horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 moist and 5 dry, and chroma of 2. It ranges from 40 to 50 percent clay. The B3 horizon has hue of 5Y and 2.5Y, value of 4 moist and 5 dry, and chroma of 2 through 4. It is silty clay loam ranging from 28 to 35 percent clay. The B3 horizon is slightly acid or neutral. The C horizon has hue of 5Y or 2.5Y, value of 4 or 5 moist and 5 or 6 dry, and chroma of 2 or 4. It is silty clay loam and is neutral or mildly alkaline.

Zook series

The Zook series consists of deep, poorly drained soils. These soils are on bottom lands. They formed in silty and clayey alluvium and have slow permeability. Slope ranges from 0 to 2 percent.

Zook soils are near Colo and Holly Springs soils. Colo soils contain less clay in the control section and are slightly higher in elevation than Zook soils. Holly Springs soils are calcareous throughout the profile, have less clay in the upper part of the control section, and are at a slightly higher elevation.

Typical pedon of Zook silty clay loam, 0 to 1 percent slopes, 2,600 feet north and 50 feet west of southeast corner sec. 3, T. 23 N., R. 8 E.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; hard, firm; neutral; abrupt smooth boundary.

A12—8 to 17 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium and fine granular structure; hard, firm; slightly acid; gradual smooth boundary.

A13—17 to 20 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; slightly acid; gradual smooth boundary.

A3—20 to 29 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; very hard, very firm, very sticky; shiny faces on peds; slightly acid; gradual smooth boundary.

B2g—29 to 45 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky; shiny faces on peds; neutral; gradual smooth boundary.

Cg—45 to 60 inches; dark gray (10YR 4/1) silty clay, gray (10YR 5/1) dry; massive; very hard, very firm, very sticky; neutral.

Typically, the thickness of the solum is more than 40 inches and ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 36 to 50 inches. Typically, the pedon is noncalcareous to a depth of 50 inches. The control section has clay content of 40 to 46 percent, and the content of clay remains constant to a depth of 4 feet or more. Reaction is neutral or mildly alkaline.

The A horizon has value of 2 in the upper part and 2 or 3 in the lower part and chroma of 0 or 1. The A horizon is dominantly silty clay loam but ranges from silt loam to silty clay. It is medium acid through neutral. The B and C horizons have hue of 10YR to 5Y, value of 3 or 4 moist and 4 or 5 dry, and chroma of 1.

factors of soil formation

Soil is produced by soil-forming processes that act on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. Parent material also affects the kind of soil profile that is formed and in extreme cases determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

parent material

Parent material is the disintegrated and partly weathered rock in which soil forms. It determines the mineralogical and chemical composition of soil. The soils of Burt County formed in Peorian loess and a younger loess, glacial till, weathered sandstone, colluvium, and alluvium.

Loess in Burt County is brown or yellowish brown, friable, calcareous material that was blown out of stream valleys and deposited by the wind on uplands. It consists mostly of silt but contains some clay and small amounts of sand. The thickness of the loess deposits is most commonly 8 to 40 feet but ranges from a few feet to more than 100 feet. Belfore, Moody, Crofton, Marshall, Monona, and Ida soils formed in this material.

Beneath the Peorian loess is a thin layer of reddish brown or strong brown material of the Loveland Formation. It is exposed on some of the steeper side slopes in the eastern part of the uplands. This material is assumed by many to be of loessial origin. No soils are mapped in this material in Burt County.

Beneath the Loveland Formation is glacial till of Kansan age. This material is exposed on some side slopes along some of the major streams and in deep gullies. It is clayey and contains pebbles, small stones, pockets of soft carbonates, and sand. The glacial till is fairly thick, ranging from a few feet to a 150 feet or more. The total acreage of soils formed in glacial till in Burt County is rather small. Burchard and Steinauer soils formed in this material.

Colluvium is on foot slopes at the base of steeper uplands. It consists of recent, deep, friable material deposited by the combined effects of gravity and moving water. The colluvium is mostly silt but contains some clay and a small amount of sand. It is mainly dark grayish brown or brown and generally is 3 to 6 feet thick. In Burt County, only Judson soils formed in colluvium.

Alluvium is water-deposited sediment on stream terraces and bottom lands. In Burt County, the texture of this sediment ranges from clay to fine sand. Because fresh deposits are laid down by floodwater after heavy rains or by rapidly flowing melt water, soils formed in alluvium are immature. The alluvium in flood plains of the Missouri River consists of sediment transported by the river and is material derived from erosion upstream and outside the county. Some of the soils formed in this alluvium are Albaton, Blyburg, Luton, Solomon, and Sarpy soils.

The alluvium in flood plains of Blackbird Creek, Logan Creek, and other upland streams consists of mixed deposits transported by the streams. This material is derived from adjacent uplands and upland areas that are outside the county but similar in origin. Some of the soils that formed in this alluvium are Zook, Colo, Calco, and Kennebec soils.

Several formations of sandstone and shale bedrock are exposed at the surface in Burt County. Boone soils are moderately deep over sandstone and formed from material that weathered from sandstone. None of the soils in this survey formed in material derived from shale.

climate

Climate affects the formation of soils through its influence on the rate of weathering and reworking of parent material by rainfall, temperature, and wind.

Because soil formation progresses slowly when the soil is dry, soils in arid regions generally are less well developed than those in humid regions. The amount of moisture, the length of the growing season, and the prevailing temperature during the growing season affect the amount of vegetation, which is the principal source of organic matter in soils. These same factors directly affect the activity of the micro-organisms that convert organic matter to humus. Wind also is an important factor in that it can remove the top layer of soil or deposit a mantle of sediment on soil.

Burt County has a continental climate characterized by wide day-to-day and season-to-season variation. Temperatures below 0 degrees F in winter and above 100 degrees in summer are common. The frost-free season averages about 160 days and thus provides an adequate growing season for many grain and forage crops. The average annual precipitation is 29.46 inches. The average snowfall is about 31 inches per year.

The climate is fairly uniform throughout the county. Differences in the soils from one place to another are the result of interrelationships of climate and other soil forming factors, not of climate alone. The amount of leaching, for example, is dependent on the amount of precipitation and the relief in the area. Because runoff and evaporation are greater, leaching is less common in the steeper soils and in soils that are exposed more directly to the wind than in the nearly level soils, even though rainfall is the same. Erosion, which is caused by rain, melting snow, and wind, can prevent development of a thick surface layer, especially on the steeper areas.

plant and animal life

After parent material is deposited, bacteria, fungi, and other simple forms of life invade it. In sequence and after a time in Burt County, prairie grasses began to grow, sending fibrous roots into the upper few feet of the soil. The roots of the grasses helped to keep the soils productive by bringing nutrients from the deeper horizons and thus contributed soluble minerals, such as calcium, iron, phosphorus, nitrogen, and sulfur. Plant roots not only produce useful nutrients for plants, but also help develop better soil structure and help aerate the soil.

When plants decay, micro-organisms such as bacteria, nematodes, and protozoa, break down the organic matter into stable humus. Nitrogen-fixing bacteria in nodules on the roots of certain legumes remove nitrogen from the air. When these bacteria die, the nitrogen becomes available in the soil. Fungi and such small animals as millipedes, spiders, and mites also act upon organic matter and decompose it into humus. Earthworms, insects, and small burrowing animals affect the formation of soils by mixing and working the organic and mineral matter. The mixing and working tend to speed soil development and make the soil more friable.

The accumulation of decayed organic matter gradually darkens the color and changes the physical and chemical characteristics of the surface layer. The soil is enriched with plant nutrients from the decaying organic matter. The tilth is improved, permeability to air and water is established, and water movement into the soil and through the soil is increased. In Burt County, Belfore, Calco, Colo, Judson, Marshall, and the uneroded Moody soils have high content of organic matter; Crofton, Ida, Percival, Sarpy, and Steinauer soils have low content of organic matter.

relief

Relief, or lay of the land, influences the formation of soil mainly through its effect on drainage, runoff, and vegetative growth. The degree of slope, shape of the surface, and permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soil. Internal drainage and availability of moisture are important factors in forming the horizons of a soil.

On steep and very steep slopes, where runoff is rapid and little moisture penetrates the soil, development of the soil is slower than on more gentle slopes. Erosion removes the surface soil almost as fast as it is formed. Lime and other elements are not leached deeply. In Burt County, the moderately steep Crofton soils and the steep Ida and Steinauer soils have little soil profile development other than a slightly darkened, thin surface layer.

The nearly level and gently sloping soils on uplands have stronger development and more distinct soil horizons than the steeper soils. They absorb more moisture, and this moisture penetrates deeper into the profile. Consequently, lime and plant nutrients are leached to a greater depth, and a B horizon develops. The nearly level and gently sloping Marshall and Moody soils and the nearly level Belfore soils have distinct horizons.

Some of the nearly level soils on bottom lands are somewhat poorly drained or poorly drained because of slow runoff or a high water table. Where runoff is slow, water penetrates the soil, causes silt to weather to clay, and leaches certain elements into lower horizons. Where the water table is moderately high, water is brought from the zone of saturation to the root zone by capillary action and is used by plants. The moisture in the soil affects the kind and amount of vegetation, which in turn influences soil development. In Burt County, the Blencoe, Colo, Calco, and Modale soils are somewhat poorly drained, and the Albaton, Forney, Solomon, and Zook soils are poorly drained.

Differences in the lay of the land slow some processes of horizon differentiation and hasten others. Relief is a local factor of soil formation. Ordinarily, soils that have gentle slopes have a thick solum and distinct horizons; soils that have steeper slopes have a thinner solum and less distinct horizons.

time

Differences in the amount of time that parent materials have been exposed to soil-forming processes are reflected in the characteristics and properties of the soils. A long time is required for the development of a mature or old soil. The longer parent material is exposed to soil weathering and soil development, the more nearly it will have a profile in equilibrium with the environment. A mature or old soil will have been in place long enough for climate, animal and plant life, and relief to have altered the parent material into a developed soil profile. The soil that has a mature profile will have a dark colored surface layer and a distinct subsoil. In Burt County, Marshall, Monona, Belfore, and Moody soils are examples of mature soils that have expressed horizons.

Nearly all the soils on bottom lands do not have a well developed profile because they formed in recently deposited alluvial sediment. Examples of these soils in Burt County are Haynie, Sarpy, Modale, Forney, and Grable soils. Some soils in Burt County are not mature because of the steepness of slope. On such soils, erosion has removed the developed soil material, and new material is exposed to weathering. Therefore, the steep and very steep Ida soils, the moderately steep and steep Steinauer soils, and the strongly sloping and moderately steep Crofton soils are immature or young.

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glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compact layers to depths below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. The total thickness of weathered soil material over mixed sand and gravel or bedrock. In this survey the classes of soil depth are—*very shallow,* 0 to 10 inches; *shallow,* 10 to 20 inches; *moderately deep,* 20 to 40 inches; and *deep,* more than 40 inches.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics.

