SOIL SURVEY

OF

Mercer County, North Dakota

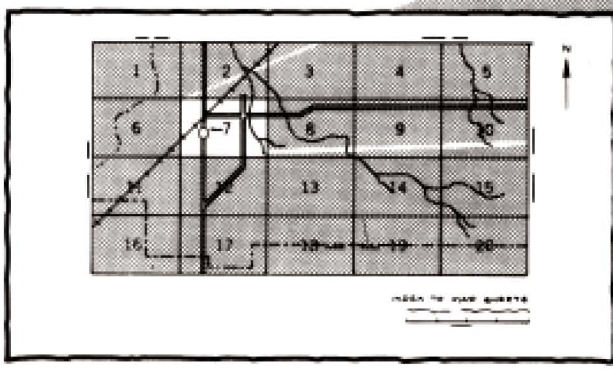
U S. Department of Agriculture
Soil Conservation Service

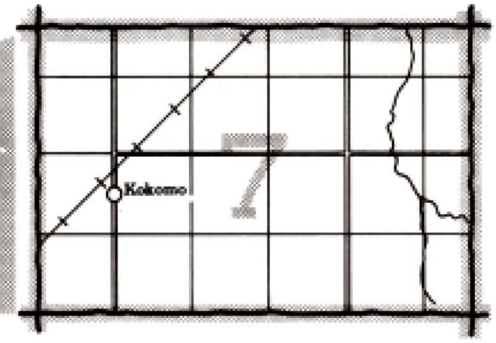
in cooperation with

U. S. Department of the Interior
Bureau of Indian Affairs and
North Dakota Agricultural Experiment Station

HOW TO USE

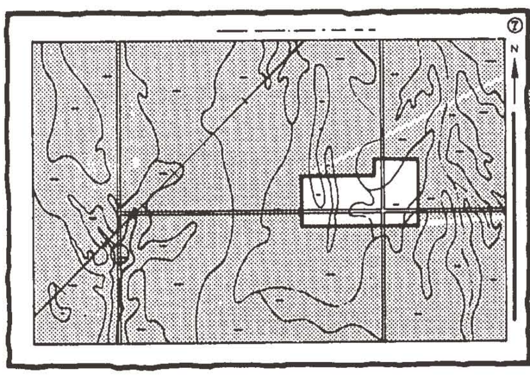
1. Locate your area of interest on the "Index to Map Sheets"

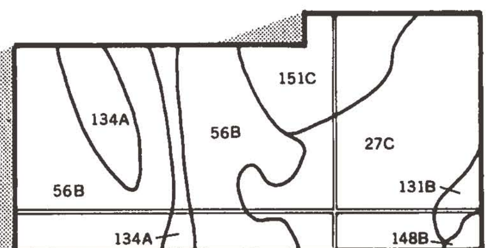




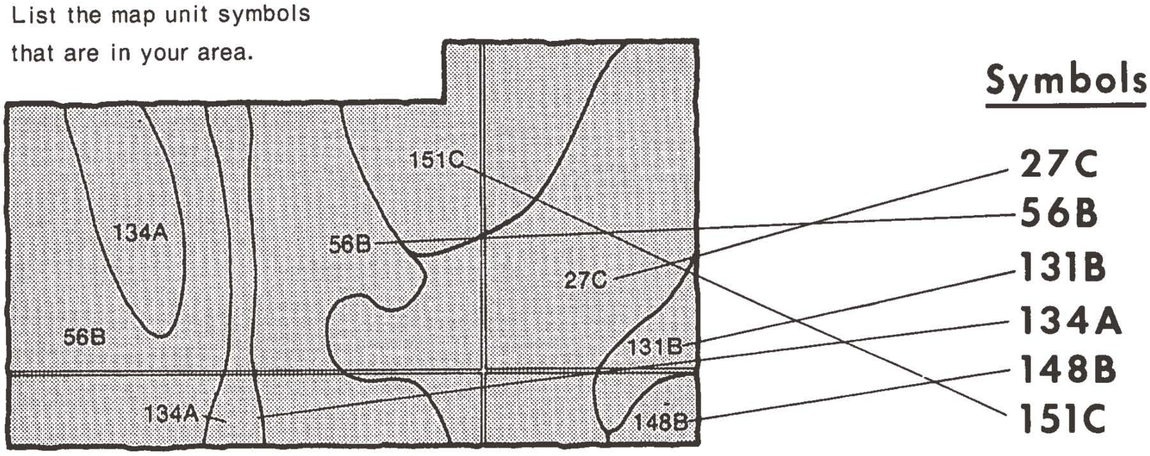
2. Note the number of the map sheet and turn to that sheet.

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



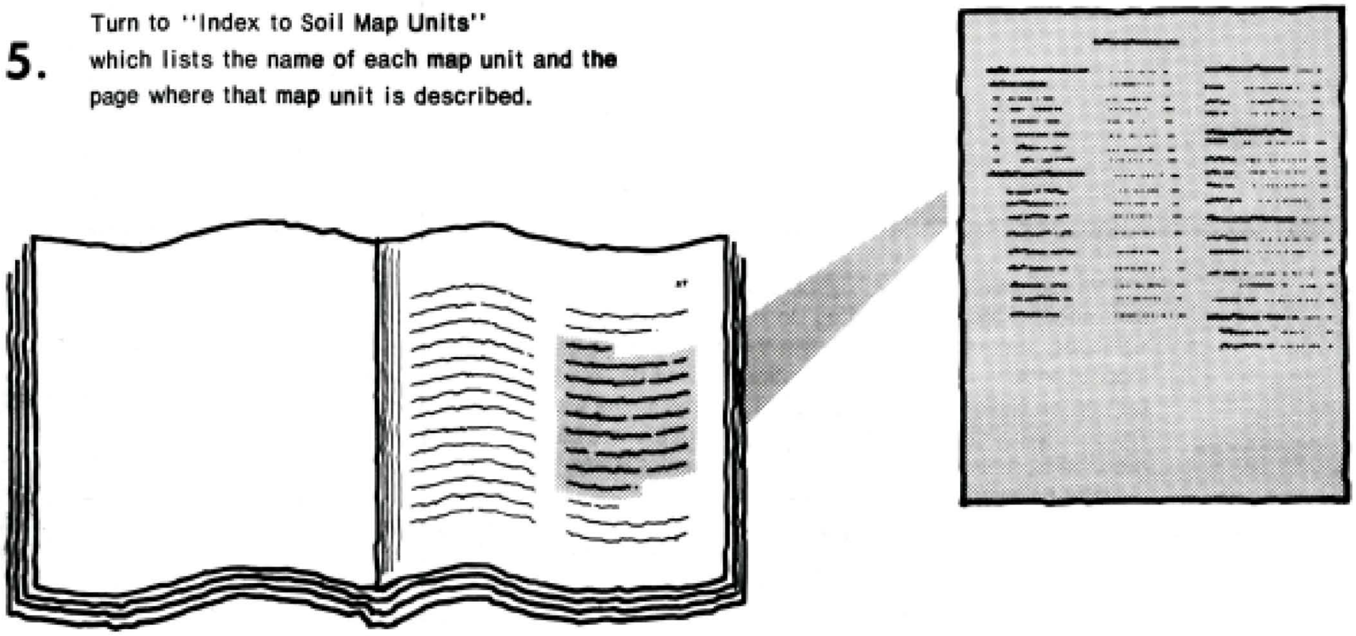


4. List the map unit symbols that are in your area.

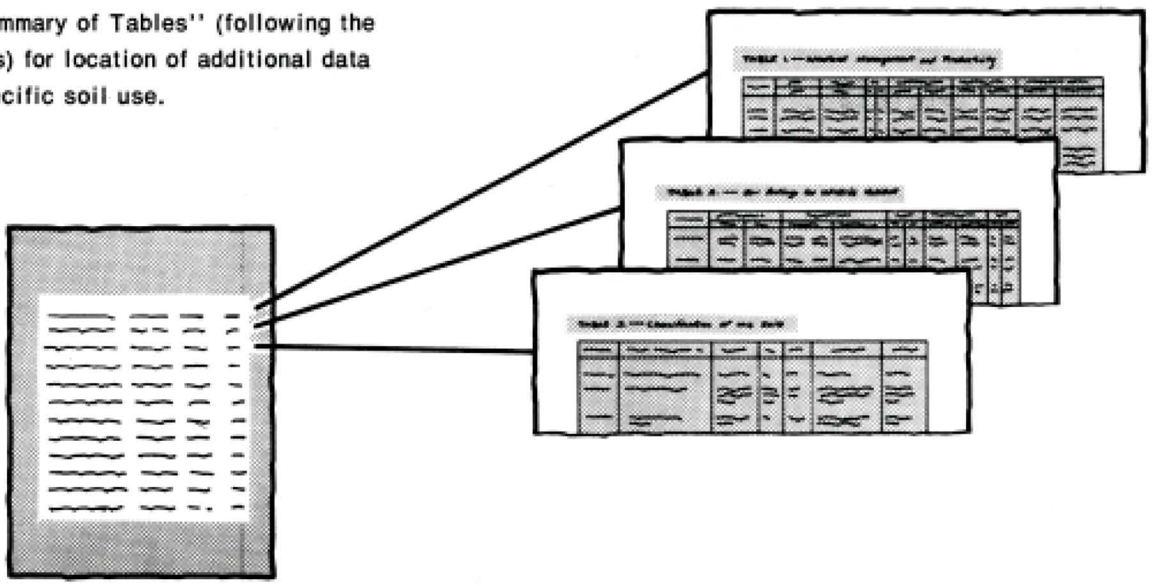


THIS SOIL SURVEY

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 is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. 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 completed in the period 1970-75. Soil names and descriptions were approved in 1976. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service, the United States Department of the Interior, Bureau of Indian Affairs, and the North Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the Mercer County Soil Conservation District. Financial assistance was provided by the Mercer County Board of Commissioners.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Contents

Issued December 1978

Contents—Continued

Index to Soil Map Units

Index to Soil Map Units—Continued

Summary of Tables

Foreword

The Soil Survey of Mercer County, North Dakota contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

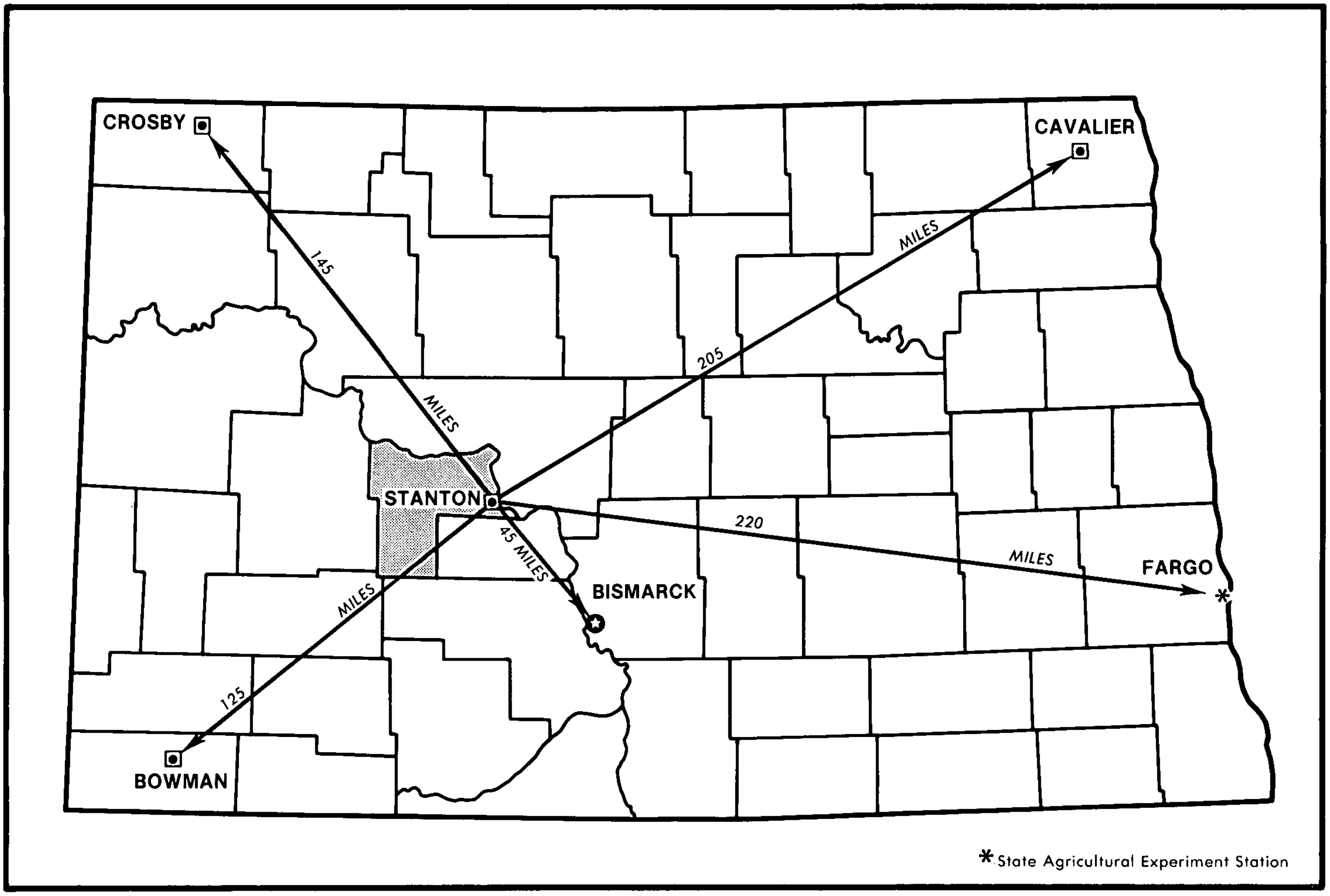
This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Allen L. Fisk
State Conservationist
Soil Conservation Service



Location of Mercer County in North Dakota.

SOIL SURVEY OF MERCER COUNTY, NORTH DAKOTA

By Francis J. Wilhelm, Soil Conservation Service

Fieldwork by Frederick P. Aziz, Kevin J. Dalsted, Kenneth W. Thompson, Paul K. Weiser, and Francis J. Wilhelm, Soil Conservation Service

U. S. Department of Agriculture, Soil Conservation Service, in cooperation with U. S. Department of the Interior, Bureau of Indian Affairs, and North Dakota Agricultural Experiment Station

MERCER COUNTY is in the west-central part of North Dakota (see facing page). The county has a total area of 710,400 acres, of which 666,560 acres, or 1,041 square miles, is land area and 43,840 acres is water area. Most of the water area is part of Lake Sakakawea.

The county is part of the Missouri Slopes vegetative zone and the Rolling Soft Shale Plains Land Resource Area of the Northern Great Plains. It is within the Missouri River Basin and is bounded on the north by Lake Sakakawea and on the east by the Missouri River.

The Knife River has cut a valley from the western boundary to the Missouri River on the eastern boundary. The part of the county north of the Knife River is mostly a glaciated upland plain interspersed with residual uplands. Immediately south of the Knife River are wind- and water-deposited sand and silt. The southwestern part of the county is a residual upland plain that has remnants of glacial till deposits. The elevation ranges from about 1,670 feet where the Missouri River leaves the county to about 2,400 feet in the southwestern part of the county.

General nature of the county

This section provides general information about the county. It describes climate, settlement, natural resources, and farming.

Climate

Mercer County has a semiarid continental climate. Moisture deficiency determines more than any other factor the production of crops and range grasses. A short period of drought coupled with hot, dry, southerly winds can result in a poor crop even though precipitation is near normal. Cool weather throughout the early and middle parts of the growing season can result in a fair crop even though rainfall during the growing season is substantially below normal.

Rainfall normally is adequate for the crops commonly grown in most areas in the northern part of the county. The lower available water capacity of the sandier soils south of the Knife River results in local drought conditions nearly every year. Crops grown on many soils in the southwestern part of the county also are subject to drought in most years because of excessive runoff, excess sodium salts, low available water capacity, and soft bedrock within a depth of 40 inches.

Frost can occur locally every month of the year but rarely occurs during June, July, or August. The average length of the growing season is about 115 days. Some of the farmers living within 5 miles of Lake Sakakawea indicate that the length of the growing season has increased by about 10 days since the closure of Garrison Dam. Winds blowing across the lake probably prevent early frost damage, but no data are available to substantiate this fact. Frost penetration averages about 4.5 feet, but it can be less than 2 feet when the soil is dry, the snow cover is substantial, and temperature is mild. Under opposite conditions, frost penetration can be as much as 7 feet (*3*).

Mercer County is usually warm in summer and has frequent spells of hot weather and occasional cool days. It is very cold in winter, when arctic air frequently surges over the county. Most precipitation falls during the warm period, and precipitation is normally heaviest late in spring and early in summer. Snowfall is normally not heavy, and the snow is blown into drifts so that much of the ground has no snow cover.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Beulah, North Dakota for the period 1955 to 1974. 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 12 degrees F, and the average daily minimum temperature is 1 degree. The lowest temperature on record, which occurred at Beulah on January 29, 1966, is minus 42 degrees. In summer the average temperature is 67 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on July 20, 1960, is 108 degrees.

Growing degree days, shown in table 1, 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 (40 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.

Of the total annual precipitation, 14 inches, or 88 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 11 inches. The heaviest 1-day rainfall during the period of record was 4.18 inches at Beulah on July 18, 1969. Thunderstorms occur on about 34 days each year, and 26 of these days are in summer.

Average seasonal snowfall is 28 inches. The greatest snow depth at any one time during the period of record was 17 inches. On the average, 51 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 in summer and 53 in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 13 miles per hour, in April.

Blizzards occur several times each winter. Hail accompanies summer thunderstorms in small scattered areas.

Settlement

The earliest known inhabitants of what is now Mercer County were the argicultural Indians now called the Mandan, Rees, and Grosventre. The Assinobines, Crows, Cheyennes, and Sioux were frequent visitors to the area. Traces of Indian villages and temporary camps are evident throughout the county, particularly along the major streams.

The Spanish adventurers may have been the first to come in contact with the Indians along the upper Missouri River system. The first documented visit of an explorer to Mercer County, however, was that of Chevalier de la Verendrye, a French Canadian who visited the Mandans in 1738. In 1802, Charles Le Raye, another French Canadian explorer, visited the Mandan and Grosventre villages along the Knife River. In 1804, Lewis and Clark, on an expedition sent out by President Jefferson to explore the Louisiana Territory, visited the Indian villages in the vicinity of what is now Stanton. There they met Sakakawea, who was chosen to guide the expedition to the Pacific Ocean.

Mercer County was designated and named by a legislative act of 1883, before the Dakota Territory was reorganized into the States of North and South Dakota. The present boundaries were established in 1885, when part of Oliver County was separated from Mercer County, and Mercer County gained nine townships in the southwestern part of the county (*6*).

The first settlement was a Swedish settlement near Fort Clark along the Missouri River. It was started by Goran Alderin in 1882. The largest group of settlers were the German immigrants from Russia. Most of these immigrants settled north of the Knife River. Ownership of land was obtained through the Homestead Act or the purchase of inexpensive railroad land. Most of the population consists of descendants of these immigrants.

The population of Mercer County was 254 in 1885, increased rapidly until 1910, and began to decrease in 1940. It was 9,611 in 1940, 8,686 in 1950, and 6,175 in 1970. Since 1970, it has increased, particularly in the towns of Beulah and Hazen. The increase can be attributed to the industries resulting from the mining of lignite coal. Stanton, the county seat, has a population of about 517, according to the 1970 census. Beulah and Hazen are the largest towns. Beulah has a population of about 1,650, according to an unofficial census in 1975, and Hazen has a population of about 1,560, according to an official census in the same year. Other communities in the county are Golden Valley, Zap, and Pick City.

Natural resources

Soil is the most important natural resource in the county. Livestock that graze the grassland and crops produced on farms are marketable products that are affected by the soil.

Most of the county has adequate water for domestic use and for use as livestock water. Important artesian aquifers are in the Fox Hills and Hell Creek Formations of Late Cretaceous age and the Tongue River Formation of Tertiary age. The water from these aquifers is suitable for livestock, for domestic use, and for some industrial uses, but it is probably not suitable for irrigation. Glacial outwash and alluvial deposits form potentially productive aquifers suitable for irrigation. These aquifers are beneath the valleys of Antelope, Elm, Goodman, and Spring Creeks and the Knife and Missouri Rivers (*5*).

Most of the water used as domestic and livestock water on farms is derived from the lignite coal veins in Ft. Union shale. Lake Sakakawea water behind the Garrison Dam on the Missouri River and water from the Missouri River are suitable for irrigation, for livestock, and for domestic and industrial uses. Water from the other major streams is of limited value because of low flow and a high content of soluble salts.

A vast amount of lignite coal is in Mercer County. Of the approximately 7.5 million tons of lignite coal mined in North Dakota in 1974, about 5 million tons was mined in Mercer County (*9*). It is estimated that Mercer County has lignite reserves of about 29,900 million tons (*4*). Three major mining companies operate in the county. Most of the coal is used in four steam-powered electric generating plants, and the rest is exported to other areas of the country. Plans for a plant that would convert lignite coal to synthetic gas have been proposed.

A few areas of sand and gravel deposits may have commercial value. Some of these deposits have been mined. Porcelanite (scoria) is in many areas of the county. It is used for surfacing secondary roads. Other potentially important natural resources are oil and natural gas deposits. Several test drills have indicated oil shows, but the oil is of no commercial value (*4*). Clay from the lower member of the Golden Valley Formation is used as raw material for making bricks. The Golden Valley Formation is moderately extensive in the county.

Farming

The first settlers were mostly farmers. Prior to settlement, the soils were used by large cattle companies as open grazing land. Farming was promoted by the sale of railroad land and by the Homestead Act. Most of the first farms were on the glacial till plain north of the Knife River. Ranches were established in the southwestern part of the county. Most of the farms are diversified, deriving income from beef-cow-calf operations and small grain. Ranches deriving most of the income from beef-cow-calf operations are dominant south of the Knife River. These ranches also derive some income from the production of small grain.

The number of farms in the county increased until the 1930's. The depression and prolonged drought of the thirties forced many landowners to abandon their farms. The number of farms decreased from 1,204 in 1935 to 852 in 1954. It continued to decrease in the period 1954 through 1975 but at a much slower rate. In 1975, a total of 806 farms were managed by 625 different operators. The average size of the farms increased from 527 acres in 1935 to 827 acres in 1975, according to the Agricultural Stabilization and Conservation Service.

About 282,000 acres, or 43 percent, of the land area is used as cropland. The rest is mostly in native grass and is used as rangeland or hayland. Almost 40 percent of the cropland is used for the production of hard red spring wheat, which is a cash crop. The average yield of spring wheat is 24 bushels per acre. Crops that are used primarily as feed for livestock are oats, corn cut for silage, and alfalfa and other tame grasses and legumes. Other commonly grown cash crops are barley and flax. Winter wheat has been planted by several farmers without any consistent success. The total income from the sale of livestock is about the same as that from the sale of cash grains.

The East Mercer County Soil Conservation District, which was organized in 1948, included all of Mercer County east of range 88 and three townships in the northwestern part of Oliver County. These townships were transferred to the Oliver County Soil Conservation District in 1959. The West Mercer County Soil Conservation District was organized in 1951. The organization of these Soil Conservation Districts enabled the Soil Conservation Service to establish an office in Mercer County. The two districts merged in 1964, forming the Mercer County Soil Conservation District.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. 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; the kinds of rock; and many facts about the soils. They dug many holes to expose 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 the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices 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 is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land-use planning

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

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it 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 kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

As a result of changes in series concepts, differing soil patterns, and differences in the design of map units, some of the boundaries and soil names on the Mercer County general soil map do not match those on the general soil maps of Oliver, Stark, and Morton Counties.

Map unit descriptions

Soils formed in glacial till and in loess over glacial till on uplands

These soils are on a glacial till plain in the northern half of the county. In places the plain has a thin mantle of loess. The soils make up about 23 percent of the county. They formed in material weathered from loamy glacial till and in silty loess deposits overlying glacial till. They are mostly nearly level to rolling.

1. Williams-Zahl

Undulating to rolling, deep, well drained soils formed in material weathered from loamy glacial till

These soils are in the northern part of the county. They are on a glacial till plain that has small areas of nearly level ground moraines and steep drainageways. They are partly drained by intermittent streams, but in some small scattered areas where the landscape is characterized by potholes and depressions, the drainage system is closed.

This map unit occupies about 7 percent of the county. It is about 55 percent Williams soils, 15 percent Zahl soils, and 30 percent soils of minor extent (fig. 1).

The undulating to rolling Zahl soils are on the tops of knobs, hills, and ridges and along drainageways. The undulating or gently rolling Williams soils are on the lower side slopes below the Zahl soils. Both soils have a loam surface layer.

The most extensive minor soils in this map unit are Arnegard, Bowbells, Bowdle, Parnell, Tonka, and Wabek soils. The very poorly drained Parnell soils and the poorly drained Tonka soils occupy the depressions or potholes. The well drained Arnegard and Bowbells soils are in the swales and the slightly concave areas. The Bowdle soils, which are moderately deep over sand and gravel, and the Wabek soils, which are shallow over sand and gravel, are in small areas of glacial outwash and on eskers.

About 75 percent of the acreage is used for cultivated crops. The rest is in native grass and is used as rangeland and hayland. The Parnell and Tonka soils are used mostly for grazing, hay, or wildlife habitat. The hazards of soil blowing and water erosion are the main limitations for farming. Slope, moderately slow permeability, and a moderate shrink-swell potential are the major limitations for most uses.

This map unit has good to fair potential for cultivated crops where Williams soils dominate and where slopes are less than about 9 percent. Where slopes are steeper than about 9 percent and where Zahl soils are dominant, it is generally unsuited to cultivated crops. It is best suited to rangeland.

The major soils have good potential for rangeland, for openland wildlife habitat, and for urban and residential uses and fair potential for rangeland wildlife habitat. The Parnell and Tonka soils have good potential for wetland wildlife habitat.

2. Williams-Bowbells

Nearly level to gently rolling, deep, well drained soils formed in material weathered from loamy glacial till

These soils are in the northeastern part of the county. They are on a glacial till plain that has small areas of level glacial lake plains, rolling moraines, and moderately steep or steep drainageways. They are partly drained by intermittent streams, but in many small scattered areas where the landscape is characterized by potholes and depressions, the drainage system is closed.

This map unit occupies about 12 percent of the county. It is about 55 percent Williams soils, 20 percent Bowbells soils, and 25 percent soils of minor extent.

The nearly level or undulating Bowbells soils are on the plane and slightly concave, mid and lower side slopes and in swales. The nearly level to gently rolling Williams soils are on the plane and convex ridges, knobs, and upper side slopes above the Bowbells soils. Both soils have a loam surface layer.

The most extensive minor soils in this map unit are Arnegard, Cabba, Makoti, Parnell, Straw, Tonka, and Zahl soils and Ustorthents.

About 75 percent of the acreage is used for cultivated crops. The rest is in native grass and is used as rangeland and hayland. The Parnell and Tonka soils are used dominantly for grazing, hay or wildlife habitat, but some drained areas are used for cultivated crops. The Ustorthents are used mostly for wildlife habitat, but some areas are used for limited grazing. The hazards of soil blowing and water erosion are the main limitations for farming. Moderately slow permeability, the shrink-swell potential, and potential frost action are the major limitations for most other uses.

This map unit has good potential for cultivated crops. The Cabba and Zahl soils and Ustorthents are generally unsuited to cultivated crops. The Cabba and Zahl soils are best suited to rangeland and have good potential for range grasses. Ustorthents have poor potential for rangeland and wildlife habitat.

The major soils have good potential for openland and rangeland wildlife habitat and urban and residential uses. The Parnell and Tonka soils have good potential for wetland wildlife habitat. Part of this map unit is underlain by lignite coal, some of which has been mined.

3. Williams-Wilton-Temvik

Nearly level or undulating, deep, well drained soils formed in material weathered from glacial till and loess

These soils are in the northern and eastern parts of the county. They are on a loess-mantled glacial till plain that has small areas of gently rolling or rolling moraines and moderately steep or steep drainageways. They are partly drained by intermittent streams, but in a few small scattered areas where the landscape is characterized by potholes and depressions, the drainage system is closed.

This map unit occupies about 4 percent of the county. It is about 25 percent Williams soils, 20 percent Wilton soils, 20 percent Temvik soils, and 35 percent soils of minor extent.

The nearly level or undulating Williams soils are on the plane and convex ridges, knobs, and upper side slopes above the Wilton and Temvik soils. The nearly level Wilton soils are on the plane and slightly concave, lower side slopes and in swales. The undulating Temvik soils are on the plane and convex, mid and upper side slopes. The Temvik and Wilton soils are in areas where deposits of loess are thin. All three soils have a silt loam surface layer.

The most extensive minor soils in this map unit are Grassna, Mandan, and Zahl soils. The well drained Grassna soils are in swales and slightly concave areas where deposits of loess are thick. The well drained Mandan soils are in the slightly higher lying areas where deposits of loess are thick. The well drained Zahl soils are on the tops of knobs and ridges and along drainageways.

About 90 percent of the acreage is used for cultivated crops. The rest is in native grasses and is used as rangeland and hayland. The hazards of soil blowing and water erosion are the main limitations for farming. Moderately slow permeability, the shrink-swell potential, and potential frost action are the major limitations for most other uses.