The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter content. The amount of organic matter in soil material. The classes used in this survey are—*very low,* less than 0.5 percent organic matter; *low,* 0.5 to 1.0 percent; *moderately low,* 1.0 to 2.0 percent; *moderate,* 2.0 to 4.0 percent; and *high,* 4.0 to 8.0 percent.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, the classes of slope and percentages are—

Nearly level	0 to 1 and 0 to 2
Gently sloping	2 to 6
Strongly sloping	6 to 11
Moderately steep	11 to 15 and 11 to 17
Steep	17 to 30
Very steep	30 to 60

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-73 at Tekamah, Nebraska]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	30.8	9.5	20.2	57	-19	0	.62	.23	.91	2	7.1
February---	37.6	15.9	26.8	65	-16	0	1.09	.27	1.73	3	6.8
March------	47.1	24.9	36.0	79	-4	45	2.00	.81	2.96	4	7.9
April------	64.5	38.0	51.2	89	19	115	2.76	1.33	3.92	6	.8
May--------	75.7	50.0	62.9	94	29	405	4.15	2.47	5.65	7	.0
June-------	85.1	59.9	72.5	100	43	675	4.65	2.65	6.28	8	.0
July-------	88.7	64.3	76.5	102	47	822	3.54	1.95	4.82	6	.0
August-----	87.1	62.2	74.6	100	47	763	3.76	1.76	5.38	6	.0
September--	78.2	52.4	65.3	96	32	459	3.16	1.43	4.57	6	.0
October----	68.3	41.4	54.9	90	20	202	2.00	.40	3.25	4	.2
November---	50.3	27.9	39.1	75	3	7	.92	.10	1.54	2	2.1
December---	36.8	16.6	26.7	62	-13	0	.81	.23	1.27	2	6.3
Yearly:											
Average--	62.5	38.6	50.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	103	-20	---	---	---	---	---	---
Total----	---	---	---	---	---	3,493	29.46	23.79	34.83	56	31.2

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-73 at Tekamah, Nebraska]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 20	April 29	May 14
2 years in 10 later than--	April 15	April 24	May 9
5 years in 10 later than--	April 7	April 16	April 30
First freezing temperature in fall:			
1 year in 10 earlier than--	October 19	October 5	September 27
2 years in 10 earlier than--	October 23	October 9	October 2
5 years in 10 earlier than--	October 31	October 18	October 11

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-73 at Tekamah, Nebraska]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	187	166	147
8 years in 10	194	172	153
5 years in 10	207	185	164
2 years in 10	220	197	175
1 year in 10	227	204	181