This map unit has good potential for cultivated crops. Areas where slopes are steeper and where the Zahl soils are dominant, however, are generally unsuited to cultivated crops. They are best suited to rangeland and have good potential for range grasses. The map unit has good potential for openland wildlife habitat and fair potential for rangeland wildlife habitat. It has good potential for urban and residential uses.

Soils formed in glacial till and in sandy and loamy water- and wind-sorted sediments on uplands

These soils are along the Knife River and Spring Creek. They are on a sandy upland plain and a glacial till plain, much of which is mantled with loamy and sandy sediments. They are nearly level to hilly on the sandy upland plain and nearly level to gently rolling on the glacial till plain. They make up about 12 percent of the county. The soils formed in material weathered from sandy and loamy sediments and in glacial till.

4. Flaxton-Williams

Nearly level to gently rolling, deep, well drained loamy soils formed in material weathered from glacial till and from loamy sediments and the underlying glacial till

These soils are south of the Knife River and on both sides of Spring Creek. They are on a glacial till plain, much of which is mantled with wind- or water-sorted loamy sediments. The plain has small areas of rolling moraines and moderately steep or steep drainageways. The soils are partly drained by intermittent streams, but in a few small scattered areas where the landscape is characterized by potholes and depressions, the drainage system is closed.

This map unit occupies about 9 percent of the county. It is about 40 percent Flaxton soils, 20 percent Williams soils, and 40 percent soils of minor extent.

The nearly level to gently rolling Flaxton soils are on the plane and slightly concave, mid and lower side slopes and in swales below the Williams soils. The nearly level to gently rolling Williams soils are on the plane and convex ridges, knobs, and upper side slopes.

The most extensive minor soils in this map unit are Cabba, Parshall, Straw, and Lihen soils and Ustorthents. The strongly sloping to steep Cabba soils, which are shallow over bedrock, are along drainageways. The well drained Straw soils occupy flood plains along streams. The somewhat excessively drained Lihen soils are in areas where sandy deposits are deep. The Parshall soils are in swales and slightly concave areas. Ustorthents are in areas that were formerly mined for lignite coal.

About 50 percent of the acreage is used for cultivated crops. The rest is in native grass and is used as rangeland

and hayland. The Cabba soils are used mostly as rangeland, and the Ustorthents are used mostly for wildlife habitat. The hazards of soil blowing and water erosion are the main limitations for farming. In areas where Flaxton soils dominate, the hazard of soil blowing is moderate to severe. Slope, moderately slow permeability, the shrink-swell potential, and potential frost action are the major limitations for most other uses.

This map unit has good to fair potential for cultivated crops. The Cabba and Lihen soils are best suited to rangeland and have fair to good potential for range grasses. Ustorthents have poor potential for rangeland and for wildlife habitat. The major soils have good to fair potential for openland wildlife habitat and fair potential for rangeland wildlife habitat. They have good to fair potential for urban and residential uses. Part of this map unit is underlain by lignite coal, some of which has been mined.

5. Lihen-Seroco-Telfer

Nearly level to hilly, deep, somewhat excessively drained and excessively drained soils formed in material weathered from sandy wind- and water-sorted sediments

These soils are in the southeastern part of the county south of the Knife River. They are on an upland plain that is dissected in small areas by moderately steep or steep drainageways. They are partly drained by intermittent streams, but they absorb most of the precipitation.

This map unit occupies about 3 percent of the county. It is about 30 percent Lihen soils, 20 percent Seroco soils, 20 percent Telfer soils, and 30 percent soils of minor extent (fig. 2).

The nearly level or undulating, somewhat excessively drained Lihen soils are on the mid and lower side slopes and in swales below the Seroco and Telfer soils. The nearly level to hilly, excessively drained Seroco soils are on the plane and convex upper side slopes and on the tops of knobs and hills and are above Telfer soils. The nearly level to rolling, excessively drained Telfer soils are on the plane and convex, mid and upper side slopes and the tops of knobs and hills.

The most extensive minor soils in this map unit are Krem, Flaxton, and Parshall soils and Dune land. The well drained Krem soils are in areas where sandy sediments are moderately deep over glacial till. The well drained Flaxton soils are in areas where loamy sediments overlie glacial till. Parshall soils are in swales and slightly concave areas. Dune land is characterized by actively shifting sand dunes.

Almost all of the acreage is rangeland. A severe hazard of soil blowing and the droughtiness resulting from low available water capacity are the main limitations for rangeland and cultivated crops. Slope, the severe hazard of soil blowing, the sandy texture, and the hazard of ground water contamination are the main limitations for most other uses. A few small scattered clumps of native shrubs are throughout the map unit.

This map unit has fair potential for rangeland. It has poor potential for openland wildlife habitat and good to fair potential for rangeland wildlife habitat. It has poor potential for urban and residential uses. The Flaxton and Parshall soils have good to fair potential for cultivated crops. The Dune land is generally unsuited to most uses, but it has esthetic value. It should be stabilized to prevent serious damage to surrounding vegetation and soils.

Soils formed in glacial till, loess over glacial till, old alluvium, and material weathered from bedrock; on uplands

These soils occur as scattered areas throughout the county. They are on a residual upland plain interspersed with areas of a glacial till plain that in places has a thin mantle of loess. They make up about 31 percent of the county. The soils formed in material weathered from glacial till, in old alluvium, in loess over glacial till, and in loamy and clayey material weathered from soft bedrock. Those on the glacial till plain are undulating to hilly. Those on the residual plain are nearly level to steep. The depth to the underlying soft bedrock varies.

6. Belfield-Williams-Vebar

Nearly level to strongly sloping, deep and moderately deep, well drained soils formed in material weathered from soft bedrock, old alluvium, and glacial till

These soils are in the western part of the county. They are on a glacial and residual upland plain that is crossed by streams and has broad terraces that are dissected by steep drainageways. They are drained by intermittent streams.

This map unit occupies about 4 percent of the county. It is about 20 percent Belfield soils, 15 percent Williams soils, 10 percent Vebar soils, and 55 percent soils of minor extent.

The nearly level or gently sloping Belfield soils are on plains and slightly concave terraces and in swales below the Williams and Vebar soils. They have a silt loam surface layer. The undulating or gently rolling Williams soils are on plane and convex knobs, ridges, and side slopes. They have a loam surface layer. The moderately sloping or strongly sloping Vebar soils are on plane and convex side slopes, knobs, ridges, and hills, generally below the Williams soils. They have a fine sandy loam surface layer.

The most extensive minor soils in this map unit are Arnegard, Cohagen, Lefor, and Straw soils. The well drained Arnegard soils are in swales and slightly concave areas. The Cohagan soils, which are shallow over bedrock, occupy the tops of knobs, ridges, and hills and the upper side slopes along drainageways. The Lefor soils, which are moderately deep over bedrock, occupy the plane and convex tops of knobs, hills, and side slopes. The well drained Straw soils occupy flood plains along streams.

About 50 percent of the acreage is used for cultivated crops. The rest is in native grasses and is used as rangeland or hayland. The hazards of soil blowing and water erosion are the main limitations for farming. In some areas these hazards are moderate to severe. Slope, moderately slow or slow permeability, the shrink-swell potential, and potential frost action are the major limitations for most other uses.

This map unit has fair potential for cultivated crops. The steeper areas are best suited to rangeland. The potential for rangeland is good. The potential for openland and rangeland wildlife habitat and for urban and residential uses is fair.

7. Williams-Cabba

Undulating to steep, deep and shallow, well drained soils formed in material weathered from glacial till and soft bedrock

These soils occur as scattered areas throughout the northern half of the county. They are on a glacial till plain that is dissected by well defined drainageways. They are undulating to rolling on the plain and strongly sloping to steep along the drainageways. Nearly level ground moraines and terraces are in some areas. The soils are drained by intermittent streams, but in a few small areas where the landscape is characterized by potholes and depressions, the drainage system is closed.

This map unit occupies about 12 percent of the county. It is about 35 percent Williams soils, 20 percent Cabba soils, and 45 percent soils of minor extent.

The undulating to hilly Williams soils are on plane and convex knobs, ridges, and hills. They have a loam surface layer. The moderately steep to steep Cabba soils are on ridges and along drainageways below the Williams soils. They have a loam or silt loam surface layer.

The most extensive minor soils in this map unit are Cohagen, Ringling, Straw, Vebar, and Zahl soils. The Cohagen soils, which are shallow over bedrock, are along strongly sloping to steep drainageways. The Ringling soils, which are shallow to porcelanite (scoria), are on the tops of knolls, hills, and ridges and along drainageways. The well drained Straw soils occupy flood plains along streams. The Zahl soils occupy rolling moraines and some steep slopes along drainageways. The Vebar soils, which are moderately deep over bedrock, occupy the plane and convex slopes on residual upland plains and the lower side slopes below the Cohagen soils.

About 60 percent of the acreage is used as rangeland, and the rest is used for cultivated crops. Slope and the hazards of soil blowing and water erosion are the main limitations if the soils are farmed or used as rangeland. Slope, moderately slow permeability, the shrink-well potential, and the depth to soft bedrock are the major limitations for most other uses.

This map unit has fair potential for cultivated crops where Williams soils dominate and where slopes are less than 9 percent. It is generally unsuited to cultivated crops in areas where slopes are steeper and where Cabba soils are dominant. In these areas it is best suited to rangeland and has good potential for range grasses. It has fair potential for openland and rangeland wildlife habitat and for urban and residential uses.

8. Cabba-Williams-Temvik

Undulating to steep, shallow and deep, well drained soils formed in material weathered from soft bedrock, glacial till, and loess

These soils are in the northeastern part of the county. They are on a glacial till plain that is dissected by well defined drainageways and on breaks of the Missouri River and Lake Sakakawea. They are undulating on the plain, strongly sloping to steep along the drainageways, and steep on the breaks. Nearly level ground moraines and rolling moraines are in a few small areas. The soils are drained by intermittent streams.

This map unit occupies about 6 percent of the county. It is about 55 percent Cabba soils, 20 percent Williams soils, 10 percent Temvik soils, and 15 percent soils of minor extent (fig. 3).

The undulating Williams and Temvik soils are on plane and convex side slopes. They have a silt loam surface layer. The Williams soils are on slight rises above the Temvik soils. The strongly sloping to steep Cabba soils are below the Williams and Temvik soils. The Cabba soils have a loam or silt loam surface layer. They are along drainageways and on hillsides, ridges, and steep breaks.

The most extensive minor soils in this map unit are Cherry, Grassna, and Zahl soils and Badland. The well drained Grassna soils are in swales and slightly concave areas. Zahl soils are on the upper side slopes along drainageways and on the tops of knobs, hills, and ridges. The well drained Cherry soils are on plane slopes below the Cabba soils. Badland, which is characterized by exposed soft bedrock and steep slopes, is below the Cabba soils on the landscape.

About 75 percent of the acreage is in native grasses and is used as rangeland. The rest is used for cultivated crops. Various species of native trees and shrubs are in some drainageways and on north- or east-facing slopes. Slope and the hazards of soil blowing and water erosion are the main limitations if the soils are farmed or used as rangeland. Slope, moderately slow permeability, the shrink-swell potential, and the depth to bedrock are the major limitations for most other uses.

This map unit has good potential for cultivated crops where Williams and Temvik soils dominate. Areas where slopes are steeper and where Cabba soils dominate are best suited to rangeland and have good potential for range grasses. This map unit has fair potential for openland wildlife habitat and good potential for rangeland wildlife habitat. It has fair potential for urban and residential uses. Part of the unit is underlain by lignite coal, some of which has been mined.

9. Williams-Belfield-Amor

Nearly level to gently rolling, deep and moderately deep, well drained soils formed in material weathered from glacial till and soft bedrock

These soils occur as scattered areas throughout the western part of the county. They are on a glacial and residual upland plain that is dissected by strongly sloping to steep drainageways. They are drained by well defined intermittent streams.

This map unit occupies about 9 percent of the county. It is about 15 percent Williams soils, 10 percent Belfield soils, 10 percent Amor soils, and 65 percent is soils of minor extent.

The undulating or gently rolling Williams soils are on plane and convex side slopes above the Belfield and Amor soils. The Williams soils have a loam surface layer. The nearly level or gently sloping Belfield soils are on plane and slightly concave side slopes and in swales below the Amor soils. They have a silt loam surface layer. The undulating to moderately sloping Amor soils are on plane and convex side slopes. They have a loam surface layer.

The most extensive minor soils in this map unit are Cabba, Daglum, Rhoades, Sen, Straw, and Werner soils. The strongly sloping to steep Cabba soils, which are shallow over bedrock, are on the tops of knobs, hills, and ridges and along drainageways. The alkali or sodic Daglum soils are in swales and slightly concave areas. The Sen soils, which are moderately deep over bedrock, are on the plane and convex, mid and upper side slopes. The well drained Straw soils occupy flood plains along streams. The alkali or sodic Rhoades soils are in swales and slightly concave areas. The Werner soils, which are shallow over bedrock, occupy knobs, hillsides, and ridges.

About 50 percent of the acreage is used for cultivated crops, and the rest is in native grasses and is used as rangeland or hayland. A few small areas of native trees are in some of the drainageways. The hazards of soil blowing and water erosion are the main limitations if the soils are farmed. In some areas these hazards are moderate to severe. Slope, moderately slow or slow permeability, frost action, the shrink-swell potential, and the depth to soft bedrock are the major limitations for other uses.

This map unit has good potential for cultivated crops. In areas where slopes are steeper and where the Rhoades soils dominate, it is best suited to rangeland. It has good potential for range grasses and openland wildlife habitat and fair potential for rangeland wildlife habitat and most urban and residential uses.

Soils formed in material weathered from bedrock and alluvium on uplands

These soils are on a residual upland plain in the western part of the county. They are nearly level to very steep. They make up about 27 percent of the county. The soils formed in material weathered from soft bedrock. The depth to soft bedrock varies. Soft bedrock commonly crops out in the steeper areas.

10. Cabba-Cohagen

Strongly sloping to very steep, shallow, well drained and somewhat excessively drained soils formed in material weathered from soft bedrock

These soils occur as scattered areas throughout the western part of the county. They are on a residual upland plain. Nearly level to rolling glacial till plains are in some small areas. The soils are drained by well defined intermittent streams.

This map unit occupies about 9 percent of the county. It is about 40 percent Cabba soils, 15 percent Cohagen soils, and 45 percent soils of minor extent.

The strongly sloping to very steep Cabba soils and the strongly sloping to very steep Cohagen soils are on convex ridgetops, hillsides, and side slopes along drainageways. The Cohagen soils generally are above the Cabba soils. They have a fine sandy loam surface layer and are somewhat excessively drained. The Cabba soils have a loam or silt loam surface layer and are well drained.