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ab	Albaton silty clay, 0 to 1 percent slopes	4,100	1.3
Ac	Albaton silty clay, depressional, 0 to 1 percent slopes	670	0.2
Be	Belfore silty clay loam, 0 to 2 percent slopes	4,800	1.6
Bf	Belfore silty clay loam, terrace, 0 to 2 percent slopes	9,000	2.9
Bn	Blencoe silty clay loam, 0 to 1 percent slopes	2,600	0.8
Bo	Blencoe silty clay, 0 to 1 percent slopes	2,900	0.9
Bs	Blyburg silt loam, 0 to 2 percent slopes	3,850	1.2
BtG	Boone-Rock outcrop complex, 20 to 60 percent slopes	410	0.1
BuD2	Burchard clay loam, 6 to 11 percent slopes, eroded	870	0.3
BuE2	Burchard clay loam, 11 to 17 percent slopes, eroded	6,800	2.2
Ca	Calco silty clay loam, 0 to 2 percent slopes	4,300	1.4
Cb	Calco silty clay loam, wet, 0 to 2 percent slopes	190	0.1
Cd	Carr silt loam, 0 to 2 percent slopes	910	0.3
Cf	Colo silt loam, overwash, 0 to 1 percent slopes	4,600	1.5
Cg	Colo silty clay loam, 0 to 1 percent slopes	14,700	4.8
CrD2	Crofton silt loam, 6 to 11 percent slopes, eroded	314	0.1
CrE2	Crofton silt loam, 11 to 15 percent slopes, eroded	2,950	0.9
Fm	Fillmore silt loam, 0 to 1 percent slopes	680	0.2
Fo	Forney silty clay, 0 to 1 percent slopes	8,800	2.8
Gb	Grable silt loam, 0 to 2 percent slopes	1,350	0.4
He	Haynie silt loam, 0 to 2 percent slopes	6,380	2.1
Hf	Haynie silt loam, channeled	430	0.1
Hg	Haynie Variant silt loam, 0 to 1 percent slopes	910	0.3
Hp	Holly Springs silty clay loam, 0 to 1 percent slopes	3,900	1.3
IdD2	Ida silt loam, 6 to 11 percent slopes, eroded	1,866	0.6
IdE	Ida silt loam, 11 to 17 percent slopes	1,200	0.4
IdE2	Ida silt loam, 11 to 17 percent slopes, eroded	16,750	5.4
IdF	Ida silt loam, 17 to 30 percent slopes	1,000	0.3
IdF2	Ida silt loam, 17 to 30 percent slopes, eroded	3,900	1.3
IdG	Ida silt loam, 30 to 60 percent slopes	890	0.3
JuC	Judson silty clay loam, 2 to 6 percent slopes	26,940	8.7
Kg	Kennebec silt loam, channeled	520	0.2
Ko	Kennebec silt loam, occasionally flooded, 0 to 2 percent slopes	3,600	1.2
Lu	Luton silty clay, 0 to 1 percent slopes	13,300	4.3
Ma	Marshall silty clay loam, 0 to 2 percent slopes	1,000	0.3
MaC	Marshall silty clay loam, 2 to 6 percent slopes	2,450	0.8
MaC2	Marshall silty clay loam, 2 to 6 percent slopes, eroded	1,050	0.3
Mb	Marshall silty clay loam, terrace, 0 to 2 percent slopes	1,700	0.6
Mk	Modale silt loam, 0 to 2 percent slopes	1,500	0.5
MnD	Monona silt loam, 6 to 11 percent slopes	6,050	2.0
MnD2	Monona silt loam, 6 to 11 percent slopes, eroded	1,920	0.6
MnE	Monona silt loam, 11 to 17 percent slopes	4,300	1.4
MnE2	Monona silt loam, 11 to 17 percent slopes, eroded	6,100	2.0
Mo	Moody silty clay loam, 0 to 2 percent slopes	4,850	1.6
MoC	Moody silty clay loam, 2 to 6 percent slopes	27,150	8.9
MoC2	Moody silty clay loam, 2 to 6 percent slopes, eroded	4,000	1.3
MoD	Moody silty clay loam, 6 to 11 percent slopes	6,800	2.2
MoD2	Moody silty clay loam, 6 to 11 percent slopes, eroded	13,400	4.3
Mt	Moody silty clay loam, terrace, 0 to 2 percent slopes	2,050	0.7
NoD	Nora silty clay loam, 6 to 11 percent slopes	2,850	0.9
NoD2	Nora silty clay loam, 6 to 11 percent slopes, eroded	16,400	5.3
NoE	Nora silty clay loam, 11 to 15 percent slopes	1,100	0.4
NoE2	Nora silty clay loam, 11 to 15 percent slopes, eroded	5,100	1.7
Om	Omadi silt loam, 0 to 1 percent slopes	2,600	0.8
On	Onawa silty clay, 0 to 2 percent slopes	3,950	1.3
Ow	Owego silty clay, 0 to 1 percent slopes	3,700	1.2
Pe	Percival silty clay, 0 to 2 percent slopes	290	0.1
Pg	Pits, gravel	158	0.1
Sa	Salix silty clay loam, 0 to 1 percent slopes	2,150	0.7
SbC	Sarpy fine sand, 0 to 6 percent slopes	2,530	0.8
SgC	Sarpy-Grable Variant complex, 0 to 6 percent slopes	2,600	0.8
So	Solomon silty clay, 0 to 1 percent slopes	10,600	3.4
StF2	Steinauer clay loam, 11 to 30 percent slopes, eroded	3,900	1.3
Wo	Woodbury silty clay, 0 to 2 percent slopes	1,550	0.5
Zn	Zook silt loam, overwash, 0 to 2 percent slopes	2,000	0.6
Zo	Zook silty clay loam, 0 to 1 percent slopes	4,750	1.5
Zw	Zook silty clay, 0 to 1 percent slopes	2,000	0.6
	Water	2,584	0.8
	Total area	311,512	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn		Soybeans		Winter wheat		Alfalfa hay		Grain sorghum		Brome-alfalfa	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu	AUM*	AUM*
Ab: Albaton	80	108	31	40	28	---	3.7	4.7	75	---	9.6	---
Ac: Albaton	---	---	---	---	---	---	---	---	---	---	---	---
Be: Belfore	95	140	37	47	36	---	4.1	6.3	85	125	4.8	---
Bf: Belfore	100	143	39	48	38	---	4.4	6.5	90	130	5.0	---
Bn: Blencoe	93	125	34	43	36	---	4.0	5.8	90	---	5.2	---
Bo: Blencoe	87	110	32	38	36	---	4.0	5.5	85	---	4.8	---
Bs: Blyburg	110	145	40	50	36	---	4.8	6.2	---	---	5.5	---
BtG: Boone-Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
BuD2: Burchard	62	---	20	---	25	---	3.0	---	65	---	3.2	---
BuE2: Burchard	45	---	---	---	23	---	2.4	---	49	---	3.0	---
Ca: Calco	99	140	38	45	36	---	4.4	6.5	105	---	5.0	---
Cb: Calco	---	---	---	---	---	---	---	---	---	---	---	---
Cd: Carr	75	125	27	40	31	---	3.4	4.8	80	---	4.2	---
Cf: Colo	109	135	35	47	34	---	4.5	6.2	100	---	6.0	---
Cg: Colo	100	140	36	49	36	---	4.6	6.3	104	---	5.9	---
CrD2: Crofton	62	90	22	---	25	---	2.8	4.5	65	---	3.1	---
CrE2: Crofton	54	---	---	---	22	---	2.2	---	50	---	2.5	---
Fm: Fillmore	55	---	25	35	28	---	2.4	4.0	60	---	4.3	---
Fo: Forney	80	110	30	39	34	---	3.7	4.5	72	---	4.8	---
Gb: Grable	75	110	28	36	30	---	3.0	5.3	80	---	4.2	---
He**: Haynie	100	145	40	50	40	---	4.6	6.5	100	---	5.2	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Soybeans		Winter wheat		Alfalfa hay		Grain sorghum		Brome-alfalfa	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu	AUM*	AUM*
Hf----------------------- Haynie	---	---	---	---	---	---	---	---	---	---	---	---
Hg----------------------- Haynie Variant	95	140	42	48	38	---	4.7	6.4	105	---	4.0	---
Hp----------------------- Holly Springs	85	120	32	42	30	---	3.9	5.9	95	---	4.6	---
IdD2--------------------- Ida	66	---	22	---	27	---	3.2	---	65	---	3.4	---
IdE---------------------- Ida	57	---	---	---	20	---	2.7	---	54	---	3.0	---
IdE2--------------------- Ida	56	---	---	---	24	---	2.5	---	51	---	2.5	---
IdF, IdF2---------------- Ida	---	---	---	---	---	---	---	---	---	---	2.5	---
IdG---------------------- Ida	---	---	---	---	---	---	---	---	---	---	---	---
JuC---------------------- Judson	100	140	40	47	38	---	4.5	6.4	105	125	5.0	---
Kg----------------------- Kennebec	---	---	---	---	---	---	---	---	---	---	---	---
Ko----------------------- Kennebec	110	145	40	50	39	---	4.8	6.5	108	---	5.3	---
Lu**--------------------- Luton	80	110	30	40	30	---	3.7	4.6	80	---	4.6	---
Ma----------------------- Marshall	100	145	38	48	38	---	4.2	6.2	95	138	5.3	---
MaC---------------------- Marshall	97	140	38	47	38	---	4.3	6.2	97	120	5.0	---
MaC2--------------------- Marshall	92	135	37	43	35	---	4.2	6.0	92	115	4.6	---
Mb----------------------- Marshall	105	148	40	50	40	---	4.5	6.5	100	140	5.5	---
Mk----------------------- Modale	96	130	36	47	38	---	4.2	6.2	94	---	5.8	---
MnD---------------------- Monona	82	120	34	---	34	---	3.8	5.8	83	---	4.8	---
MnD2--------------------- Monona	76	112	31	---	32	---	3.4	5.4	78	---	4.5	---
MnE---------------------- Monona	67	---	---	---	25	---	3.2	---	65	---	4.0	---
MnE2--------------------- Monona	62	---	---	---	22	---	3.0	---	62	---	3.8	---
Mo----------------------- Moody	95	140	37	46	36	---	4.2	6.3	95	135	4.9	---
MoC---------------------- Moody	92	130	36	47	36	---	4.0	6.2	92	115	5.0	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Soybeans		Winter wheat		Alfalfa hay		Grain sorghum		Brome-alfalfa	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu	AUM*	AUM*
MoC2---------------------- Moody	88	125	34	43	33	---	3.8	6.0	85	105	4.8	---
MoD----------------------- Moody	80	120	30	---	33	---	3.6	5.6	76	---	4.5	---
MoD2---------------------- Moody	68	107	28	---	31	---	3.2	5.3	72	---	4.2	---
Mt------------------------ Moody	100	143	39	49	38	---	4.4	6.5	100	138	5.1	---
NoD----------------------- Nora	76	112	28	---	32	---	3.4	5.2	65	---	4.4	---
NoD2---------------------- Nora	67	104	26	---	29	---	3.1	4.9	61	---	4.1	---
NoE----------------------- Nora	64	---	17	---	26	---	3.0	---	52	---	4.0	---
NoE2---------------------- Nora	60	---	---	---	21	---	2.9	---	58	---	3.2	---
Om------------------------ Omadi	110	145	40	50	39	---	4.8	6.5	105	---	5.0	---
On------------------------ Onawa	90	114	35	40	38	---	4.2	5.7	87	---	4.8	---
Ow------------------------ Owego	84	115	31	43	30	---	3.1	4.5	72	---	4.5	---
Pe------------------------ Percival	65	100	25	34	26	---	2.6	4.8	75	---	3.8	---
Pg***. Pits												
Sa------------------------ Salix	112	150	40	50	40	---	5.0	6.5	110	---	5.0	---
SbC----------------------- Sarpy	---	---	---	---	---	---	---	---	---	---	---	---
SgC----------------------- Sarpy-Grable Variant	---	---	---	---	---	---	---	---	---	---	---	---
So------------------------ Solomon	72	105	26	37	33	---	3.0	4.3	62	---	4.2	---
StF2---------------------- Steinauer	---	---	---	---	---	---	---	---	---	---	---	---
Wo------------------------ Woodbury	80	110	33	39	33	---	3.0	4.7	74	---	4.8	---
Zn------------------------ Zook	98	128	34	42	34	---	4.0	5.9	88	---	4.6	---
Zo------------------------ Zook	95	130	36	44	36	---	4.2	6.0	97	---	4.7	---
Zw------------------------ Zook	85	112	32	42	30	---	3.9	5.8	76	---	4.6	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** Yields are for areas protected from flooding.
*** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	38,380	---	---	---	---
(I)	38,380	---	---	---	---
II (N)	113,850	61,590	50,910	1,350	---
(I)	52,260	---	50,910	1,350	---
III (N)	94,886	50,156	44,730	---	---
(I)	106,270	61,540	44,730	---	---
IV (N)	44,614	44,614	---	---	---
(I)	52,130	49,600	---	2,530	---
V (N)	860	---	860	---	---
VI (N)	14,880	9,750	---	5,130	---
VII (N)	410	410	---	---	---
VIII(N)	1,048	890	---	158	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Ab: Albaton	Redosier dogwood, American plum.	Autumn-olive, common choke-cherry.	Eastern redcedar	Green ash, honey-locust, Russian mulberry, Austrian pine, Scotch pine.	Eastern cottonwood, silver maple.
Ac: Albaton	---	---	---	---	---
Be, Bf: Belfore	Lilac, Peking cotoneaster.	Autumn-olive, Amur honeysuckle, skunkbush sumac.	Eastern redcedar, Russian mulberry.	Green ash, common hackberry, honeylocust, Austrian pine, Scotch pine.	---
Bn, Bo: Blencoe	American plum, redosier dogwood.	Autumn-olive, common choke-cherry.	Eastern redcedar	Austrian pine, Scotch pine, green ash, honeylocust, Russian mulberry.	Eastern cottonwood, silver maple.
Bs: Blyburg	Redosier dogwood, Peking coton-easter, American plum.	Autumn-olive, Amur honeysuckle.	Eastern redcedar	Green ash, common hackberry, honeylocust, black walnut, Scotch pine, bur oak.	Eastern cottonwood.
BtG*:					
Boone	---	---	---	---	---
Rock outcrop.					
BuD2, BuE2: Burchard	Lilac, Peking cotoneaster.	Autumn-olive, Amur honeysuckle, skunkbush sumac.	Eastern redcedar, Russian mulberry.	Austrian pine, green ash, honeylocust, Scotch pine, common hackberry.	---
Ca: Calco	Redosier dogwood, American plum.	Autumn-olive, common choke-cherry.	Eastern redcedar	Green ash, Austrian pine, Scotch pine, honeylocust, Russian mulberry.	Eastern cottonwood, silver maple.
Cb: Calco	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Cd: Carr	American plum	Skunkbush sumac, Amur honeysuckle, autumn-olive.	Russian mulberry, eastern redcedar.	Honeylocust, common hackberry, green ash, Scotch pine, Austrian pine.	Eastern cottonwood.
Cf, Cg: Colo	Redosier dogwood, American plum.	Autumn-olive, common choke-cherry.	Eastern redcedar	Green ash, honeylocust, Russian mulberry, Austrian pine, Scotch pine.	Silver maple, eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
CrD2, CrE2: Crofton	Skunkbush sumac, Peking cotoneaster.	Russian-olive	Eastern redcedar, bur oak.	Ponderosa pine, Austrian pine, Scotch pine.	---
Fm: Fillmore	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Fo: Forney	Redosier dogwood, American plum.	Autumn-olive, common chokecherry.	Eastern redcedar	Green ash, Scotch pine, honeylocust, Russian mulberry, Austrian pine.	Eastern cottonwood, silver maple.
Gb: Grable	American plum, Peking cotoneaster, redosier dogwood.	Autumn-olive, Amur honeysuckle.	Eastern redcedar	Scotch pine, green ash, common hackberry, honeylocust, bur oak.	Eastern cottonwood.
He: Haynie	American plum, redosier dogwood.	Autumn-olive, Amur honeysuckle.	Eastern redcedar	Scotch pine, green ash, common hackberry, honeylocust, bur oak.	Eastern cottonwood.
Hf: Haynie	---	---	---	---	---
Hg: Haynie Variant	Redosier dogwood	Autumn-olive, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar, common hackberry.	Green ash, Austrian pine, blue spruce, Scotch pine, black walnut.	Eastern cottonwood.
Hp: Holly Springs	Redosier dogwood, American plum.	Autumn-olive, common chokecherry.	Eastern redcedar	Green ash, honeylocust, Scotch pine, Russian mulberry, Austrian pine.	Eastern cottonwood, silver maple.
IdD2, IdE, IdE2, IdF, IdF2, IdG: Ida	Peking cotoneaster, skunkbush sumac.	Russian-olive	Bur oak, eastern redcedar.	Austrian pine, Scotch pine, Ponderosa pine.	---
JuC: Judson	Peking cotoneaster, lilac.	Amur honeysuckle, autumn-olive, skunkbush sumac.	Russian mulberry, eastern redcedar.	Common hackberry, green ash, honeylocust, Austrian pine, Scotch pine.	---
Kg, Ko: Kennebec	American plum, redosier dogwood.	Amur honeysuckle, autumn-olive.	Eastern redcedar	Common hackberry, Norway spruce, Scotch pine.	Eastern cottonwood.
Lu: Luton	American plum, redosier dogwood.	Common chokecherry, autumn-olive.	Eastern redcedar	Russian mulberry, green ash, Austrian pine, Scotch pine, honeylocust.	Eastern cottonwood, silver maple.
Ma, MaC, MaC2: Marshall	Redosier dogwood, lilac.	Amur honeysuckle, skunkbush sumac, autumn-olive.	Eastern redcedar, Russian mulberry.	Scotch pine, common hackberry, Austrian pine, green ash, honeylocust.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Mb: Marshall	American plum, Peking cotoneaster, redosier dogwood.	Autumn-olive, Amur honeysuckle.	Eastern redcedar	Green ash, honeylocust, common hackberry, bur oak.	Eastern cottonwood.
Mk: Modale	American plum, redosier dogwood.	Common chokecherry, autumn-olive.	Eastern redcedar	Silver maple, Scotch pine, Austrian pine, Russian mulberry, green ash, honeylocust.	Eastern cottonwood, silver maple.
MnD, MnD2, MnE, MnE2: Monona	Redosier dogwood, lilac.	Autumn-olive, Amur honeysuckle, skunkbush sumac.	Eastern redcedar, Russian mulberry.	Common hackberry, green ash, Scotch pine, Austrian pine, honeylocust.	---
Mo, MoC, MoC2, MoD, MoD2, Mt: Moody	Lilac, redosier dogwood.	Amur honeysuckle, autumn-olive, skunkbush sumac.	Russian mulberry, eastern redcedar.	Green ash, honeylocust. common hackberry, Scotch pine, Austrian pine.	---
NoD, NoD2, NoE, NoE2: Nora	Lilac, redosier dogwood.	Amur honeysuckle, autumn-olive, skunkbush sumac.	Russian mulberry, eastern redcedar.	Honeylocust, green ash, common hackberry, Scotch pine, Austrian pine.	---
Om: Omadi	American plum, Peking cotoneaster, redosier dogwood.	Autumn-olive, Amur honeysuckle.	Eastern redcedar	Green ash, common hackberry, bur oak, Scotch pine, honeylocust.	Eastern cottonwood.
On: Onawa	American plum, redosier dogwood.	Common chokecherry, autumn-olive.	Eastern redcedar	Green ash, honeylocust, Austrian pine, Scotch pine, Russian mulberry.	Eastern cottonwood, silver maple.
Ow: Owego	American plum, redosier dogwood.	Common chokecherry, autumn-olive.	Eastern redcedar	Green ash, honeylocust, Austrian pine, Scotch pine, Russian mulberry.	Eastern cottonwood, silver maple.
Pe: Percival	Redosier dogwood, American plum.	Autumn-olive, common chokecherry.	Eastern redcedar	Green ash, honeylocust, Austrian pine, Scotch pine, Russian mulberry.	Eastern cottonwood, silver maple.
Pg*: Pits	---	---	---	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Sa: Salix	American plum, redosier dogwood, Peking cotoneaster.	Autumn-olive, Amur honeysuckle.	Eastern redcedar	Green ash, common hackberry, honeylocust, Scotch pine, bur oak.	Eastern cottonwood.
SbC: Sarpy	---	---	Eastern redcedar	Scotch pine, jack pine, ponderosa pine, Austrian pine.	Eastern cottonwood.
SgC*:					
Sarpy	---	---	---	Ponderosa pine, jack pine, Scotch pine, Austrian pine.	---
Grable Variant.					
So: Solomon	American plum, redosier dogwood.	Common chokecherry, autumn-olive.	Eastern redcedar	Honeylocust, green ash, Scotch pine, Russian mulberry.	Eastern cottonwood, silver maple.
StF2: Steinauer	Skunkbush sumac, Peking cotoneaster.	Russian-olive	Eastern redcedar, bur oak.	Ponderosa pine, Austrian pine, Scotch pine.	---
Wo: Woodbury	Redosier dogwood, American plum.	Autumn-olive, common chokecherry.	Eastern redcedar	Green ash, honeylocust, Austrian pine, Scotch pine, Russian mulberry.	Eastern cottonwood, silver maple.
Zn, Zo, Zw: Zook	Redosier dogwood, American plum.	Autumn-olive, common chokecherry.	Eastern redcedar	Green ash, honeylocust, Austrian pine, Scotch pine, Russian mulberry.	Eastern cottonwood, silver maple.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ab-------------------- Albaton	Severe: floods, wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.
Ac-------------------- Albaton	Severe: floods, ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding, floods.	Severe: ponding, too clayey.	Severe: too clayey, ponding, floods.
Be, Bf---------------- Belfore	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
Bn-------------------- Blencoe	Severe: floods.	Moderate: wetness.	Severe: wetness.	Slight----------	Moderate: floods.
Bo-------------------- Blencoe	Severe: floods, wetness, too clayey.	Severe: too clayey.	Severe: wetness, too clayey.	Severe: too clayey.	Severe: too clayey.
Bs-------------------- Blyburg	Severe: floods.	Slight----------	Slight----------	Slight----------	Slight.
BtG*:					
Boone----------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
BuD2, BuE2------------ Burchard	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
Ca-------------------- Calco	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: floods, wetness.
Cb-------------------- Calco	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Cd-------------------- Carr	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.
Cf, Cg---------------- Colo	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
CrD2, CrE2------------ Crofton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Fm-------------------- Fillmore	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Fo-------------------- Forney	Severe: floods, wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
Gb-------------------- Grable	Severe: floods.	Slight----------	Moderate: floods.	Slight----------	Moderate: floods.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
He----- Haynie	Severe: floods.	Slight-----	Slight-----	Slight-----	Severe: frost action, low strength.
Hf----- Haynie	Severe: floods.	Slight-----	Moderate: floods.	Slight-----	Severe: floods, frost action, low strength.
Hg----- Haynie Variant	Severe: floods.	Moderate: wetness.	Moderate: wetness.	Severe: erodes easily.	Slight.
Hp----- Holly Springs	Severe: floods, wetness, percs slowly.	Moderate: wetness, too clayey.	Severe: wetness, percs slowly.	Moderate: wetness, too clayey.	Moderate: too clayey, floods, wetness.
IdD2----- Ida	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
IdE, IdE2----- Ida	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
IdF, IdF2, IdG----- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
JuC----- Judson	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Kg----- Kennebec	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
Ko----- Kennebec	Severe: floods.	Slight-----	Moderate: floods.	Slight-----	Moderate: floods.