The most extensive minor soils in this map unit are Williams, Zahl, Vebar, and Ringling soils. The nearly level to gently rolling Williams soils are on small glacial till plains between incised drainageways. They are above the Cabba and Cohagen soils on the landscape. The gently rolling to steep Zahl soils are on moraines and the upper side slopes along drainageways. The moderately sloping to strongly sloping Vebar soils are on the plane and convex, mid and lower side slopes below the Cohagen soils. The Ringling soils, which are shallow over porcelanite (scoria), are on the tops of knobs and hills and on the lower side slopes below the Cabba soils.

Almost all of the acreage is in native grasses and is used as rangeland. A few small, irregularly shaped areas, primarily of Williams soils, are cultivated. Many of the drainageways support stands of native trees and shrubs. The hazard of water erosion, the excessive loss of water resulting from rapid runoff, and the shallowness to bedrock are the main limitations if the soils are used as rangeland. The slope and the shallowness to soft bedrock are the major limitations for other uses.

This map unit is best suited to rangeland and has fair potential for range grasses. It has poor potential for openland wildlife habitat and good potential for rangeland wildlife habitat. The major soils have poor potential for urban and residential uses. The Williams soils have good potential for urban and residential uses.

11. Cabba-Rhoades

Nearly level to very steep, shallow and deep, well drained soils formed in material weathered from soft bedrock and alluvium

These soils are on a residual upland plain in the southwestern part of the county. Undulating glacial till plains are in small areas. The soils are drained by many well defined intermittent streams.

This map unit occupies about 11 percent of the county. It is about 45 percent Cabba soils, 15 percent Rhoades soils, and 40 percent soils of minor extent (fig. 4).

The strongly sloping to very steep Cabba soils are on convex ridgetops, hillsides, and side slopes along drainageways. The nearly level to moderately sloping, alkali or sodic Rhoades soils are on plane and slightly concave side slopes below the Cabba soils. The Cabba soils have a loam or silt loam surface layer. The Rhoades soils have a thin surface layer of silt loam and a dense silty clay subsoil. They contain excess sodium salts.

The most extensive minor soils in this map unit are Amor, Werner, Cherry, Moreau, and Cohagen soils and Badland. The Badland is characterized by exposed soft bedrock and is generally below the Cabba soils on the landscape. The well drained Cherry soils are on plane slopes below the Cabba soils and the Badland. The Amor soils, which are moderately deep over soft bedrock, are on plane and convex slopes above the Cabba soils. The Werner soils, which are shallow over soft bedrock, are on convex ridgetops and the upper side slopes above the Cabba soils. The Moreau soils, which are moderately deep over soft bedrock, are on plane and convex slopes below the Cabba soils. The Cohagen soils, which are shallow over soft bedrock, are on ridgetops and the upper side slopes above the Cabba soils.

Almost all of the acreage is in native grasses and is used as rangeland. A few small, irregularly shaped areas are cultivated. Some of the drainageways support stands of native trees and shrubs. The hazard of water erosion, excessive loss of water resulting from rapid runoff, and shallowness to bedrock are the main limitations if the soils are used as rangeland. Slope, depth to soft bedrock, excess sodium salts, and very slow permeability are the major limitations for other uses.

This map unit is best suited to rangeland and has fair potential for range grasses. It has poor potential for openland wildlife habitat and fair potential for rangeland wildlife habitat. It has poor potential for urban and residential uses. The Amor soils have good potential for urban and residential uses.

12. Rhoades-Belfield-Moreau

Nearly level to strongly sloping, deep and moderately deep, well drained soils formed in material weathered from soft bedrock and alluvium

These soils are in the southwestern part of the county. They are on a residual upland plain that is dissected by steep drainageways. They are drained by well defined intermittent streams.

This map unit occupies about 7 percent of the county. It is about 40 percent Rhoades soils, 15 percent Belfield soils, 10 percent Moreau soils, and 35 percent soils of minor extent.

The nearly level to moderately sloping Rhoades soils are on plane and slightly concave side slopes below the Belfield and Moreau soils. They have a thin surface layer of silt loam and a dense silty clay subsoil, and they contain excess sodium salts. The nearly level to moderately sloping Belfield soils are on plane and concave side slopes below the Moreau soils. They have a silt loam surface layer. The gently sloping to strongly sloping Moreau soils are on the plane and convex, upper side slopes and the tops of ridges. They have a silty clay surface layer.

The most extensive minor soils in this map unit are Cabba, Regent, Straw, and Lawther soils. The Cabba soils, which are shallow over soft bedrock, are on the tops of knobs and ridges and along drainageways. The Regent soils, which are moderately deep over soft bedrock, occupy plane and convex slopes. The well drained Straw soils occupy flood plains along streams. The Lawther soils occupy plane and slightly concave slopes.

About 50 percent of the acreage is used for cultivated crops, and the rest is in native grass and is used as rangeland. Native trees and shrubs are along the major streams and drainageways. Excess sodium salts, the hazard of water erosion, and the moderate depth to bedrock are the main limitations if the soils are farmed or used as rangeland. Slope, depth to soft bedrock, excess sodium salts, and very slow to slow permeability are the major limitations for other uses.

This map unit has poor potential for cultivated crops and fair potential for range grasses. It has poor potential for openland wildlife habitat and fair potential for rangeland wildlife habitat and urban and residential uses.

Soils formed in alluvium on bottom land and terraces

These soils are on the flood plains and terraces along the Missouri and Knife Rivers and Spring, Goodman, and Antelope Creeks. They make up about 7 percent of the county. The soils formed in material weathered from alluvium. They are level to gently sloping. The drainage pattern is well defined to indistinct.

13. Straw-Velva

Level to gently sloping, deep, well drained soils formed in material weathered from alluvium

These soils are on the flood plains along the Knife River, Spring Creek, and Goodman Creek and in the glacial outwash trench occupied by Antelope Creek. High terraces and oxbows are in some areas. The soils are drained by the major streams and by a few shallow intermittent streams. In many areas they support groves of native trees and shrubs.

This map unit occupies about 6 percent of the county. It is about 55 percent Straw soils, 10 percent Velva soils, and 35 percent soils of minor extent.

The level to gently sloping Straw soils occupy plane and slightly concave slopes, generally above the Velva soils. They have a silt loam or loam surface layer. The nearly level or gently sloping Velva soils occupy plane and slightly concave slopes, generally adjacent to the major streams. They have a fine sandy loam surface layer.

The most extensive minor soils in this map unit are Shambo, Belfield, and Parshall soils. The Shambo and Parshall soils occupy plane and slightly concave slopes on the high terraces. The alkali or sodic Belfield soils occupy plane and slightly concave slopes on bottom land adjacent to the Straw soils.

About 80 percent of the acreage is used for cultivated crops. The rest is in native grasses and is used as rangeland and hayland. All the towns and villages in the county but Pick City are entirely or partly in areas of this map unit. The hazards of soil blowing, water erosion, and flooding are the major limitations if the soils are farmed. The flood hazard, shrink-swell potential, and potential frost action are the major limitations for other uses.

This map unit has good potential for cultivated crops, range grasses, and openland and rangeland wildlife habitat. If protected against flooding, it has good potential for urban and residential uses.

14. Havrelon-Lohler

Level, deep, well drained and moderately well drained soils formed in material weathered from alluvium

These soils are on the flood plain of the Missouri River and the flood plain where the Knife River joins the Missouri River. High terraces and oxbows are in some areas. In many areas the soils support groves of native trees and shrubs.

This map unit occupies about 1 percent of the county. It is about 75 percent Havrelon soils, 10 percent Lohler soils, and 15 percent soils of minor extent.

The level Havrelon soils occupy plane slopes, generally above the Lohler soils. They are well drained and have a silt loam surface layer. The level Lohler soils occupy plane and slightly concave slopes. They are moderately well drained and have a silty clay surface layer.

The most extensive minor soils in this map unit are Banks, Dimmick, and Seroco soils. The Banks soils occupy plane and slightly convex slopes. The very poorly drained Dimmick soils are in the oxbows. The excessively drained Seroco soils are on convex slopes along the edge of the flood plain and in some small areas on the flood plain.

About 75 percent of the acreage has been cleared of trees and is used for cultivated crops. Some areas are irrigated. The rest of the acreage is in native trees and shrubs and in grasses and is used as rangeland. The flood plain below the Garrison Dam is protected against flooding. Flooding of the Knife River and the hazard of soil blowing are the main limitations if the soils are farmed. Flooding of the Knife River, potential frost action, and the moderate to high shrink-swell potential are the major limitations for most other uses.

This map unit has good potential for cultivated crops and openland wildlife habitat and fair potential for rangeland wildlife habitat. The Havrelon soils have good potential for irrigated crops. Uncleared areas have fair potential for rangeland. The areas below Garrison Dam that are protected against flooding have good potential for most urban and residential uses.

Broad land-use considerations

Deciding which soils should be used for urban and industrial development and which soils should be preserved as cropland and rangeland is becoming an increasingly important issue in the survey area. As a result of the lignite coal industry, soils in and near Hazen, Beulah, and Stanton are under urban and industrial development. The general soil map is most helpful in planning the general outline of urban and industrial areas; it cannot be used for the selection of sites for specific urban and industrial structures. In general, the soils in the survey area that have good potential for cultivated crops also have good potential for urban and industrial development. The data about soils can be useful in planning future land-use patterns in Mercer County.

Large areas of the Cabba-Cohagen and Cabba-Rhoades map units, are not suitable for urban and industrial development because steep slopes, depth to bedrock, a high shrink-swell potential, and excess sodium salts are severe limitations. Urban development in the Rhoades-Belfield-Moreau map unit is also very costly because of a high shrink-swell potential and excess sodium salts.

In many parts of the other map units, the soils have severe limitations, and urban development can be costly. The sandy soils of the Lihen-Seroco-Telfer map unit are suitable for most urban uses, but they are very droughty and extremely susceptible to soil blowing. Many of the soils in the Straw-Velva and the Havrelon-Lohler map units are subject to stream overflow, which damages structures and other property. The steep slopes and shallowness to bedrock of the Cabba soils are severe limitations for urban development in the Williams-Cabba and Cabba-Williams-Temvik map units, but some areas of these map units can be successfully developed.

In many large areas of the Williams-Bowbells, Flaxton-Williams, Williams-Wilton-Temvik, and Williams-Zahl map units, urban development is less costly. The soils have severe limitations for septic tank absorption fields, but these limitations can be overcome by enlarging the absorption field or using a municipal sewer system.

The map units adjoining the major streams and Lake Sakakawea have the best potential for recreational areas, such as parks and campgrounds. These are the Straw-Velva, Havrelon-Lohler, Cabba-Williams-Temvik map units and possibly the Cabba-Cohagen map unit. These map units support some native trees and shrubs and are close to fishing areas. The steep slope of the Cabba-Cohagen and Cabba-Williams-Temvik map units is a severe limitation for some recreation uses, but in some areas the soils can be used for paths and trails, and in some access to fishing areas is good.

All of the map units in the survey area provide habitat for many important species of wildlife. The small depressions and potholes characteristic of the landscape of the Williams-Zahl and Williams-Bowbells map units provide good waterfowl habitat. White-tailed deer, antelope, and sharp-tailed grouse are attracted to the large areas of native grasses and woody plants in the Straw-Velva and Cabba-Cohagen map units.

The Williams-Zahl, Williams-Bowbells, Williams-Wilton-Temvik, Flaxton-Williams, Straw-Velva, and Havrelon-Lohler map units have the best potential for cultivated crops. The potential for crop production should not be overlooked when broad land uses are considered. Many areas of the Flaxton-Williams map unit are highly susceptible to soil blowing, but conservation practices can minimize the hazard. The Belfield-Williams-Vebar, Williams-Cabba, Cabba-Williams-Temvik, and Williams-Belfield-Amor map units have fair potential for cultivated crops. The Cabba-Williams and Cabba-Williams-Temvik map units are dissected by many deeply entrenched drainageways.

Many areas in the county, for example, most areas of the Cabba-Cohagen and Cabba-Rhoades map units and large areas of the Rhoades-Belfield-Moreau map unit, are best suited to rangeland. The Rhoades-Belfield-Moreau map unit has such severe limitations for urban development and cultivated crops that the cost generally prohibits such uses.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. Seroco and Krem, for example, are the names of two soil series.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Williams loam, 3 to 6 percent slopes, is one of several phases within the Williams series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Rhoades-Daglum complex, 1 to 9 percent slopes, is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits, gravel, is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

As a result of changes in series concepts and differences in the design of map units or the extent of soils, some of the boundaries and soil names on the Mercer County soil maps do not match those on the soil maps of Oliver, Stark, and Morton Counties.

1—Parnell silt loam. This deep, level, very poorly drained soil is in slight depressions and potholes on glacial till uplands. Unless drained or affected by drought, it is ponded throughout most of the growing season. Individual areas are round or oblong and range from 2 to 70 acres in size.

Typically, the surface layer is black silt loam about 16 inches thick. It is mottled in the lower part. The subsoil is about 27 inches thick. It is firm, very dark gray, mottled silty clay loam over silty clay. The substratum to a depth of about 60 inches is mottled, olive gray silty clay loam. In some places the surface layer is silty clay loam. In others a dark gray subsurface layer less than 4 inches thick is evident.

Included with this soil in mapping are small areas of the poorly drained, slightly higher lying Heil and Tonka soils. These soils make up less than 15 percent of the unit. The Heil soils contain excess sodium and have a dense subsoil at a depth of 1 inch to 5 inches. The Tonka soils have a dark gray subsurface layer that is thicker than 4 inches.

Permeability is slow, and available water capacity is high. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Even in dry years, the water table is seldom more than 2 feet below the surface. The shrink-swell potential is high. Potential frost action also is high.

Most areas are undrained and are used as wetland wildlife habitat or as rangeland. Drained areas are used mostly for late-seeded, annual hay or small grain. The potential for wetland wildlife habitat, crops, and windbreaks is good; the potential for rangeland is fair; and the potential for recreation uses and most engineering uses is poor.

Drained areas are suited to wheat, oats, barley, and grasses and legumes. In most years wetness delays seeding. These areas are generally unsuited to cultivated crops because of flooding and the high water table. Suitable outlets for drainage are difficult to locate in many areas. The hazards of soil blowing and water erosion are slight.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing during wet periods keep the pasture and the soil in good condition. In some years undrained areas are too wet to allow hay cutting.

Undrained areas are generally unsuited to windbreaks and environmental plantings because of the high water table and the flooding. Drained areas are well suited to trees and shrubs; all climatically suited species grow well.

This soil is generally not suitable for building site development and onsite waste disposal. As a result of the seasonal high water table, the flooding, the high shrink-swell potential, and the slow permeability, design, installation, and maintenance are costly. In this survey area Parnell soils are generally not used as building sites. More desirable sites are generally nearby. Capability subclass Vw; Wetland range site.

2—Tonka silt loam. This deep, level, poorly drained soil is in shallow basins and potholes on glacial till uplands. It is ponded for a few weeks to several months following snowmelt and heavy rains. Individual areas are generally round or oblong and range from 2 to 40 acres in size.

Typically, the surface layer is silt loam about 9 inches thick. It is black in the upper part and very dark gray in the lower part. The subsurface layer is mottled, dark gray loam about 7 inches thick. The subsoil is firm, mottled, very dark gray clay loam about 22 inches thick. The substratum to a depth of about 60 inches is mottled, olive clay loam. In places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of very poorly drained Parnell soils in the lowest part of the basins or potholes. These soils make up less than 15 percent of the unit. They are wetter than this Tonka soil and do not have a leached subsurface layer.

Permeability is slow, and available water capacity is high. Unless the soil is drained or affected by drought, the water table is within 1 foot of the surface during most of the year. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high to moderate. Potential frost action is high.

Most areas are undrained and are used as rangeland, wetland wildlife habitat, or native hayland. Some areas are used for late-seeded cultivated crops. Drained areas are used for cultivated crops and hayland.

Undrained areas have good potential for range grasses and a few species of trees and shrubs. They have poor potential for cultivated crops and most hay crops. Drained areas have good potential for range grasses, windbreaks, and most of the cultivated crops commonly grown in the county. The potential for sewage lagoons is good. Even if the soil is drained, the potential for most engineering and recreation uses is poor. The potential for wetland wildlife habitat is good.

Undrained areas are poorly suited to cultivated crops. In most years wetness delays tillage and seeding. Drained areas are well suited to wheat, oats, barley, and grasses and legumes. Suitable outlets for drainage are difficult to locate in many areas. Soil blowing and water erosion are only slight hazards and are easily controlled by managing crop residue.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling soil blowing. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods keep the pasture and the soil in good condition.

Undrained areas of this soil are generally unsuited to windbreaks and environmental plantings because of wetness and flooding. Drained areas are well suited to trees and shrubs; all climatically suited species can grow well.

This soil is generally not suitable for building site development and onsite waste disposal. As a result of the high water table, the flooding, and the slow permeability, design, installation, and maintenance are costly. In this survey area Tonka soils are generally not used as building sites. More desirable sites are generally nearby. Capability subclass IVw; Wet Meadow range site.

3D—Seroco-Telfer loamy fine sands, 1 to 15 percent slopes. This map unit consists of deep, nearly level to rolling, excessively drained soils on terraces and uplands. Most areas are crossed by a few sharply incised stream channels. Individual areas are irregular in shape and range from 3 to more than 1,000 acres in size. Slopes are short and uneven.

Areas of this map unit are 50 to 75 percent Seroco soils and 25 to 40 percent Telfer soils. The Seroco soils are on the tops of ridges and the upper side slopes, and the Telfer soils are on the lower side slopes and toe slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Seroco soil has a surface layer of dark grayish brown loamy fine sand about 3 inches thick. The substratum to a depth of about 60 inches is brown fine sand. In places the substratum is loam or clay loam glacial till at a depth of about 50 inches.

Typically, the Telfer soil has a dark grayish brown loamy fine sand surface layer about 10 inches thick. Below this is a grayish brown fine sand transitional layer about 5 inches thick. The substratum to a depth of about 60 inches is brown fine sand. In places the substratum is loam or clay loam glacial till at a depth of about 50 inches.

Included with this unit in mapping are small areas of Lihen soils in swales. These soils make up 5 to 20 percent of the unit. They are dark colored to a greater depth than the Seroco and Telfer soils. Also included are small areas of Krem soils on plane slopes, a few small areas of Banks soils, and a few blowouts. The Krem soils have clay loam glacial till at a depth of 16 to 40 inches. The Banks soils are similar to Seroco soils but are subject to flooding.

Permeability is rapid. Available water capacity is low, but soil moisture is readily available to plants. Surface runoff is very slow to slow.

Most areas are used as rangeland. These soils have fair potential for range grasses. They have poor potential for cultivated crops and windbreaks, good potential for septic tank absorption fields, poor potential for other sanitary facilities, and good potential for building site development.

These soils are generally unsuited to cultivated crops because the soil blowing hazard is severe, available water capacity is low, and the soils are droughty.

The use of these soils as rangeland or hayland is effective in controlling erosion. Overstocking and overgrazing reduce the plant cover, cause deterioration of the plant community, and increase the hazard of soil blowing. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the range and the soil in good condition.

The Seroco soil is generally unsuited to trees and shrubs. The Telfer soil is poorly suited; only a few trees and shrubs can grow well. Intensive management is required to insure survival and adequate growth.

These soils are well suited as sites for buildings and septic tank absorption fields. Alternative sites should be selected for sanitary landfills and sewage lagoons because of seepage and the possible contamination of ground water by effluent. Cutbanks in shallow excavations can cave unless trench walls are shored. An adequate plant cover on lawns and recreation areas is difficult to maintain, but this difficulty can be overcome in part by frequent applications of irrigation water and fertilizer. Capability subclass VIe; Seroco soil in Thin Sands range site, Telfer soil in Sands range site.

3E—Seroco-Dune land complex, 3 to 25 percent slopes. This map unit consists of deep, undulating to hilly, excessively drained Seroco soils and Dune land. Individual areas are irregular in shape and range from about 5 to 200 acres in size. They are about 50 to 70 percent Seroco soils and 25 to 40 percent Dune land. The Seroco soils and Dune land are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Seroco soil has a surface layer of dark grayish brown loamy fine sand about 3 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Typically, Dune land has no discernible soil layers, but in places darkened buried layers are at various depths (fig. 5). The sand is predominately fine.

Included with this unit in mapping are small areas of Lihen and Telfer soils in swales. These soils make up about 5 to 15 percent of the unit. They have a thicker, darker colored surface layer than the Seroco soil.

Permeability in the Seroco soil is rapid, and available water capacity is low. Surface runoff is slow.

Most areas are used as rangeland. This map unit has fair to poor potential for building site development, recreation uses, and sanitary facilities; poor potential for crops and windbreaks; and good potential for rangeland.

This map unit is generally not suitable for cultivation because of droughtiness and a severe soil blowing hazard. The Dune land is unstable and is constantly shifted by the wind.

The use of this map unit as rangeland or hayland is effective in controlling erosion. Overstocking and overgrazing reduce the plant cover, cause deterioration of the plant community, and increase the hazard of soil blowing. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the range and the soil in good condition.

This map unit is generally unsuited to windbreaks and environmental plantings because of the low available water capacity and the droughtiness.

This map unit is poorly suited to building site development because the soil blowing hazard is severe and the plant cover is difficult to maintain in intensively used areas. Alternative sites should be selected for sanitary landfills and sewage lagoons because of seepage and the possible contamination of ground water by effluent. The plant cover in intensively used areas, such as lawns and recreation areas, can be maintained in part by frequent applications of fertilizer and irrigation water. Capability subclass VIIe; Seroco soil in Thin Sands range site, Dune land not assigned to a range site.

5—Dimmick silty clay. This deep, level, very poorly drained soil is in basins on uplands and in oxbows on terraces and bottom land. Unless drained or affected by drought, it is ponded throughout most of the year. Individual areas range from 5 to more than 100 acres in size.

Typically, the surface layer is mottled, very dark gray silty clay about 18 inches thick. The substratum to a depth of about 60 inches is mottled, dark gray clay.

Included with this soil in mapping are small areas of poorly drained Heil soils on the outer rims of the basins. These soils make up less than 20 percent of the unit. They contain a higher amount of sodium than this Dimmick soil.

Permeability is very slow, and available water capacity is moderate to high. Even in dry years, the water table is seldom more than 3 feet below the surface. The shrink-swell potential is high. Potential frost action is moderate.

Most areas are undrained and are used for rangeland or for hay that is harvested late in the growing season. Drained areas are used for hay and small grain. The potential for hay, pasture, and wetland wildlife habitat is good, and the potential for crops, recreation uses, and most engineering uses is poor.

This soil is generally unsuited to wheat, oats, barley, and grasses and legumes because it is wet and suitable outlets for drainage are not available. In areas where outlets are available, the potential for cultivated crops is good. The hazard of water erosion is slight, and areas having no plant cover are subject to soil blowing.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in poor tilth and surface compaction and reduces the infiltration rate. Proper stocking rates, pasture rotation, and timely deferment of grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas are generally unsuited to windbreaks and environmental plantings because of wetness and flooding. Drained areas are well suited to trees and shrubs; all climatically suited species can grow well.

This soil is suited to sewage lagoons. It is generally not suitable for building site development and onsite waste disposal. As a result of the seasonal high water table, the flooding, the high shrink-swell potential, and the very slow permeability, design, installation, and maintenance are costly. In this survey area Dimmick soils are generally not used as building sites. More desirable sites are generally nearby. Capability subclass Vw; Wetland range site.

7—Straw silty clay loam. This deep, level, well drained soil is on low terraces and bottom land along the major streams and on fans in glacial outwash trenches. Most areas are occasionally flooded for a brief period, but some are only rarely flooded. The areas are generally long and irregularly shaped and range from 20 to more than 300 acres in size.

Typically, the surface layer is silty clay loam about 13 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown loam over light brownish gray, stratified silt loam and fine sandy loam. In most places a darkened buried layer is in the substratum. In some the surface layer is thinner, and in others it is clay loam. In a few, fine sand or loamy fine sand is at a depth of 40 inches or more.

Included with this soil in mapping are small areas of Magnus soils in swales. These soils make up 5 to 20 percent of the unit. They contain more clay than this Straw soil.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. The surface layer can be easily tilled within a fairly narrow range in moisture content. It tends to puddle and form a crust following heavy rains. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. A few are in native grass. A few small areas are in native trees and shrubs and are used for recreation, wildlife habitat, or rangeland. The potential for crops, rangeland, windbreaks, and openland and rangeland wildlife habitat is good; the potential for most engineering and recreation uses is fair; and the potential for wetland wildlife habitat is poor.

This soil is well suited to wheat, oats, barley, and grasses and legumes. Stubble mulch tillage, crop residue management, and stripcropping help to control soil blowing and water erosion. Tillage at the optimum moisture content prevents crusting and provides a suitable seedbed. Flooding generally occurs before spring planting and therefore does not damage crops. Some areas are suitable for water spreading.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is generally not suitable as a site for buildings and sanitary facilities because of the flood hazard. If protected against flooding, however, it is suited to those uses. Seepage from sewage lagoons can be prevented by sealing with clay blankets. Capability subclass IIc; Overflow range site.

8—Grail silty clay loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is in upland swales and on valley fans and foot slopes. Individual areas are irregular in shape and range from 3 to more than 100 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil is about 26 inches thick. It is dark gray silty clay loam in the upper part, dark grayish brown silty clay in the next part, and dark grayish brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is grayish brown in the upper part and light brownish gray in the lower part. In some places the surface layer is thinner, and in others it is silt loam.

Included with this soil in mapping are small areas of Belfield and Regent soils. These soils make up 5 to 20 percent of the unit. The Belfield soils are high in content of sodium, and the Regent soils have shale bedrock at a depth of 20 to 40 inches.

Permeability is slow, and available water capacity is high. The surface layer can be easily tilled within a fairly narrow range in moisture content. It tends to puddle and crust after heavy rains. The shrink-swell potential is high to moderate. Potential frost action is moderate.

Most areas are cultivated. A few are in native grass. The potential for crops, range grasses, windbreaks, recreation uses, and openland wildlife habitat is good, and the potential for most engineering uses and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. Stubble mulch tillage, grassed waterways, and contour farming help to control soil blowing and water erosion. Tillage at the optimum moisture content prevents puddling and provides a good seedbed.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is suited to most engineering and recreation uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. If the soil is used as a site for dwellings and buildings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Capability subclass IIc; Overflow range site.

8B—Grail silty clay loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is in upland swales and on valley fans and foot slopes. Individual areas vary in shape and range from about 3 to 40 acres in size. Slopes are short and smooth.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 22 inches thick. It is dark gray silty clay loam in the upper part, dark grayish brown silty clay in the next part, and dark grayish brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is grayish brown in the upper part and light brownish gray in the lower part. In some places the surface layer is lighter colored, and in others it is silt loam.

Included with this soil in mapping are small areas of Belfield and Regent soils. These soils make up about 5 to 20 percent of the unit. The Belfield soils are high in content of sodium, and the Regent soils have shale bedrock at a depth of 20 to 40 inches.

Permeability is slow, and available water capacity is high. Runoff is medium. The surface layer can be easily tilled within a fairly narrow range in moisture content. It tends to puddle and crust after heavy rains. The shrink-swell potential is high to moderate. Potential frost action is moderate.

Most areas are cultivated. Some are in native grass. The potential for crops, rangeland, windbreaks, openland wildlife habitat, and recreation uses is good, and the potential for most engineering uses and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is moderate, and drainageways are subject to gullying. Stubble mulch, minimum tillage, grassed waterways, and tillage and cultivation across the slope help to control erosion. Tillage at the optimum moisture content prevents puddling and provides a good seedbed.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is suited to most engineering and recreation uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. If the soil is used as a site for dwellings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Capability subclass IIe; Silty range site.

8C—Grail silty clay loam, 6 to 9 percent slopes. This deep, moderately sloping, well drained soil is on fans and foot slopes. Individual areas are long and narrow and range from about 3 to 20 acres in size. Slopes are short and smooth.

Typically, the surface layer is dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 18 inches thick. It is dark gray silty clay loam in the upper part, dark grayish brown silty clay in the next part, and dark grayish brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is grayish brown in the upper part and light brownish gray in the lower part. In a few places the surface layer is silt loam, and in others it is light colored.

Included with this soil in mapping are small areas of Belfield and Regent soils. These soils make up 5 to 20 percent of the unit. The Belfield soils are high in content of sodium, and the Regent soils have shale bedrock at a depth of 20 to 40 inches.

Permeability is slow, and available water capacity is high. Runoff is medium. The surface layer can be easily tilled within a fairly narrow range in moisture content. It tends to puddle and crust after heavy rains. The shrink-swell potential is high to moderate. Potential frost action is moderate.

Most areas are used as rangeland. Some are used for cultivated crops. The potential for crops, rangeland, windbreaks, openland wildlife habitat, and most recreation uses is good, and the potential for engineering uses and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is severe if the soil is cultivated. Stubble mulch, minimum tillage, grassed waterways, diversions, and cultivation across the slope help to control erosion. Tillage at the optimum moisture content prevents puddling and provides a good seedbed.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to most engineering and recreation uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. If the soil is used as a site for buildings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Alternative sites should be selected for playgrounds. Capability subclass IIIe; Silty range site.