Lu----- Luton	Severe: wetness, percs slowly, too clayey.	Severe: too clayey.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
Ma----- Marshall	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
MaC, MaC2----- Marshall	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Mb----- Marshall	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
Mk----- Modale	Severe: floods.	Moderate: wetness.	Moderate: percs slowly, wetness.	Slight-----	Moderate: floods.
MnD, MnD2----- Monona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
MnE, MnE2----- Monona	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Mo----- Moody	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
MoC, MoC2----- Moody	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MoD, MoD2: Moody	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Mt: Moody	Slight	Slight	Slight	Slight	Slight.
NoD, NoD2: Nora	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
NoE, NoE2: Nora	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Om: Omadi	Severe: floods.	Slight	Slight	Slight	Slight.
On: Onawa	Severe: floods, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Ow: Owego	Severe: floods, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Pe: Percival	Severe: floods, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Pg*. Pits					
Sa: Salix	Severe: floods.	Slight	Slight	Slight	Slight.
SbC: Sarpy	Severe: floods, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: floods.
SgC*:					
Sarpy	Severe: floods, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: floods.
Grable Variant	Severe: floods, wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
So: Solomon	Severe: floods, wetness, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
StF2: Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Wo: Woodbury	Severe: floods, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Zn, Zo: Zook	Severe: wetness, floods.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Zw----------------------- Zook	Severe: wetness, floods, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Ab-----------------Albaton	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
Ac-----------------Albaton	Very poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Be, Bf-------------Belfore	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Bn, Bo-------------Blencoe	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
Bs-----------------Blyburg	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
BtG*:										
Boone--------------	Very poor	Very poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
Rock outcrop.										
BuD2, BuE2---------Burchard	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Ca-----------------Calco	Good	Fair	Good	Poor	Poor	Good	Good	Fair	Poor	Fair.
Cb-----------------Calco	Very poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Cd-----------------Carr	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Cf, Cg-------------Colo	Good	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
CrD2, CrE2---------Crofton	Fair	Good	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Fm-----------------Fillmore	Fair	Good	Fair	Fair	Fair	Good	Fair	Fair	Fair	Good.
Fo-----------------Forney	Fair	Fair	Fair	Poor	Very poor	Good	Good	Fair	Poor	Good.
Gb-----------------Grable	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor.
He-----------------Haynie	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Hf-----------------Haynie	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
Hg-----------------Haynie Variant	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Hp-----------------Holly Springs	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
IdD2, IdE, IdE2----Ida	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
IdF, IdF2---------- Ida	Poor	Fair	Good	Poor	Poor	Very poor	Very poor	Fair	Fair	Very poor.
IdG---------------- Ida	Very poor	Very poor	Good	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
JuC---------------- Judson	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Kg----------------- Kennebec	Poor	Fair	Fair	Good	Good	Poor	Poor	Fair	Good	Poor.
Ko----------------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Lu----------------- Luton	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
Ma, MaC, MaC2, Mb-- Marshall	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Mk----------------- Modale	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
MnD, MnD2, MnE, MnE2-------------- Monona	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Mo, MoC, MoC2------ Moody	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
MoD, MoD2---------- Moody	Fair	Good	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Mt----------------- Moody	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
NoD, NoD2, NoE, NoE2-------------- Nora	Fair	Good	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Om----------------- Omadi	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
On----------------- Onawa	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
Ow----------------- Owego	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
Pe----------------- Percival	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair.
Pg*. Pits										
Sa----------------- Salix	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
SbC---------------- Sarpy	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
SgC*: Sarpy--------------	Poor	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Poor	Very poor.
Grable Variant----	Poor	Poor	Fair	Good	Good	Good	Fair	Poor	Good	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
So------------------ Solomon	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
StF2--------------- Steinauer	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor.
Wo------------------ Woodbury	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
Zn, Zo, Zw---------- Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ab: Albaton	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: wetness, low strength, floods.	Severe: too clayey.
Ac: Albaton	Severe: ponding, floods.	Severe: floods, ponding, shrink-swell.	Severe: floods, ponding, shrink-swell.	Severe: floods, ponding, shrink-swell.	Severe: low strength, ponding, floods.	Severe: too clayey, ponding, floods.
Be, Bf: Belfore	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Bn: Blencoe	Severe: wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness, floods.
Bo: Blencoe	Severe: wetness.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey, floods.
Bs: Blyburg	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action.	Slight.
BtG*:						
Boone	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.						
BuD2, BuE2: Burchard	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Ca: Calco	Severe: wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, floods.	Moderate: floods, wetness.
Cb: Calco	Severe: wetness.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, low strength.	Severe: floods, wetness.
Cd: Carr	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Cf, Cg: Colo	Severe: wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, shrink-swell, wetness.	Severe: floods, low strength, shrink-swell.	Moderate: wetness, floods.
CrD2, CrE2: Crofton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Fm: Fillmore	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.	Severe: ponding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Fo----------------- Forney	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, floods, shrink-swell.	Severe: too clayey.
Gb----------------- Grable	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
He----------------- Haynie	Slight---------	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action, low strength.	Severe: frost action, low strength.
Hf----------------- Haynie	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Severe: floods, frost action, low strength.
Hg----------------- Haynie Variant	Severe: wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: low strength, frost action.	Slight.
Hp----------------- Holly Springs	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: floods, low strength, shrink-swell.	Moderate: too clayey, floods, wetness.
IdD2--------------- Ida	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
IdE, IdE2---------- Ida	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
IdF, IdF2, IdG----- Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action, low strength.	Severe: slope.
JuC---------------- Judson	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
Kg----------------- Kennebec	Moderate: wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Severe: floods.
Ko----------------- Kennebec	Moderate: wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action, low strength.	Moderate: floods.
Lu----------------- Luton	Severe: wetness.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, low strength, floods.	Severe: too clayey.
Ma, MaC, MaC2, Mb- Marshall	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
Mk----------------- Modale	Severe: wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods.	Moderate: floods.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MnD, MnD2: Monona	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: low strength, frost action.	Moderate: slope.
MnE, MnE2: Monona	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Mo: Moody	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
MoC, MoC2, MoD, MoD2: Moody	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: frost action, low strength.	Slight.
Mt: Moody	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
NoD, NoD2: Nora	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Moderate: slope.
NoE, NoE2: Nora	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
Om: Omadi	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, frost action.	Slight.
On: Onawa	Severe: wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength, frost action.	Severe: too clayey.
Ow: Owego	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, wetness, floods.	Severe: too clayey.
Pe: Percival	Severe: wetness, cutbanks cave.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: low strength, shrink-swell, floods.	Severe: too clayey.
Pg*. Pits						
Sa: Salix	Moderate: wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, frost action.	Slight.
SbC: Sarpy	Severe: cutbanks cave, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
SgC*: Sarpy	Severe: cutbanks cave, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Grable Variant	Severe: cutbanks cave, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, frost action.	Severe: floods.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
So----------------- Solomon	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, wetness, floods.	Severe: wetness, too clayey.
StF2-------------- Steinauer	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.	Severe: slope.
Wo----------------- Woodbury	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: wetness, low strength, floods.	Severe: too clayey.
Zn, Zo------------ Zook	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength.	Moderate: wetness.
Zw----------------- Zook	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength.	Severe: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ab------------------ Albaton	Severe: percs slowly, wetness, floods.	Severe: floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
Ac------------------ Albaton	Severe: floods, ponding, percs slowly.	Severe: floods, ponding.	Severe: floods, ponding, too clayey.	Severe: floods, ponding.	Poor: too clayey, ponding.
Be, Bf-------------- Belfore	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Bn, Bo-------------- Blencoe	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Bs------------------ Blyburg	Moderate: floods, percs slowly.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
BtG*:					
Boone---------------	Severe: slope, depth to rock.	Severe: seepage, depth to rock, slope.	Severe: slope, depth to rock, seepage.	Severe: seepage, slope.	Poor: slope, too sandy, seepage.
Rock outcrop.					
BuD2, BuE2---------- Burchard	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ca------------------ Calco	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Cb------------------ Calco	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Cd------------------ Carr	Severe: floods, poor filter.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: thin layer.
Cf, Cg-------------- Colo	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
CrD2, CrE2---------- Crofton	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Fm------------------ Fillmore	Severe: percs slowly, ponding.	Severe: ponding.	Severe: too clayey, ponding.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Fo------------------ Forney	Severe: floods, wetness, percs slowly.	Severe: floods.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
Gb------------------ Grable	Severe: floods.	Severe: floods, seepage.	Severe: seepage, floods, too sandy.	Severe: floods, seepage.	Poor: too sandy, seepage.
He------------------ Haynie	Moderate: floods.	Moderate: seepage.	Moderate: floods.	Moderate: floods.	Good.
Hf------------------ Haynie	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Hg------------------ Haynie Variant	Severe: wetness, percs slowly.	Severe: floods, wetness.	Moderate: floods, wetness.	Moderate: floods, wetness.	Fair: wetness, thin layer.
Hp------------------ Holly Springs	Severe: percs slowly, wetness, floods.	Slight-----------	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
IdD2---------------- Ida	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
IdE, IdE2----------- Ida	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
IdF, IdF2, IdG------ Ida	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
JuC----------------- Judson	Slight-----------	Moderate: slope, seepage.	Slight-----------	Slight-----------	Good.
Kg------------------ Kennebec	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Good.
Ko------------------ Kennebec	Severe: floods.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Good.
Lu------------------ Luton	Severe: percs slowly, wetness, floods.	Severe: floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: wetness, too clayey.
Ma------------------ Marshall	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Good.
MaC, MaC2----------- Marshall	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
Mb------------------ Marshall	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Good.
Mk------------------ Modale	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: too clayey, wetness.
MnD, MnD2----------- Monona	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair. slope.
MnE, MnE2----------- Monona	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Mo----------------- Moody	Severe: percs slowly.	Moderate: seepage.	Slight-----------	Slight-----------	Good.
MoC, MoC2----------- Moody	Severe: percs slowly.	Moderate: slope, seepage.	Slight-----------	Slight-----------	Good.
MoD, MoD2----------- Moody	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Mt----------------- Moody	Severe: percs slowly.	Moderate: seepage.	Moderate: slope.	Moderate: slope.	Fair: slope.
NoD, NoD2----------- Nora	Moderate: percs slowly, slope.	Severe: slope.	Slight-----------	Slight-----------	Good.
NoE, NoE2----------- Nora	Moderate: slope, percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Om----------------- Omadi	Moderate: floods, percs slowly.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
On----------------- Onawa	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: floods, seepage, wetness.	Severe: wetness, floods, seepage.	Fair: wetness.
Ow----------------- Owego	Severe: percs slowly, wetness, floods.	Severe: floods, wetness.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
Pe----------------- Percival	Severe: wetness, floods, poor filter.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: floods, seepage, wetness.	Poor: too clayey.
Pg*. Pits					
Sa----------------- Salix	Moderate: floods, wetness.	Moderate: wetness, seepage.	Severe: wetness.	Moderate: floods, wetness.	Good.
SbC----------------- Sarpy	Severe: floods.	Severe: seepage, floods.	Severe: seepage, floods, too sandy.	Severe: seepage, floods.	Poor: too sandy, seepage.
SgC*:					
Sarpy--------------	Severe: floods.	Severe: seepage, floods.	Severe: seepage, floods, too sandy.	Severe: seepage, floods.	Poor: too sandy.
Grable Variant-----	Severe: floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: too sandy, seepage.
So----------------- Solomon	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, hard to pack, wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
StF2----------------- Steinauer	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Wo------------------- Woodbury	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
Zn, Zo, Zw----------- Zook	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ab-------------------- Albaton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ac-------------------- Albaton	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Be, Bf---------------- Belfore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Bn-------------------- Blencoe	Poor: wetness, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Bo-------------------- Blencoe	Poor: wetness, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Bs-------------------- Blyburg	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
BtG*:				
Boone----------------	Poor: slope, thin layer, area reclaim.	Improbable: thin layer.	Improbable: too sandy.	Poor: too sandy, slope.
Rock outcrop.				
BuD2, BuE2------------ Burchard	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Ca-------------------- Calco	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cb-------------------- Calco	Poor: wetness, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Cd-------------------- Carr	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
Cf, Cg---------------- Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
CrD2, CrE2------------ Crofton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Fm-------------------- Fillmore	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Fo: Forney	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Gb: Grable	Good	Probable	Improbable: too sandy.	Fair: area reclaim.
He, Hf: Haynie	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Hg: Haynie Variant	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hp: Holly Springs	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
IdD2: Ida	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
IdE, IdE2: Ida	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
IdF, IdF2, IdG: Ida	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
JuC: Judson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Kg, Ko: Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lu: Luton	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ma, MaC, MaC2, Mb: Marshall	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Mk: Modale	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
MnD, MnD2: Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
MnE, MnE2: Monona	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Mo, MoC, MoC2, MoD, MoD2, Mt: Moody	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
NoD, NoD2: Nora	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
NoE, NoE2: Nora	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
Om: Omadi	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
On-------------------- Onawa	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ow-------------------- Owego	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Pe-------------------- Percival	Fair: wetness.	Probable-------------	Improbable: too sandy.	Poor: too clayey.
Pg*. Pits				
Sa-------------------- Salix	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
SbC------------------- Sarpy	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
SgC*:				
Sarpy----------------	Good-----------------	Probable-------------	Improbable: too sandy.	Poor: too sandy.
Grable Variant-------	Fair: wetness.	Probable-------------	Improbable: excess fines.	Fair: thin layer.
So-------------------- Solomon	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
StF2------------------ Steinauer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Wo-------------------- Woodbury	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Zn-------------------- Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Zo-------------------- Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Zw-------------------- Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ab----------------- Albaton	Slight----------	Severe: hard to pack, wetness.	Percs slowly, floods.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Percs slowly, wetness.
Ac----------------- Albaton	Slight----------	Severe: ponding.	Ponding, percs slowly, floods.	Ponding, floods, slow intake.	Ponding, percs slowly.	Wetness, percs slowly.
Be, Bf------------- Belfore	Slight----------	Moderate: hard to pack.	Deep to water	Favorable------	Favorable------	Favorable.
Bn----------------- Blencoe	Moderate: seepage.	Severe: piping.	Frost action, floods.	Wetness, floods.	Wetness, erodes easily.	Wetness, erodes easily.
Bo----------------- Blencoe	Moderate: seepage.	Severe: piping.	Frost action, floods.	Wetness, slow intake, floods.	Wetness, erodes easily.	Wetness, erodes easily.
Bs----------------- Blyburg	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
BtG*:						
Boone-------------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
Rock outcrop.						
BuD2, BuE2--------- Burchard	Severe: slope.	Slight----------	Deep to water	Slope----------	Slope----------	Slope.
Ca----------------- Calco	Slight----------	Moderate: piping.	Floods, frost action.	Floods, wetness.	Wetness---------	Wetness.
Cb----------------- Calco	Slight----------	Severe: wetness.	Floods, frost action.	Floods, wetness.	Wetness---------	Wetness.
Cd----------------- Carr	Severe: seepage.	Severe: piping.	Deep to water	Rooting depth, floods.	Favorable------	Rooting depth.
Cf, Cg------------- Colo	Slight----------	Severe: wetness.	Floods, frost action.	Floods, wetness.	Wetness---------	Wetness.
CrD2, CrE2--------- Crofton	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Fm----------------- Fillmore	Moderate: seepage.	Severe: hard to pack, ponding.	Percs slowly, frost action, ponding.	Percs slowly, ponding.	Erodes easily, ponding, percs slowly.	Wetness, percs slowly.
Fo----------------- Forney	Slight----------	Severe: wetness, hard to pack.	Percs slowly, floods.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
Gb----------------- Grable	Severe: seepage.	Severe: seepage, piping.	Deep to water	Floods---------	Erodes easily, too sandy.	Favorable.
He----------------- Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Hf----------------- Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, floods.	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Hg---------------- Haynie Variant	Moderate: seepage.	Severe: piping.	Frost action---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness.	Erodes easily.
Hp---------------- Holly Springs	Slight----------	Severe: hard to pack, wetness.	Percs slowly, frost action, floods.	Wetness, percs slowly, floods.	Not needed-----	Wetness, percs slowly.
IdD2-------------- Ida	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily, slope.	Erodes easily, slope.
IdE, IdE2, IdF, IdF2, IdG--------- Ida	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
JuC--------------- Judson	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Kg---------------- Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Floods---------	Erodes easily	Erodes easily.
Ko---------------- Kennebec	Moderate: seepage.	Moderate: piping.	Deep to water	Floods---------	Erodes easily	Erodes easily.
Lu---------------- Luton	Slight----------	Severe: hard to pack, wetness.	Percs slowly, floods.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
Ma---------------- Marshall	Moderate: seepage.	Slight----------	Deep to water	Favorable------	Erodes easily	Erodes easily.
MaC, MaC2--------- Marshall	Moderate: seepage, slope.	Slight----------	Deep to water	Slope----------	Erodes easily	Erodes easily.
Mb---------------- Marshall	Moderate: seepage.	Slight----------	Deep to water	Favorable------	Erodes easily	Erodes easily.
Mk---------------- Modale	Moderate: seepage.	Severe: hard to pack, wetness.		Wetness, percs slowly, erodes easily.	Wetness, erodes easily, percs slowly.	Wetness, erodes easily, percs slowly.
MnD, MnD2--------- Monona	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope----------	Erodes easily, slope.	Erodes easily, slope.
MnE, MnE2--------- Monona	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Mo---------------- Moody	Moderate: seepage.	Moderate: thin layer, piping, hard to pack.	Deep to water	Favorable------	Erodes easily	Erodes easily.
MoC, MoC2, MoD, MoD2------------ Moody	Moderate: seepage, slope.	Moderate: thin layer, piping, hard to pack.	Deep to water	Slope----------	Erodes easily, slope.	Erodes easily, slope.
Mt---------------- Moody	Slight----------	Moderate: thin layer, piping, hard to pack.	Deep to water	Favorable------	Erodes easily	Erodes easily.
NoD, NoD2--------- Nora	Severe: slope	Severe: piping.	Deep to water	Slope----------	Erodes easily, slope.	Erodes easily, slope.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
NoE, NoE2: Nora	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Om: Omadi	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
On: Onawa	Severe: seepage.	Severe: piping.	Floods, frost action.	Wetness, slow intake, percs slowly.	Wetness, erodes easily.	Erodes easily, percs slowly.
Ow: Owego	Moderate: seepage.	Severe: hard to pack.	Percs slowly, floods.	Wetness, percs slowly, slow intake.	Wetness, percs slowly.	Wetness, percs slowly.
Pe: Percival	Severe: seepage.	Severe: seepage, piping, wetness.	Floods	Wetness, percs slowly, slow intake.	Wetness, too sandy, percs slowly.	Percs slowly.
Pg*. Pits						
Sa: Salix	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
SbC: Sarpy	Severe: seepage.	Severe: seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
SgC*:						
Sarpy	Severe: seepage.	Severe: seepage, piping.	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Grable Variant	Severe: seepage.	Severe: seepage, wetness.	Floods, frost action, cutbanks cave.	Wetness, floods.	Wetness, too sandy.	Wetness.
So: Solomon	Slight	Severe: hard to pack, wetness.	Percs slowly, floods.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
StF2: Steinauer	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
Wo: Woodbury	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, frost action, floods.	Wetness, percs slowly, slow intake.	Wetness, erodes easily, percs slowly.	Erodes easily, percs slowly.
Zn, Zo, Zw: Zook	Slight	Severe: hard to pack.	Floods, percs slowly, frost action.	Floods, wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ab----------------- Albaton	0-8	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
	8-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
Ac----------------- Albaton	0-60	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
Be, Bf------------- Belfore	0-14	Silty clay loam	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	15-30
	14-36	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	100	95-100	45-60	20-30
	36-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	15-30
Bn----------------- Blencoe	0-23	Silty clay loam	CH, CL	A-7, A-6	0	100	100	95-100	90-100	35-55	15-30
	23-36	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	41-60	20-30
	36-60	Silt loam-------	ML, CL	A-4, A-6	0	100	100	95-100	85-100	30-40	5-15
Bo----------------- Blencoe	0-25	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	30-50
	25-36	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	41-60	20-30
	36-60	Silt loam-------	ML, CL	A-4, A-6	0	100	100	95-100	85-100	30-40	5-15
Bs----------------- Blyburg	0-19	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-95	22-40	3-20
	19-60	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	50-90	22-35	3-12
BtG*: Boone-------------	0-8	Loamy fine sand	SM	A-2, A-4	0	100	100	50-90	15-50	---	NP
	8-20	Loamy fine sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	50-75	5-30	---	NP
	20-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
BuD2, BuE2--------- Burchard	0-8	Clay loam-------	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	14-24
	8-30	Clay loam-------	CL	A-6, A-7	0-5	95-100	90-100	85-95	65-80	35-50	20-30
	30-60	Clay loam-------	CL	A-6, A-7	0-5	95-100	90-100	85-95	60-80	35-50	15-30
Ca, Cb------------- Calco	0-39	Silty clay loam	ML, MH, CH, CL	A-7	0	100	100	95-100	85-100	40-60	15-30
	39-60	Silty clay loam, loam, clay loam.	CL	A-7, A-6	0	100	100	90-100	80-100	30-45	10-20
Cd----------------- Carr	0-8	Silt loam-------	ML, CL-ML, CL	A-4	0	100	95-100	85-100	55-75	15-30	3-10
	8-60	Stratified fine sandy loam to silt loam.	SM, SC, ML, CL	A-4	0	100	95-100	70-100	35-65	10-25	2-10
Cf----------------- Colo	0-12	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
	12-42	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	42-60	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Cg----------------- Colo	0-30	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	30-38	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	38-60	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
CrD2, CrE2--------- Crofton	0-6	Silt loam-------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-48	11-20
	6-60	Silt loam-------	CL	A-6	0	100	100	95-100	95-100	32-40	11-18
Fm----------------- Fillmore	0-18	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-40	2-20
	18-48	Silty clay------	CH	A-7	0	100	100	100	95-100	50-75	30-45
	48-60	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
Fo----------------- Forney	0-9	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
	9-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Gb----------------- Grable	0-8	Silt loam-------	CL	A-4, A-6	0	100	100	80-95	50-75	25-40	8-20
	8-21	Silt loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	80-95	50-75	25-40	8-20
	21-60	Fine sand, loamy sand, sand.	SM, SM-SC, SP-SM	A-2, A-3	0	100	100	65-80	5-35	<20	NP-5
He, Hf------------- Haynie	0-60	Silt loam, very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	25-40	5-15
Hg----------------- Haynie Variant	0-50	Silt loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	85-100	70-100	30-40	8-15
	50-60	Silty clay------	CH	A-7	0	100	100	90-100	75-100	50-70	35-50
Hp----------------- Holly Springs	0-28	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-65	20-40
	28-60	Silty clay, silty clay loam, clay.	CH	A-7	0	100	100	95-100	95-100	60-85	30-50
IdD2, IdE, IdE2, IdF, IdF2, IdG---- Ida	0-60	Silt loam-------	ML, CL	A-4, A-6	0	100	100	95-100	95-100	30-40	5-15
JuC---------------- Judson	0-34	Silty clay loam	CL, CL-ML	A-6, A-7	0	100	100	100	95-100	25-50	11-25
	34-60	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	100	95-100	25-50	5-25
Kg, Ko------------- Kennebec	0-46	Silt loam-------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	46-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
Lu----------------- Luton	0-27	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
	27-46	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
	46-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
Ma, MaC, MaC2, Mb-- Marshall	0-15	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	15-25
	15-33	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
	33-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	15-25
Mk----------------- Modale	0-24	Silt loam-------	CL	A-4, A-6	0	100	100	95-100	70-90	25-40	8-18
	24-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	65-85	40-60
MnD, MnD2, MnE, MnE2-------------- Monona	0-11	Silt loam-------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	11-30	Silt loam, silty clay loam.	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	30-60	Silt loam-------	CL	A-6	0	100	100	95-100	95-100	30-40	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Mo, MoC, MoC2, MoD, MoD2, Mt---------- Moody	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	13-25
	11-46	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	32-55	11-33
	46-60	Silt loam, silty clay loam.	CL, CL-ML, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-45	6-20
NoD, NoD2, NoE, NoE2-------------- Nora	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	12-25
	10-20	Silt loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-100	35-50	11-25
	20-60	Silt loam, silty clay loam.	CL, CL-ML, ML	A-4, A-6, A-7	0	95-100	95-100	95-100	85-100	27-50	6-24
Om----------------- Omadi	0-22	Silt loam-------	ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	3-15
	22-60	Silt loam-------	ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	3-15
On----------------- Onawa	0-8	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
	8-24	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
	24-60	Silt loam, very fine sandy loam, loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
Ow----------------- Owego	0-14	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	30-55
	14-25	Silt loam, silty clay loam, clay loam.	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	25-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	30-55
Pe----------------- Percival	0-19	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	35-60
	19-60	Stratified fine sand to loamy fine sand.	SM, SM-SC, SP-SM	A-2	0	100	100	80-95	7-25	<20	NP-5
Pg*. Pits											
Sa----------------- Salix	0-19	Silty clay loam	CL	A-7	0	100	100	95-100	95-100	35-50	15-30
	19-26	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-30
	26-60	Silt loam, loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
SbC---------------- Sarpy	0-4	Fine sand-------	SM, SP-SM, SP	A-2-4, A-3	0	100	100	60-80	2-15	---	NP
	4-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
SgC*: Sarpy-------------	0-6	Fine sand-------	SM, SP-SM, SP	A-2-4, A-3	0	100	100	60-80	2-15	---	NP
	6-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
Grable Variant----	0-6	Silt loam-------	CL	A-4, A-6	0	100	100	80-95	50-75	25-40	7-20
	6-21	Very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	80-95	50-70	20-35	4-15
	21-60	Fine sand-------	SM, SP-SM	A-2, A-3	0	100	100	65-80	5-30	<20	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
So-----------------	0-20	Silty clay------	CH	A-7	0	100	100	95-100	90-100	50-75	35-50
Solomon	20-60	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-75	25-50
StF2---------------	0-7	Clay loam--------	CL	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-50	15-25
Steinauer	7-25	Clay loam--------	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	70-90	30-55	12-30
	25-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	95-100	90-100	60-75	20-45	10-26
Wo-----------------	0-22	Silty clay------	CH	A-7	0	100	100	100	95-100	60-85	35-60
Woodbury	22-36	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	60-85	35-60
	36-42	Silty clay loam	CH, CL	A-7	0	100	100	90-100	80-100	40-60	20-35
	42-60	Silt loam-------	CL, ML	A-4, A-6	0	100	100	90-100	80-95	30-40	5-15
Zn-----------------	0-22	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-15
Zook	22-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Zo-----------------	0-20	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
Zook	20-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Zw-----------------	0-40	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
Zook	40-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; the symbol > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
Ab--------------- Albaton	0-8 8-60	45-60 50-60	1.35-1.40 1.35-1.45	<0.06 <0.06	0.11-0.13 0.11-0.13	7.4-8.4 7.4-8.4	High--------- High---------	0.28 0.28	5	4	2-3
Ac--------------- Albaton	0-60	40-55	1.20-1.30	<0.06	0.11-0.14	7.9-8.4	High---------	0.28	5	8	2-4
Be, Bf----------- Belfore	0-14 14-36 36-60	27-40 35-42 25-35	1.30-1.50 1.20-1.40 1.30-1.50	0.2-0.6 0.06-0.2 0.2-0.6	0.21-0.24 0.11-0.18 0.18-0.22	5.6-6.5 6.1-8.4 6.1-8.4	High--------- High--------- High---------	0.32 0.32 0.32	5	7	2-4
Bn--------------- Blencoe	0-13 13-37 37-60	30-40 35-50 15-24	1.30-1.35 1.30-1.35 1.35-1.40	0.06-0.2 0.06-0.6 0.6-2.0	0.12-0.14 0.18-0.20 0.20-0.22	6.1-7.3 6.6-7.3 6.6-8.4	High--------- High--------- Moderate-----	0.28 0.43 0.43	5	4	3-5
Bo--------------- Blencoe	0-25 25-36 36-60	38-55 35-50 15-24	1.35-1.45 1.30-1.35 1.35-1.40	0.2-0.6 0.2-2.0 0.6-2.0	0.12-0.14 0.18-0.20 0.20-0.22	6.1-7.3 6.6-7.3 6.6-8.4	High--------- High--------- Moderate-----	0.28 0.43 0.43	5	4	3-5
Bs--------------- Blyburg	0-19 19-60	10-20 10-20	1.20-1.40 1.30-1.50	0.6-2.0 0.6-2.0	0.21-0.24 0.17-0.22	6.6-8.4 7.9-8.4	Low----------- Low-----------	0.32 0.43	5	5	1-2
BtG*: Boone----------- Rock outcrop.	 0-8 8-21 21-60	 2-6 0-3 ---	 1.55-1.65 1.55-1.70 ---	 6.0-20 6.0-20 ---	 0.10-0.12 0.06-0.08 ---	 5.1-6.5 5.1-6.5 ---	 Low----------- Low----------- -------------	 0.15 0.15 ----	 3	 2	 <1
BuD2, BuE2------- Burchard	0-8 8-30 30-60	27-35 27-35 27-35	1.40-1.60 1.40-1.60 1.40-1.60	0.2-0.6 0.2-0.6 0.2-0.6	0.17-0.19 0.15-0.17 0.14-0.16	5.6-7.3 6.6-7.8 7.4-8.4	Moderate----- Moderate----- Moderate-----	0.32 0.32 0.32	5	6	1-3
Ca, Cb----------- Calco	0-39 39-60	27-33 22-32	1.25-1.30 1.30-1.45	0.2-0.6 0.2-0.6	0.21-0.23 0.18-0.20	7.4-8.4 7.4-8.4	High--------- Moderate-----	0.28 0.28	5	7	5-7
Cd--------------- Carr	0-8 8-60	5-15 5-15	1.50-1.75 1.50-1.75	0.6-2.0 2.0-6.0	0.20-0.22 0.13-0.18	7.4-8.4 7.4-8.4	Low----------- Low-----------	0.32 0.24	5	5	<1
Cf--------------- Colo	0-12 12-42 42-60	20-26 32-36 28-35	1.25-1.30 1.25-1.35 1.35-1.45	0.2-0.6 0.2-0.6 0.2-0.6	0.22-0.24 0.18-0.20 0.18-0.20	6.6-7.3 6.1-7.3 6.1-7.3	Moderate----- High--------- High---------	0.28 0.28 0.28	5	6	3-5
Cg--------------- Colo	0-30 30-38 38-60	27-32 32-36 28-35	1.28-1.32 1.25-1.35 1.35-1.45	0.2-0.6 0.2-0.6 0.2-0.6	0.21-0.23 0.18-0.20 0.18-0.20	5.6-7.3 6.1-7.3 6.1-7.3	High--------- High--------- High---------	0.28 0.28 0.28	5	7	5-7
CrD2, CrE2------- Crofton	0-6 6-60	20-27 15-27	1.10-1.20 1.20-1.30	0.6-2.0 0.6-2.0	0.21-0.24 0.18-0.22	7.4-8.4 7.4-8.4	Low----------- Low-----------	0.43 0.43	5	4L	<1
Fm--------------- Fillmore	0-18 18-48 48-60	18-35 45-55 32-40	1.30-1.40 1.30-1.50 1.10-1.40	0.6-2.0 <0.06 0.2-0.6	0.21-0.24 0.11-0.14 0.18-0.20	5.6-6.5 5.6-7.8 6.6-7.8	Moderate----- High--------- High---------	0.37 0.37 0.37	4	6	3-4
Fo--------------- Forney	0-9 9-60	40-60 50-60	1.30-1.35 1.35-1.45	<0.06 <0.06	0.11-0.13 0.11-0.13	6.1-7.8 6.1-7.8	High--------- High---------	0.28 0.28	5	4	2-4
Gb--------------- Grable	0-8 8-21 21-60	18-27 12-16 2-10	1.20-1.25 1.30-1.45 1.20-1.50	0.6-2.0 0.6-2.0 6.0-20	0.22-0.24 0.20-0.22 0.02-0.07	7.4-8.4 7.4-8.4 7.4-8.4	Low----------- Low----------- Low-----------	0.32 0.43 0.15	4	4L	1-3
He, Hf----------- Haynie	0-60	15-25	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	Low-----------	0.37	5	4L	1-3