9B—Regent silty clay loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on plane and convex uplands. Individual areas are irregular in shape and range from 5 to 80 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 32 inches thick. It is dark grayish brown silty clay in the upper part, grayish brown silty clay in the next part, and grayish brown silty clay loam in the lower part. Pale olive shale is at a depth of about 38 inches. In places the shale is at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Grail soils in swales and small areas of Rhoades soils. These soils make up less than 15 percent of the unit. The Grail soils have a darker colored surface layer and are deeper than this Regent soil. The Rhoades soils contain a large amount of sodium.

Permeability is slow, and available water capacity is moderate. Runoff is medium. The surface layer can be easily tilled within a narrow range in moisture content. Roots are somewhat restricted by the shale bedrock. The shrink-swell potential is high. Potential frost action is low.

Most areas are used for cultivated crops. Some are used as rangeland. The potential for crops, rangeland, and openland wildlife habitat is good, and the potential for windbreaks, rangeland wildlife habitat, recreation uses, and most engineering uses is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is moderate. Stubble mulch, crop residue management, stripcropping, and windbreaks help to control erosion. They also help to maintain the organic-matter content, fertility, tilth, and the infiltration rate.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs can grow well.

This soil is generally suitable for most engineering and recreation uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. If the soil is used as a site for dwellings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Capability subclass IIe; Clayey range site.

9C—Regent silty clay loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on plane and convex uplands. Individual areas are irregular in shape and range from about 5 to 50 acres in size. Slopes are long and narrow.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown silty clay in the upper part, grayish brown silty clay in the next part, and grayish brown silty clay loam in the lower part. Pale olive shale is at a depth of about 34 inches. In places the surface layer is lighter colored.

Included with this soil in mapping are small areas of Grail soils in swales, Wayden soils on knobs and ridges, and Rhoades soils on plane and slightly concave slopes. These soils make up 5 to 20 percent of the unit. The Grail soils do not have shale bedrock within a depth of 40 inches and are dark colored to a greater depth than this Regent soil. The Wayden soils have shale bedrock at a depth of 10 to 20 inches. The Rhoades soils contain a large amount of sodium.

Permeability is slow, and available water capacity is moderate. Surface runoff is medium. The surface layer can be easily tilled within a narrow range in moisture content. Roots are somewhat restricted by the shale bedrock. The shrink-swell potential is high. Potential frost action is low.

Most areas are used for cultivated crops. Some are used as rangeland. The potential for rangeland is good, and the potential for crops, windbreaks, most engineering and recreation uses, and openland and rangeland wildlife habitat is fair.

This soil is suited to wheat, barley, oats, and grasses and legumes. The hazard of water erosion is moderate. Stubble mulch, grassed waterways, crop residue management, stripcropping, windbreaks, and cultivation across the slope help to control erosion. They also maintain the organic-matter content, fertility, and tilth and improve the intake of water.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs can grow well.

This soil is generally suited to most engineering and recreation uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the field. If the soil is used as a site for dwellings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Alternative sites should be selected for playgrounds. Capability subclass IIIe; Clayey range site.

10—Savage silty clay loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and fans. Individual areas are irregular in shape and range from about 10 to 80 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown silty clay loam about 8 inches thick. The subsoil is about 16 inches thick. It is grayish brown silty clay in the upper part and light olive brown silty clay loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown silty clay and silty clay loam with thin strata of silt loam. In a few places the surface layer is silt loam. In others it is dark colored to a depth of more than 7 inches. In some the subsoil is silt loam.

Included with this soil in mapping are small areas of Daglum and Rhoades soils on plane and slightly concave slopes. These soils make up less than 20 percent of the unit. They contain an excessive amount of sodium and have a dense subsoil.

Permeability is moderately slow, and available water capacity is high. Surface runoff is slow. This soil can be easily tilled within a fairly narrow range in moisture content. It tends to puddle and crust following heavy rains. The shrink-swell potential is high. Potential frost action is moderate.

Most areas are used for cultivated crops. Some are used as rangeland. The potential for rangeland, crops, and windbreaks is good, and the potential for most engineering and recreation uses and for openland and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of erosion is moderate. Stubble mulch, crop residue management, grassed waterways, and diversions help to control erosion. They also maintain the organic-matter content, fertility, and tilth and improve water intake. Tillage at the optimum moisture content prevents crusting and provides a good seedbed.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture in good condition.

This soil is suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is generally suited to most engineering and recreation uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. If the soil is used as a site for dwellings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Capability subclass IIc; Clayey range site.

11C—Cherry silty clay loam, gullied, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, well drained soil is on upland fans and foot slopes. Individual areas are irregular in shape and range from about 10 to 80 acres in size. Gullies are common (fig. 6). Slopes are short and uneven.

Typically, the surface layer is grayish brown silty clay loam about 4 inches thick. The subsoil is silty clay loam about 32 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum to a depth of about 60 inches is light brownish gray, stratified silty clay loam and clay loam. In places the surface layer is silt loam.

Included with this soil in mapping are small areas of Cabba, Belfield, and Rhoades soils. These soils make up about 5 to 20 percent of the unit. The shallow Cabba soils occupy knobs, hilltops, and ridgetops. The Belfield and Rhoades soils contain excess sodium. They occupy the concave lower slopes.

Permeability is moderately slow, and available water capacity is high. Surface runoff is medium to rapid. The surface layer can be easily tilled within a narrow range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used as rangeland. Some are used for cultivated crops. The potential for crops and windbreaks is poor, and the potential for rangeland, recreation uses, most engineering uses, and for openland and rangeland wildlife habitat is fair.

This soil is poorly suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is severe. Diversions and grassed waterways are needed to control and intercept runoff from higher lying slopes. Stubble mulch and cultivation across the slope help to control water erosion.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion. Overgrazing reduces plant vigor and increases the hazard of erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture and the soil in good condition. The gullies make the use of machinery somewhat difficult.

This soil is suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs can grow well.

This soil is suited to most engineering and recreation uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. If the soil is used as a site for dwellings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Alternative sites should be selected for playgrounds. If this soil is disturbed, the hazard of erosion is severe because runoff flows in from higher lying soils. Diversions and grassed waterways can divert the runoff. Capability subclass IVe; Silty range site.

14—Havrelon silty clay loam. This deep, level, well drained soil is on bottom land. All areas but those where the Knife and Missouri Rivers flow together are protected against flooding by the Garrison Dam. The areas are long and narrow in shape and range from about 50 to 300 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 8 inches thick. The substratum to a depth of about 60 inches is stratified silty clay loam, silt loam, very fine sandy loam, and very fine sand. It is grayish brown in the upper part and light brownish gray in the lower part. In some places the surface layer is silty clay, and in a few it is silt loam.

Included with this soil in mapping are small areas of moderately well drained Lohler soils. These soils make up less than 15 percent of the unit. They contain more clay than this Havrelon soil.

Permeability and available water capacity are moderate. The surface layer can be tilled within a fairly narrow range in moisture content. The shrink-swell potential is low to moderate. Potential frost action is moderate.

Most areas are used for cultivated crops. Some are in native trees and grass and are used for range. A few are irrigated. The potential for crops, recreation uses, openland wildlife habitat, windbreaks, and rangeland is good, and the potential for most engineering uses and rangeland wildlife habitat is fair.

This soil is suited to wheat, barley, oats, and grasses and legumes. If irrigated, it is suited to sugar beets, pinto beans, and potatoes. Minimum tillage, stubble mulch, and crop residue management protect the soil against erosion, maintain the organic-matter content, and improve water intake. The soil should be tilled at the optimum moisture content because it tends to puddle and crust.

The use of this soil as pastureland, rangeland, or hayland protects the soil. Overgrazing or grazing when the soil is wet reduces plant vigor and lowers yields. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

If protected against flooding, this soil is suitable as a site for buildings and sanitary facilities. If the soil is used as a site for buildings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. Unless the soil is protected against flooding, the hazard of damage to buildings by floodwater is severe. Capability subclass IIc; Overflow range site.

15—Lawther silty clay, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and fans and in upland swales. Individual areas are irregular in shape and range from about 15 to 100 acres in size. Slopes are long and smooth.

Typically, the surface layer is gray silty clay about 6 inches thick. The subsoil is dark gray clay about 30 inches thick. The substratum to a depth of about 60 inches is clay. It is olive gray in the upper part and olive in the lower part. In a few places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Belfield, Daglum, Regent, and Moreau soils. These soils make up less than 15 percent of the unit. The Belfield and Daglum soils contain excess sodium. The Regent and Moreau soils have bedrock at a depth of 20 to 40 inches.

Permeability is slow, and available water capacity is high. The surface layer can be easily tilled within a narrow range in moisture content. It tends to puddle and crust following heavy rains. The shrink-swell potential is high. Potential frost action is low.

Most areas of this soil are cultivated. Some are used as rangeland. The potential for cultivated crops and rangeland is good; the potential for windbreaks, openland wildlife habitat, and most engineering uses is fair; and the potential for recreation uses and rangeland wildlife habitat is poor.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is slight. Stubble mulch, stripcropping, and minimum tillage and grassed waterways in drainageways help in controlling erosion. They also maintain the organic-matter content and fertility and increase the infiltration rate. Tillage at the proper moisture content provides a good seedbed.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion. Overgrazing reduces plant vigor and lowers yields. Proper stocking rates, pasture rotation, and timely deferment of grazing keep the pasture in good condition.

This soil is suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can grow well.

This soil is suitable as a site for most sanitary facilities and for engineering structures. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the tile field. If the soil is used as a site for buildings, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Capability subclass IIs; Clayey range site.

17—Heil silty clay loam. This deep, level, poorly drained soil is on terraces, in glacial trenches, and in basins on uplands. Unless drained, it is usually ponded early in spring and for short periods following heavy rains. Individual areas are irregular in shape and range from about 3 to 60 acres in size.

Typically, the surface layer is black silt loam about 2 inches thick. The subsurface layer is dark gray silty clay loam about 2 inches thick. The subsoil is very dark gray clay about 34 inches thick. The substratum to a depth of about 60 inches is very dark gray clay over olive silty clay and silty clay loam. In places the thickness of the surface layer combined with that of the subsurface layer is more than 5 inches.

Included with this soil in mapping are small areas of Harriet Variant silt loam. This included soil makes up about 5 to 15 percent of the unit. It contains less clay and more salts than the Heil soil.

Permeability is very slow, and available water capacity is moderate. The water table is within a depth of 1 foot during most of the year. Some areas are drained. The shrink-swell potential is high. Potential frost action is moderate.

Most areas are used as rangeland. A few are used for cultivated crops. This soil has good potential for rangeland and for wetland wildlife habitat and poor potential for crops, windbreaks, and most engineering and recreation uses.

This soil is generally unsuited to wheat, oats, barley, and grasses and legumes because it is wet and contains excess salts and sodium.

The use of this soil as rangeland, hayland, or pastureland protects the soil. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing during wet periods keep the pasture and the range in good condition.

This soil is generally unsuited to trees and shrubs grown as windbreaks and environmental plantings because of the ponding and the excess sodium.

This soil is generally unsuited to building site development and onsite waste disposal. As a result of the seasonal high water table, the high content of clay, the excess sodium, the shrink-swell potential, and the ponding, design, installation, and maintenance are costly. In this survey area Heil soils are generally not used as building sites. More desirable sites are generally nearby. Capability subclass VIs; Closed Depression range site.

20—**Lohler silty clay.** This deep, level, moderately well drained soil is on bottom land. All areas but those where the Knife and Missouri Rivers flow together are protected against flooding by the Garrison Dam. The areas are mostly long and narrow and range from about 25 to 200 acres in size.

Typically, the surface layer is grayish brown silty clay about 8 inches thick. The substratum to a depth of about 60 inches is grayish brown silty clay with thin, dark layers and thin strata of silty clay loam and loam. In a few places thin strata of sandy material are below a depth of 40 inches.

Included with this soil in mapping are small areas of well drained Havrelon soils and a few areas of poorly drained soils. These soils make up about 5 to 20 percent of the unit. The Havrelon soils contain less clay than this Lohler soil.

Permeability is moderately slow or slow, and available water capacity is high. The seasonal high water table fluctuates between depths of 3 and 5 feet during part of the year. Surface runoff is slow. This soil can be easily tilled within a narrow range in moisture content. The shrink-swell potential is high. Potential frost action is moderate.

Most areas are used for cultivated crops. A few are in native grass and trees and are used as rangeland. A few are irrigated. This soil has good potential for crops, windbreaks, rangeland, and for openland wildlife habitat and fair potential for most engineering and recreation uses and rangeland wildlife habitat.

This soil is well suited to wheat, barley, oats, and grasses and legumes. Tillage at the optimum moisture content overcomes the tendency of the soil to puddle and crust and provides an adequate seedbed. The hazard of soil blowing is severe, especially early in spring. Stripcropping, minimum tillage, stubble mulch, and windbreaks help to control erosion, conserve moisture, and improve water intake. In some areas leaving belts of native trees when clearing the land helps to control soil blowing.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Proper stocking rates, pasture rotation, and timely deferment of grazing during wet periods keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is suitable as a site for buildings and sanitary facilities if it is protected against flooding by the Garrison Dam. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIs; Overflow range site.

21B—Lihen loamy fine sand, 1 to 6 percent slopes. This deep, nearly level and undulating, somewhat excessively drained soil is on terraces and uplands. It is crossed by a few shallow drainageways. In most places the drainageways are indistinct. Individual areas range from about 10 to 200 acres in size. Slopes are short and uneven.

Typically, the surface layer is dark grayish brown loamy fine sand about 17 inches thick. Next is a dark brown loamy fine sand transitional layer about 7 inches thick. The substratum to a depth of about 60 inches is dark brown and pale brown fine sand with layers of loamy fine sand and very fine sandy loam. In some places clay loam glacial till is at a depth of about 50 inches. In others the surface layer is thinner and lighter colored.

Included with this soil in mapping are small areas of Krem soils. These soils make up about 15 percent of the unit. They have clay loam glacial till at a depth of 16 to 40 inches. Also included are a few areas of a similar soil in which the seasonal high water is about 4 feet from the surface.

Permeability is rapid, and available water capacity is low. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is low. Potential frost action also is low.

Most areas are in native grass and are used as rangeland or hayland. A few are cultivated. The potential for cultivated crops, windbreaks, some sanitary facilities, and rangeland wildlife habitat is poor; the potential for openland wildlife habitat and recreation uses is fair; and the potential for some engineering uses and for rangeland is good.

This soil is poorly suited to wheat, oats, barley, and grasses and legumes because of a severe hazard of soil blowing, the low available water capacity, and droughtiness. Intensive use of stubble mulch helps in controlling soil blowing.