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
Hg---------------- Haynie Variant	0-50	15-25	1.20-1.35	0.6-2.0	0.20-0.24	7.4-8.4	Low----------	0.37	5	4L	1-3
	50-60	40-60	1.10-1.20	0.06-0.2	0.10-0.13	6.6-8.4	High---------	0.28			
Hp---------------- Holly Springs	0-28	30-40	1.20-1.30	0.2-0.6	0.21-0.23	7.4-8.4	High---------	0.28	5	4	2-4
	28-60	40-50	1.10-1.20	<0.06	0.11-0.13	7.4-8.4	High---------	0.28			
IdD2, IdE, IdE2, IdF, IdF2, IdG-- Ida	0-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.43	5-4	4L	<1
JuC--------------- Judson	0-34	25-32	1.30-1.35	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.28	5	7	4-5
	34-60	25-32	1.35-1.45	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.43			
Kg, Ko------------ Kennebec	0-46	26-30	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	6	5-6
	46-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43			
Lu---------------- Luton	0-27	45-60	1.30-1.35	<0.06	0.12-0.14	6.6-7.8	High---------	0.28	5	4	3-5
	27-46	50-65	1.30-1.35	<0.06	0.12-0.14	6.6-7.8	High---------	0.28			
	46-60	40-60	1.35-1.45	<0.06	0.11-0.13	6.6-8.4	High---------	0.28			
Ma, MaC, MaC2, Mb--------------- Marshall	0-15	27-35	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7	3-4
	15-33	27-34	1.30-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	33-60	22-27	1.30-1.40	0.6-2.0	0.20-0.22	6.6-7.3	Moderate-----	0.43			
Mk---------------- Modale	0-24	12-22	1.20-1.30	0.6-2.0	0.21-0.23	7.4-8.4	Moderate-----	0.37	5	4L	1-3
	24-60	50-60	1.35-1.45	<0.2	0.11-0.13	7.4-8.4	High---------	0.28			
MnD, MnD2, MnE, MnE2------------ Monona	0-11	20-27	1.25-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5-4	6	1-4
	11-30	24-28	1.30-1.35	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43			
	30-60	18-24	1.35-1.40	0.6-2.0	0.20-0.22	6.6-8.4	Moderate-----	0.43			
Mo, MoC, MoC2, MoD, MoD2, Mt--- Moody	0-11	27-35	1.25-1.30	0.2-0.6	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	7	1-4
	11-46	27-35	1.20-1.30	0.2-0.6	0.17-0.20	6.1-7.8	Moderate-----	0.43			
	46-60	20-30	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	Moderate-----	0.43			
NoD, NoD2, NoE, NoE2------------ Nora	0-10	27-35	1.20-1.25	0.6-2.0	0.19-0.22	6.1-7.3	Moderate-----	0.32	5	7	1-4
	10-20	27-35	1.25-1.35	0.6-2.0	0.17-0.20	6.1-7.3	Moderate-----	0.43			
	20-60	18-30	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	Moderate-----	0.43			
Om---------------- Omadi	0-22	12-20	1.30-1.40	0.6-2.0	0.22-0.24	6.6-8.4	Low----------	0.32	5	5	1-2
	22-60	18-25	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43			
On---------------- Onawa	0-8	38-55	1.30-1.35	0.06-0.2	0.12-0.14	7.4-8.4	High---------	0.32	5	4	2-3
	8-24	50-60	1.30-1.40	0.06-0.2	0.12-0.14	7.4-8.4	High---------	0.32			
	24-60	12-18	1.40-1.50	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43			
Ow---------------- Owego	0-14	40-50	1.30-1.35	<0.06	0.12-0.14	6.1-7.8	High---------	0.32	5	4	2-4
	14-25	15-30	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	0.32			
	25-60	48-58	1.35-1.45	<0.06	0.11-0.13	7.4-8.4	High---------	0.32			
Pe---------------- Percival	0-19	40-60	1.30-1.35	0.06-0.2	0.12-0.14	7.4-8.4	High---------	0.28	4	4	1-2
	19-60	2-12	1.30-1.50	6.0-20	0.06-0.08	7.4-8.4	Low----------	0.15			
Pg*. Pits											
Sa---------------- Salix	0-19	26-30	1.25-1.30	0.6-2.0	0.21-0.23	6.1-7.8	Moderate-----	0.28	5	6	3-4
	19-26	28-38	1.30-1.35	0.6-2.0	0.18-0.20	6.1-7.8	Moderate-----	0.43			
	26-60	16-22	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.43			
SbC--------------- Sarpy	0-4	2-5	1.20-1.50	6.0-20	0.05-0.09	6.6-8.4	Low----------	0.15	5	1	<1
	4-60	2-5	1.20-1.50	6.0-20	0.05-0.09	6.6-8.4	Low----------	0.15			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
SgC*:											
Sarpy-----------	0-4	2-5	1.20-1.50	6.0-20	0.05-0.09	6.6-8.4	Low-----------	0.15	5	1	<1
	4-60	2-5	1.20-1.50	6.0-20	0.05-0.09	7.4-8.4	Low-----------	0.15			
Grable Variant--	0-6	15-25	1.30-1.40	0.6-2.0	0.22-0.24	7.9-8.4	Low-----------	0.32	5	4L	1-2
	6-21	10-20	1.40-1.50	0.6-2.0	0.17-0.19	7.9-8.4	Low-----------	0.32			
	21-60	0-8	1.60-1.70	6.0-20	0.05-0.07	7.4-7.8	Low-----------	0.15			
So--------------- Solomon	0-20	40-55	1.35-1.45	<0.06	0.11-0.15	7.4-8.4	High----------	0.28	5	4	2-4
	20-60	40-55	1.35-1.45	<0.06	0.09-0.14	7.9-9.0	High----------	0.28			
StF2------------- Steinauer	0-7	27-35	1.30-1.60	0.2-0.6	0.17-0.19	7.4-8.4	Moderate------	0.32	5	4L	.5-1
	7-25	27-35	1.30-1.60	0.2-0.6	0.15-0.17	7.9-8.4	Moderate------	0.32			
	25-60	16-30	1.30-1.60	0.2-2.0	0.14-0.19	7.9-8.4	Moderate------	0.32			
Wo--------------- Woodbury	0-22	40-55	1.30-1.35	0.06-0.2	0.12-0.14	6.1-7.3	High----------	0.28	5	4	3-5
	22-36	40-50	1.30-1.35	0.06-0.2	0.11-0.13	6.1-6.5	High----------	0.43			
	36-42	28-35	1.30-1.40	0.2-0.6	0.18-0.20	6.6-7.8	High----------	0.43			
	42-60	20-27	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	Moderate------	0.43			
Zn--------------- Zook	0-22	20-26	1.30-1.35	0.6-2.0	0.22-0.24	5.6-7.8	Moderate------	0.28	5	6	3-4
	22-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28			
Zo--------------- Zook	0-20	32-38	1.25-1.30	0.2-0.6	0.21-0.23	5.6-7.8	High----------	0.28	5	7	5-7
	20-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28			
Zw--------------- Zook	0-40	40-46	1.20-1.30	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28	5	4	5-7
	40-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The terms "flooding" and "water table" are described in the section "Soil and water features" as are "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth*	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ab----------------- Albaton	D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Low.
Ac----------------- Albaton	D	Frequent----	Very long	Nov-Jun	+.5-2.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
Be, Bf------------- Belfore	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Bn----------------- Blencoe	D	Occasional	Brief-----	Feb-Nov	2.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Bo----------------- Blencoe	D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Bs----------------- Blyburg	B	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.
BtG**:												
Boone-------------	A	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low------	Moderate.
Rock outcrop.												
BuD2, BuE2--------- Burchard	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ca----------------- Calco	B/D	Occasional	Brief-----	Feb-Nov	1.5-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Cb----------------- Calco	B/D	Occasional	Brief-----	Feb-Nov	0-2.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Cd----------------- Carr	B	Occasional	Very brief	Mar-Sep	>6.0	---	---	>60	---	Low------	Low------	Low.
Cf, Cg------------- Colo	B/D	Occasional	Very brief to long.	Feb-Nov	2.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
CrD2, CrE2--------- Crofton	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Fm----------------- Fillmore	D	None--------	---	---	+.5-1.0	Perched	Mar-Jul	>60	---	High-----	High-----	Low.
Fo----------------- Forney	D	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	Moderate	High-----	Low.
Gb----------------- Grable	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	Low------	Low------	Low.
He----------------- Haynie	B	Rare--------	---	---	>6.0	---	---	>60	---	High-----	Low------	Low.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth*	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Hf: Haynie	B	Occasional	Very brief	Feb-Nov	>6.0	---	---	>60	---	High	Low	Low.
Hg: Haynie Variant	B	Rare	---	---	2.0-4.0	Perched	Mar-Jun	>60	---	High	Low	Low.
Hp: Holly Springs	D	Occasional	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High	High	Low.
IdD2, IdE, IdE2, IdF, IdF2, IdG: Ida	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
JuC: Judson	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
Kg: Kennebec	B	Frequent	Brief	Feb-Nov	4.0-5.0	---	---	>60	---	High	Moderate	Low.
Ko: Kennebec	B	Occasional	Brief	Feb-Nov	4.0-5.0	Apparent	Nov-Jul	>60	---	High	Moderate	Low.
Lu: Luton	D	Occasional	Brief	Mar-Jun	1.0-3.0	Apparent	Nov-Jul	>60	---	Moderate	High	Low.
Ma, MaC, MaC2, Mb: Marshall	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
Mk: Modale	C	Occasional	Brief	Feb-Nov	2.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
MnD, MnD2, MnE, MnE2: Monona	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
Mo, MoC, MoC2, MoD, MoD2, Mt: Moody	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
NoD, NoD2, NoE, NoE2: Nora	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
Om: Omadi	B	Rare	---	---	5.0-8.0	---	---	>60	---	High	Low	Low.
On: Onawa	D	Occasional	Brief	Feb-Nov	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Low.
Ow: Owego	D	Occasional	Brief	Feb-Nov	2.0-3.0	Apparent	Nov-Jul	>60	---	Moderate	High	Low.
Pe: Percival	C	Occasional	Very brief	Feb-Nov	1.5-3.0	Apparent	Nov-Jul	>60	---	Moderate	High	Low.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth*	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Pg**. Pits												
Sa----------------- Salix	B	Rare---------	---	---	4.0-5.0	Apparent	Nov-Jul	>60	---	High-----	Moderate	Low.
SbC---------------- Sarpy	A	Occasional	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
SgC**:												
Sarpy-------------	A	Occasional	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	Low------	Low.
Grable Variant---	B	Frequent----	Long------	Mar-Jun	1.0-3.0	Apparent	Jan-Jun	>60	---	High-----	Low------	Low.
So----------------- Solomon	D	Occasional	Brief to long.	Nov-May	1.0-2.0	Apparent	Dec-May	>60	---	Moderate	High-----	Low.
StF2--------------- Steinauer	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Wo----------------- Woodbury	D	Occasional	Brief-----	Feb-Nov	2.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Low.
Zn, Zo, Zw-------- Zook	C/D	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.