The use of this soil as pastureland, hayland, or rangeland is effective in controlling erosion. Overgrazing reduces plant vigor and increases the hazard of soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and uniform grazing distribution keep the pasture and the soil in good condition.

This soil is poorly suited to windbreaks and environmental plantings. A few of the climatically suited trees and shrubs can grow fairly well. Soil blowing is a severe hazard in disturbed areas.

If this soil is used as a site for sanitary facilities, seepage can be a problem and the effluent can contaminate ground water. The low available water capacity and resultant droughtiness are problems in establishing and maintaining lawns and in landscaping around buildings and in recreation areas. Frequent applications of fertilizer and irrigation water and additions of topsoil are beneficial. Cutbanks can cave unless trench and excavation walls are shored. Capability subclass IVe; Sands range site.

21D—Telfer loamy fine sand, 6 to 15 percent slopes. This deep, gently rolling and rolling, excessively drained soil is on terraces and uplands. It is crossed by a few shallow drainageways. Individual areas are irregular in shape and range from about 10 to 100 acres in size. Slopes are convex and mostly short and uneven, but some are long and smooth.

Typically, the surface layer is dark grayish brown loamy fine sand about 10 inches thick. Next is a grayish brown fine sand transitional layer. The substratum to a depth of about 60 inches is brown fine sand. In some places the surface layer is thinner and lighter colored, in some it is fine sandy loam, and in others it is dark colored to a greater depth.

Included with this soil in mapping are small areas of Parshall soils in swales. These soils make up less than 15 percent of the unit. They have a fine sandy loam subsoil.

Permeability is rapid, and available water capacity is low. Surface runoff is slow to medium. The shrink-swell potential is low. Potential frost action also is low.

Nearly all areas are used as rangeland. A few small areas are cultivated. This soil has good potential for rangeland and some engineering uses, fair potential for rangeland wildlife habitat and most recreation uses, and poor potential for cultivated crops, windbreaks, and most sanitary facilities.

This soil is generally unsuited to cultivated crops because of a severe hazard of soil blowing, droughtiness, the low available water capacity, and the slope.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Overgrazing reduces plant vigor and increases the hazard of soil blowing. Proper stocking rates, pasture rotation, timely deferment of grazing, and a planned grazing system keep the pasture and the soil in good condition.

This soil is generally unsuited to trees and shrubs grown as windbreaks and environmental plantings because of the low available water capacity, the droughtiness, and the hazard of soil blowing.

This soil is generally suitable as a site for buildings. If the soil is disturbed, however, soil blowing is a hazard. Minimizing the size of the area that is stripped of vegetation reduces the risk of soil blowing. The soil is also generally suited to onsite disposal of waste from septic tanks. Contamination of ground water is a hazard because of seepage. The limitations in establishing and maintaining lawns and in landscaping can be overcome in part by frequent applications of fertilizer and irrigation water and by additions of topsoil. Capability subclass VIe; Sands range site.

22B—Krem loamy fine sand, 1 to 6 percent slopes. This deep, nearly level and undulating, well drained soil is on sand-mantled glacial till plains. It is crossed by a few shallow drainageways that in places are indistinct. Slopes are plane, concave, or convex and are mostly short and smooth. Individual areas are irregular in shape and range from about 10 to more than 400 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 25 inches thick. The subsoil is about 35 inches thick. The upper part is brown loamy sand, and the lower part is light brownish gray clay loam. In some places the clay loam subsoil is at a depth of about 10 inches, in others the surface layer is fine sandy loam about 3 inches thick, and in a few soft bedrock is at a depth of about 50 inches.

Included with this soil in mapping are small areas of Lihen soils in swales and Williams soils on the tops of knobs and ridges. These soils make up 5 to 20 percent of the unit. The Lihen soils are somewhat excessively drained and are not underlain by clay loam glacial till. The Williams soils do not have a sandy surface layer. Also included are formerly cultivated areas that are moderately eroded to severely eroded.

Permeability is rapid in the upper part of this soil and moderately slow in the lower part. Available water capacity is moderate. Surface runoff is slow to medium. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate in the sandy surface layer and moderate in the clay loam. Potential frost action is moderate.

Most areas are in native grass and are used as rangeland or hayland. A few areas are used for cultivated crops. The potential for rangeland, most engineering uses, and openland wildlife habitat is good, and the potential for cultivated crops, windbreaks, sanitary facilities, recreation uses, and rangeland wildlife habitat is fair.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is severe. Intensive management that includes the use of stubble mulch, crop residue management, windbreaks, and minimum tillage is needed to control soil blowing.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Overgrazing reduces plant vigor, decreases the desirable species, and increases the hazard of soil blowing. Proper stocking rates, uniform grazing distribution, pasture rotation, and timely deferment of grazing keep the pasture in good condition.

This soil is suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can grow well. Soil blowing is a severe hazard in disturbed areas. The moderate available water capacity in the surface layer is a limitation in establishing trees and shrubs.

This soil is generally suitable as a site for buildings, most sanitary facilities, and engineering structures. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IVe; Sands range site.

22D—**Krem loamy fine sand, 6 to 15 percent slopes.** This deep, gently rolling and rolling, well drained soil is on sand-mantled glacial till plains that are crossed by a few shallow drainageways. Many areas are along or at the head of incised drainageways. Slopes are mostly short and smooth. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 25 inches thick. The subsoil is about 35 inches thick. The upper part is brown loamy sand, and the lower part is light brownish gray clay loam. In some places the clay loam subsoil is at a depth of about 10 inches, in some the surface layer is fine sandy loam about 3 inches thick, and in others soft bedrock is at a depth of about 50 inches.

Included with this soil in mapping are small areas of Lihen soils in swales and Williams and Zahl soils on the tops of knobs, ridges, and hills. These soils make up about 5 to 20 percent of the unit. The Lihen soils are somewhat excessively drained and are not underlain by clay loam glacial till. The Williams and Zahl soils do not have a sandy surface layer.

Permeability is rapid in the upper part of this soil and moderately slow in the lower part. Available water capacity is moderate. Surface runoff is medium. The shrink-swell potential is low in the sandy surface layer and moderate in the clay loam. Potential frost action is moderate.

Most areas are in native grass and are used as rangeland. The soil has good potential for rangeland, fair potential for most recreation uses and for engineering uses and openland and rangeland wildlife habitat, and poor potential for windbreaks and cultivated crops.

This soil is generally unsuited to wheat, barley, oats, and grasses and legumes because of a severe hazard of soil blowing, slope, and droughtiness.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Overgrazing reduces the desirable species, decreases plant vigor, and increases the hazard of soil blowing. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the pasture in good condition.

This soil is poorly suited to trees and shrubs in windbreaks. Special plantings can be made for esthetic purposes or for wildlife habitat. Some of the climatically suited species can grow fairly well. In disturbed areas the hazard of soil blowing is severe.

This soil is generally suited to building site development and to most sanitary facilities and engineering uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Less sloping sites should be selected for sewage lagoons and playgrounds. Capability subclass VIe; Sands range site.

27—**Mandan silt loam, 1 to 3 percent slopes.** This deep, nearly level, well drained soil is on loess-mantled glacial till uplands and on terraces. It is crossed by a few shallow drainageways that in places fan out and are indistinct. Individual areas are irregular in shape and range from about 5 to 150 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is dark grayish brown silt loam about 13 inches thick. The subsoil is silt loam about 17 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is silt loam. The upper part is light brownish gray, and the lower part is light yellowish brown. The substratum contains a thin, dark old buried surface layer. In some places clay loam glacial till is at a depth of about 50 inches, in others gravel is at a depth of about 50 inches, and in a few the subsoil is silty clay loam.

Included with this soil in mapping are small areas of poorly drained Tonka soils in slight depressions and Wilton soils on slightly convex slopes. These soils make up less than 10 percent of the unit. The Wilton soils have clay loam glacial till at a depth of 26 to 40 inches.

Permeability and available water capacity are moderate. Surface runoff is slow. The soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are cultivated. Some are in native grasses and are used as rangeland. The potential for windbreaks, rangeland, cultivated crops, most sanitary facilities, engineering uses, recreation uses, and openland wildlife habitat is good, and the potential for rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is moderate. Soil blowing can be controlled by the use of stubble mulch, minimum tillage, stripcropping, and crop residue management.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates, uniform grazing distribution, and a planned grazing system keep the pasture in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited as a site for buildings, sanitary facilities, and most engineering structures. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIe; Silty range site.

27B—Mandan silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on loess-mantled glacial till uplands and on terraces. Areas are crossed by shallow drainageways. They are mostly irregular in shape and range from about 10 to 250 acres in size. The surface is plane and convex.

Typically, the surface layer is dark grayish brown silt loam about 13 inches thick. The subsoil is silt loam about 17 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is silt loam. The upper part is light brownish gray, and the lower part is light yellowish brown. The substratum contains a thin, dark old buried surface layer. In some areas clay loam glacial till is at a depth of about 50 inches, in others gravel is at a depth of about 50 inches, and in a few the subsoil is silty clay loam. In a few places the surface layer is not dark colored to so great a depth.

Included with this soil in mapping are small areas of Temvik soils on convex slopes and poorly drained Tonka soils in slight depressions. These soils make up less than 15 percent of the unit. The Temvik soils have clay loam glacial till at a depth of 26 to 40 inches.

Permeability and available water capacity are moderate. Surface runoff is slow. The soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are cultivated. Some are in native grasses and are used as rangeland. This soil has good potential for windbreaks, rangeland, cultivated crops, sanitary facilities, most engineering uses, recreation uses, and openland wildlife habitat. It has fair potential for rangeland wildlife habitat.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is moderate. Stubble mulch, minimum tillage, stripcropping, and crop residue management help to control soil blowing. They also maintain the organic-matter content and the water intake rate.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates, uniform grazing distribution, and a planned grazing system keep the pasture in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited as a site for buildings, sanitary facilities, and most engineering structures. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIe; Silty range site.

28—Wilton silt loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on loess-mantled glacial till plains. Areas are crossed by shallow drainageways that fan out and are indistinct in places. They are irregular in shape and range from about 20 to 100 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsoil is about 22 inches thick. It is dark grayish brown silt loam in the upper part and grayish brown clay loam in the lower part. The substratum to a depth of about 60 inches is clay loam. It is light brownish gray in the upper part and light yellowish brown in the lower part. In some places the soil is not dark colored to so great a depth. In others the clay loam is below a depth of 40 inches, and in a few it is within a depth of 26 inches.

Included with this soil in mapping are small areas of Williams soils on convex knobs and ridges and poorly drained Tonka soils in depressions. These soils make up 5 to 20 percent of the unit. The Williams soils have a clay loam subsoil.

Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is high. Surface runoff is slow. The soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. A few are in grass and are used as rangeland. The potential for rangeland, windbreaks, cultivated crops, most engineering uses, recreation uses, and openland wildlife habitat is good. The potential for sanitary facilities and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Stubble mulch, minimum tillage, windbreaks, and stripcropping help to control soil blowing and maintain the organic-matter content and fertility.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion. Proper stocking rates, deferred grazing, uniform grazing distribution, and a planned grazing system keep the pasture in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and most engineering uses. The slow absorption of effluent in septic tank absorption fields can be overcome by enlarging the field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIc; Silty range site.

28B—Temvik-Williams silt loams, 3 to 6 percent slopes. This map unit consists of deep, undulating, well drained soils on loess-mantled glacial till plains. Areas are crossed by a few shallow drainageways. They are irregular in shape and range from about 5 to more than 800 acres in size. Slopes are mostly short and smooth.

Areas of this map unit are about 50 to 75 percent Temvik soils and 20 to 45 percent Williams soils. The Temvik soils are on the plane and convex lower side slopes. The Williams soils are on the convex knobs, ridges, and upper side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Temvik soil has a dark grayish brown silt loam surface layer about 11 inches thick. The subsoil is brown silt loam about 16 inches thick. The substratum to a depth of about 60 inches is clay loam glacial till. It is grayish brown in the upper part, light brownish gray in the next part, and light yellowish brown in the lower part. In places the soil is dark colored to a greater depth.

Typically, the Williams soil has a dark grayish brown silt loam surface layer about 8 inches thick. The subsoil is clay loam about 16 inches thick. It is dark brown in the upper part and brown in the lower part. The substratum to a depth of about 60 inches is clay loam. It is light brownish gray in the upper part and light yellowish brown in the lower part. In some places the soil is dark colored to a greater depth, and in others the surface layer is loam.

Included with this unit in mapping are small areas of the poorly drained Tonka soils and very poorly drained Parnell soils in potholes and slight depressions, well drained Grassna soils in swales, and Zahl soils on convex knobs and ridges. These soils make up about 5 to 20 percent of the unit. The Grassna soils do not have a clay loam till glacial substratum. The Zahl soils are lighter colored than the Temvik and Williams soils.

Permeability is moderate in the subsoil of the Temvik and Williams soils and moderately slow in the substratum. Available water capacity is high, and surface runoff is medium. These soils can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. A few are in native grasses and are used as rangeland. The potential for cultivated crops, rangeland, windbreaks, most sanitary facilities, most recreation uses, and openland wildlife habitat is good. The potential for rangeland wildlife habitat is fair.

These soils are well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Stubble mulch, minimum tillage, windbreaks, and strip-cropping help to control erosion and maintain the organic-matter content and fertility.

The use of these soils as rangeland is effective in controlling erosion. Proper stocking rates, deferred grazing, uniform grazing distribution, and a planned grazing system keep the range and the soil in good condition.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

These soils are well suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soils are used as building sites, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. The slope is a limitation if the soils are used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIe; Silty range site.

28C—Temvik-Williams silt loams, 6 to 9 percent slopes. This map unit consists of deep, gently rolling, well drained soils on loess-mantled glacial till plains. Areas are crossed by well defined, shallow drainageways. They are irregular in shape and range from about 5 to 80 acres in size. They are about 50 to 65 percent Temvik soils and 20 to 45 percent Williams soils. The Temvik soils are on the plane and convex lower side slopes. The Williams soils are on the convex knobs, ridges, and upper side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Temvik soil has a dark grayish brown silt loam surface layer about 8 inches thick. The subsoil is brown silt loam about 16 inches thick. The substratum to a depth of 60 inches is clay loam glacial till. It is grayish brown in the upper part, light brownish gray in the next part, and light yellowish brown in the lower part. In places the soil is dark colored to a greater depth.

Typically, the Williams soil has a dark grayish brown silt loam surface layer about 6 inches thick. The subsoil is clay loam about 16 inches thick. It is dark brown in the upper part and brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light brownish gray in the upper part and light yellowish brown in the lower part. In some places the soil is dark colored to a greater depth, and in others the surface layer is loam.