* The plus sign under "High water table--Depth" indicates ponding.
**See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution							Liquid limit	Plasticity index	Specific gravity
			Percentage passing sieve--				Percentage smaller than--					
	AASHTO[1]	Unified	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm			
										Pct		G/cm3
Luton silty clay:[2] (S74NE-021-012)												
Ap-------- 0 to 8	A-7-6(21)	CH	100	100	100	98	94	58	46	59	32	2.68
B21g-----27 to 34	A-7-6(25)	CH	100	100	100	99	98	61	50	65	39	2.71
C1g------46 to 60	A-7-6(32)	CH	100	100	100	99	99	80	67	86	57	2.70
Modale silt loam:[3] (S74NE-021-002)												
Ap------- 0 to 7	A-4 (07)	ML	100	100	100	71	45	11	9	26	NP	2.67
C1------- 7 to 24	A-4 (08)	ML	100	100	100	81	65	12	11	27	1	2.67
2C2g-----24 to 60	A-7-5(30)	CH	100	100	100	99	99	77	64	78	47	2.69
Monona silt loam:[4] (S76NE-021-001)												
Ap------- 0 to 6	A-6 (09)	ML	100	100	100	99	95	33	25	38	13	2.64
B2-------16 to 33	A-7-6(11)	ML	100	100	100	99	96	31	23	42	16	2.71
C2-------42 to 60	A-7-6(11)	CL	100	100	100	100	96	31	25	41	17	2.75
Omadi silt loam:[5] (S75NE-021-001)												
Ap------- 0 to 9	A-6 (9)	ML	100	100	100	99	92	27	23	38	12	2.63
A12------ 9 to 16	A-7-6(14)	ML	100	100	100	99	97	34	27	49	21	2.65
C--------48 to 60	A-7-6(14)	CL	100	100	100	99	96	37	31	47	21	2.65
Sarpy fine sand:[6] (S74NE-021-003)												
A1------- 0 to 4	A-3 (-2)	SP-SM	100	100	99	6	5	4	2	--	NP	2.65
C1------- 4 to 36	A-3 (-2)	SP-SM	100	100	99	8	6	4	3	--	NP	2.66

[1]The group index number is computed by using the Nebraska modified system.

[2]Luton silty clay: 1,000 feet east and 200 feet north of southwest corner, sec. 17, T. 23 N., R. 11 E.

[3]Modale silt loam: 2,010 feet east and 150 feet south of northwest corner, sec. 29, T. 80 N., R. 45 W.

[4]Monona silt loam: 1,100 feet north and 500 feet west of center of sec. 13, T. 23 N., R. 10 E.

[5]Omadi silt loam: 1,150 feet west and 60 feet south of northeast corner, sec. 1, T. 21 N., R. 10 E.

[6]Sarpy fine sand: 1,500 feet north and 1,400 feet west of southeast corner, sec. 7, T. 20 N., R. 12 E.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Albaton	Fine, montmorillonitic (calcareous), mesic Vertic Fluvaquents
Belfore	Fine, montmorillonitic, mesic Udic Haplustolls
Blencoe	Clayey over loamy, montmorillonitic, mesic Aquic Hapludolls
Blyburg	Coarse-silty, mixed, mesic Fluventic Hapludolls
Boone	Mesic, uncoated Typic Quartzipsamments
*Burchard	Fine-loamy, mixed, mesic Typic Argiudolls
Calco	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Carr	Coarse-loamy, mixed (calcareous), mesic Typic Udifluvents
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Crofton	Fine-silty, mixed (calcareous), mesic Typic Ustorthents
Fillmore	Fine, montmorillonitic, mesic Typic Argialbolls
*Forney	Fine, montmorillonitic, nonacid, mesic Vertic Fluvaquents
Grable	Coarse-silty over sandy or sandy-skeletal, mixed (calcareous), mesic Mollic Udifluvents
Grable Variant	Coarse-silty over sandy or sandy-skeletal, mixed (calcareous), mesic Mollic Fluvaquents
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Haynie Variant	Coarse-silty, mixed (calcareous), mesic Aquic Udifluvents
Holly Springs	Fine, montmorillonitic (calcareous), mesic Cumulic Haplaquolls
Ida	Fine-silty, mixed (calcareous), mesic Typic Udorthents
Judson	Fine-silty, mixed, mesic Cumulic Hapludolls
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Luton	Fine, montmorillonitic, mesic Vertic Haplaquolls
Marshall	Fine-silty, mixed, mesic Typic Hapludolls
Modale	Coarse-silty over clayey, mixed (calcareous), mesic Aquic Udifluvents
Monona	Fine-silty, mixed, mesic Typic Hapludolls
Moody	Fine-silty, mixed, mesic Udic Haplustolls
Nora	Fine-silty, mixed, mesic Udic Haplustolls
Omadi	Fine-silty, mixed, mesic Fluventic Hapludolls
Onawa	Clayey over loamy, montmorillonitic (calcareous), mesic Mollic Fluvaquents
Owego	Fine, montmorillonitic, nonacid, mesic Mollic Fluvaquents
Percival	Clayey over sandy or sandy-skeletal, montmorillonitic (calcareous), mesic Aquic Udifluvents
Salix	Fine-silty, mixed, mesic Typic Hapludolls
Sarpy	Mixed, mesic Typic Udipsamments
Solomon	Fine, montmorillonitic (calcareous), mesic Vertic Haplaquolls
Steinauer	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Woodbury	Fine, montmorillonitic, mesic Vertic Haplaquolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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