Included with this unit in mapping are small areas of Grassna soils in swales and Zahl soils on convex knobs, hills, and ridges. These soils make up about 5 to 15 percent of the unit. The Grassna soils do not have a clay loam glacial till substratum. The Zahl soils are lighter colored than the Temvik and Williams soils.

Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is high, and surface runoff is medium. The soils can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops or rangeland. The potential for rangeland, windbreaks, most sanitary facilities, most engineering uses, and most recreation uses is good. The potential for openland wildlife and rangeland wildlife habitat and cultivated crops is fair.

These soils are suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Stubble mulch, crop residue management, stripcropping, windbreaks, grassed waterways, and minimum tillage help to control erosion and maintain tilth, organic-matter content, and fertility.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion. Proper stocking rates, deferred grazing, uniform grazing distribution, and a planned grazing system keep the pasture and the soil in good condition.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

These soils are well suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soils are used as building sites, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Alternative sites should be selected for playgrounds because of the slope. Capability subclass IIIe; Silty range site.

35C—Amor-Werner loams, 6 to 9 percent slopes. This map unit consists of moderately deep and shallow, moderately sloping, well drained soils on residual uplands. Areas are dissected by well defined drainageways. They are mostly irregular in shape and range from about 10 to more than 150 acres in size. Slopes are mostly long and smooth.

Areas of this map unit are 50 to 70 percent Amor soils and 20 to 40 percent Werner soils. The Amor soils are on the plane or convex, mid and lower side slopes. The Werner soils are on the convex tops of ridges and knobs and on the upper side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Amor soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is loam about 12 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum is light brownish gray loam about 12 inches thick. Below this to a depth of about 60 inches is pale olive, soft sandstone. In places the subsoil is silt loam or fine sandy loam.

Typically, the Werner soil has a surface layer of grayish brown loam about 8 inches thick. Below this is a transitional layer of light brownish gray loam about 4 inches thick. The substratum is light brownish gray loam about 5 inches thick. Below this to a depth of about 60 inches is light olive gray sandstone. In some areas the surface layer is not so dark colored. In some places the soil is silt loam, and in others it is less than 10 inches deep over soft sandstone.

Included with this unit in mapping are small areas of Arnegard and Grail soils in swales and on foot slopes. These soils make up 5 to 15 percent of the unit. They are dark colored to a greater depth than the Amor or Werner soils, and they do not have soft sandstone within 60 inches of the surface.

Permeability is moderate in the Amor and Werner soils. Available water capacity is moderate in the Amor soil and low in the Werner soil. Surface runoff is medium. The Amor soil can be easily tilled throughout a fairly wide range in moisture content, but the Werner soil is more difficult to till, especially when too wet or too dry. Roots are restricted by the soft sandstone at a depth of about 32 inches in the Amor soil and 17 inches in the Werner soil. The shrink-swell potential is moderate. Potential frost action also is moderate.

About half of the acreage is cultivated, and the rest is in native grass and is used as rangeland. The potential for rangeland is good. The potential for cultivated crops, some sanitary facilities, some engineering uses, most recreation uses, and openland and rangeland wildlife habitat is fair. The potential for windbreaks is good on the Amor soil and poor on the Werner soil.

These soils are suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight to moderate. Minimum tillage, crop residue management, stubble mulch, grassed waterways, windbreaks, and stripcropping help to control soil blowing and also maintain tilth, organic-matter content, and fertility.

The use of these soils as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates, uniform distribution of grazing, deferred grazing, and a planned grazing system keep the pasture and the soil in good condition.

The Amor soil is well suited and the Werner soil poorly suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well on the Amor soil, but only a limited number of species can grow fairly well on the Werner soil.

These soils are suited to building site development and most engineering uses. If the soils are used as building sites, the depth to rock can be easily overcome because the rock is soft and easily excavated. The effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Septic tank absorption fields should be located on the Amor part of the unit. Alternative sites should be selected for sewage lagoons, pond reservoir areas, and playgrounds. Capability subclass IIIe; Amor soil in Silty range site, Werner soil in Shallow range site.

35D—Amor-Werner loams, 9 to 15 percent slopes. This map unit consists of moderately deep and shallow, strongly sloping, well drained soils on residual uplands. Individual areas are mostly irregular in shape and range from about 10 to 80 acres in size. Slopes are mostly long and smooth.

Areas of this map unit are about 45 to 65 percent Amor soils and 25 to 45 percent Werner soils. The Amor soils are on the plane or convex, mid and lower side slopes. The Werner soils are on the convex tops of ridges and knobs and on the upper side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Amor soil has a dark grayish brown loam surface layer about 6 inches thick. The subsoil is loam about 10 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum is light brownish gray loam about 10 inches thick. Below this to a depth of about 60 inches is pale olive, soft sandstone. In places the subsoil is silt loam or fine sandy loam.

Typically, the Werner soil has a surface layer of grayish brown loam about 8 inches thick. Below this is a transitional layer of light brownish gray loam about 4 inches thick. The substratum is light brownish gray loam about 5 inches thick. Below this to a depth of about 60 inches is light olive gray sandstone. In some areas the surface layer is not so dark colored. In some places the soil is silt loam, and in others it is less than 10 inches deep over soft sandstone.

Included with this unit in mapping are small areas of Arnegard and Grail soils in swales and on foot slopes. These soils make up 5 to 15 percent of the unit. They are dark colored to a greater depth than the Amor and Werner soils, and they do not have soft sandstone within 60 inches of the surface.

Permeability is moderate in the Amor and Werner soils. Available water capacity is moderate in the Amor soil and low in the Werner soil. Surface runoff is medium to rapid. The Amor soil can be easily tilled throughout a fairly wide range in moisture content, but the Werner soil is more difficult to till, especially when too wet or too dry. Roots are restricted by the soft sandstone at a depth of about 26 inches in the Amor soil and 17 inches in the Werner soil. The shrink-swell potential is moderate. Potential frost action also is moderate.

The potential of these soils for cultivated crops is poor, the potential for rangeland is good, and the potential for some sanitary facilities, some engineering uses, most recreation uses, and rangeland and openland wildlife habitat is fair. The Amor soil has fair potential and the Werner soil poor potential for windbreaks.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes. The soil blowing hazard is moderate to slight, and the water erosion hazard is severe. Minimum tillage, grassed waterways, stubble mulch, and stripcropping help to control erosion and maintain the organic-matter content and fertility.

The use of these soils as rangeland is effective in controlling erosion. Proper stocking rates, uniform distribution of grazing, deferred grazing, and a planned grazing system keep the range and the soil in good condition.

The Amor soil is suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs can grow well. The Werner soil is poorly suited; only a few species can grow fairly well.

These soils are suited to building site development and to most engineering uses. If the soils are used as building sites, the depth to rock can be easily overcome because the rock is soft and easily excavated. The effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Septic tank absorption fields are best located on the Amor part of the unit. Alternative sites should be selected for sewage lagoons, pond reservoir areas, and playgrounds. For most uses, for example, building site development, the slope can be overcome by cutting and filling. Capability subclass IVe; Amor soil in Silty range site, Werner soil in Shallow range site.

36—Williams loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on glacial till uplands. Areas are crossed by a few shallow drainageways that fan out and are indistinct in places. They are irregular in shape and range from about 5 to 80 acres in size. Slopes are short and smooth.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is clay loam about 19 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In a few places the surface layer is silt loam, and in a few the surface is very stony. In some the dark colored surface layer is thicker. In others the upper part of the subsoil has been mixed with the surface layer by plowing.

Included with this soil in mapping are small areas of the poorly drained Tonka soils and very poorly drained Parnell soils in shallow depressions and potholes. These soils make up less than 10 percent of the unit.

Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is high. Surface runoff is slow. The soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland and hayland. The potential for rangeland, windbreaks, cultivated crops, most engineering uses, recreation uses, and openland wildlife habitat is good. The potential for rangeland wildlife habitat and most sanitary facilities is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Stubble mulch, minimum tillage, and grasses and legumes in the cropping system help to control erosion and maintain the organic-matter content and fertility.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion and protecting the soil. Proper stocking rates and uniform grazing distribution keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is generally suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIc; Silty range site.

36B—Williams loam, 3 to 6 percent slopes. This deep, undulating well drained soil is on glacial till uplands. Areas are crossed by a few shallow drainageways that fan out and are indistinct in places. They are irregular in shape and range from about 20 to more than 800 acres in size. Slopes are short and smooth.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is clay loam about 19 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In a few places the surface layer is silt loam, and in a few the soil has cobblestones on the surface or is very stony. In some the dark colored surface layer is thicker. In others the upper part of the subsoil has been mixed with the surface layer by plowing.

Included with this soil in mapping are small areas of Tonka, Parnell, and Zahl soils. These soils make up less than 10 percent of the unit. The poorly drained Tonka soils and very poorly drained Parnell soils occupy shallow depressions and potholes. The Zahl soils occupy knobs and low ridges. They have no subsoil, whereas the Williams soil has a subsoil in which clay has accumulated.

Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is high. Surface runoff is medium. The soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland or hayland. The potential for rangeland, windbreaks, cultivated crops, most engineering uses, recreation uses, and openland wildlife habitat is good. The potential for rangeland wildlife habitat and most sanitary facilities is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are slight. Stubble mulch, minimum tillage, windbreaks, and stripcropping help to control erosion and maintain the organic-matter content and fertility.

The use of this soil as rangeland is effective in controlling erosion. Proper stocking rates and uniform grazing distribution keep the range and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is generally suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIe; Silty range site.

36C—Williams loam, 6 to 9 percent slopes. This deep, gently rolling, well drained soil is on glacial till uplands. Areas are crossed by a few well defined drainageways. They are irregular in shape and range from 10 to more than 100 acres in size. Slopes are mostly short and smooth, but some are long.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In a few places the surface layer is silt loam. In a few the soil is very stony or the surface layer contains cobblestones. In some the dark colored surface layer is thicker. In others the upper part of the subsoil has been mixed with the surface layer by plowing.

Included with this soil in mapping are small areas of Zahl, Tonka, Parnell, Amor, Sen, and Vebar soils. These soils make up 5 to 10 percent of the unit. The poorly drained Tonka soils and very poorly drained Parnell soils are in shallow depressions and potholes. The Zahl soils are on knobs and ridges. They are lighter colored than this Williams soil. Amor, Sen, and Vebar soils have soft bedrock at a depth of 20 to 40 inches.

Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is high. Surface runoff is medium. This soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland. The potential for cultivated crops, most sanitary facilities, and rangeland wildlife habitat is fair. The potential for most recreation uses, rangeland, most engineering uses, and openland wildlife habitat is good.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Stubble mulch, minimum tillage, stripcropping, windbreaks, and grassed waterways help to control erosion and maintain the organic-matter content and fertility.

The use of this soil as rangeland is effective in controlling erosion. Proper stocking rates and uniform grazing distribution keep the range and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is generally suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Alternative sites should be selected for playgrounds. Capability subclass IIIe; Silty range site.

38C—**Williams-Zahl loams, 6 to 9 percent slopes.** This map unit consists of deep, gently rolling, well drained soils on glacial till uplands. Areas are crossed by a few shallow to well defined drainageways. They are mostly long and narrow and range from about 5 to 80 acres in size. Slopes are short and smooth.

Areas of this map unit are about 50 to 70 percent Williams soils and 20 to 45 percent Zahl soils. The Williams soils are on side slopes, and the Zahl soils are on the crests and tops of ridges and knobs. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 6 inches thick. The subsoil is clay loam about 12 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In a few places the surface layer is very stony or contains some cobblestones, in others the subsoil has been mixed with the surface layer by plowing, and in a few the dark colored surface layer is thicker.

Typically, the Zahl soil has a surface layer of dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is clay loam glacial till. It is light brownish gray in the upper part and light yellowish brown in the lower part. In cultivated areas the lighter colored part of the clay loam substratum has been mixed with the surface layer by plowing. In some places a transitional layer of grayish brown loam is between the surface layer and the substratum, in a few the surface is very stony, and in some bedrock is at a depth of about 35 inches.

Included with this unit in mapping are small areas of Tonka, Parnell, and Werner soils. These soils make up less than 10 percent of the unit. The poorly drained Tonka soils and very poorly drained Parnell soils occupy shallow depressions and potholes. The Werner soils occupy the tops of knobs and ridges. They have soft bedrock at a depth of 10 to 20 inches.

Permeability is moderate in the subsoil of the Williams soil and moderately slow in the substratum. It is moderately slow in the Zahl soil. Available water capacity is high. Surface runoff is medium. The Williams soil can be easily tilled throughout a fairly wide range and the Zahl soil within a fairly narrow range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

About half of the acreage is used as rangeland, and the rest is used for cultivated crops. The potential for rangeland, most engineering uses, most recreation uses, and openland wildlife habitat is good. The potential for windbreaks, sanitary facilities, cultivated crops, and rangeland wildlife habitat is fair.

These soils are suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight to moderate. Stubble mulch, minimum tillage, stripcropping, windbreaks, and grassed waterways help to control soil blowing and maintain good tilth, organic-matter content, and fertility.

The use of these soils as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the range in good condition.

The Zahl soil is poorly suited to windbreaks and environmental plantings. Only a few of the climatically suited trees and shrubs can grow fairly well. The Williams soil is well suited; all climatically suited species can grow well.

These soils are suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Alternative sites should be selected for playgrounds. Capability subclass IIIe; Williams soil in Silty range site, Zahl soil in Thin Upland range site.

38D—**Zahl-Williams loams, 9 to 15 percent slopes.** This map unit consists of deep, well drained soils on glacial till uplands. It is on moraines of the glacial till plain or in areas adjacent to incised drainageways. It is rolling on the moraines and strongly sloping in the areas adjacent to drainageways. Individual areas are mostly long and narrow or irregularly shaped and range from about 5 to 80 acres in size. Scattered pebbles, cobblestones, and stones are on the surface. Slopes are mostly short and smooth.

Areas of this map unit are about 45 to 70 percent Zahl soils and 25 to 50 percent Williams soils. The Zahl soils are on the crests of ridges, the upper side slopes, and the narrow ridgetops. The Williams soils are on side slopes and broad ridgetops. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Zahl soil has a surface layer of dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is clay loam glacial till. It is light brownish gray in the upper part and light yellowish brown in the lower part. In cultivated areas the lighter colored part of the clay loam substratum has been mixed with the surface layer by plowing. In some places a transitional layer of grayish brown loam is between the surface layer and the substratum, in others the surface is very stony, and in a few soft bedrock is at a depth of about 35 inches.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 5 inches thick. The subsoil is clay loam about 10 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In a few places the surface is very stony, in others the subsoil has been mixed with the surface layer by plowing, and in a few the dark colored surface layer is thicker.

Included with this unit in mapping are small areas of Tonka, Parnell, and Werner soils. These soils make up less than 10 percent of the unit. The poorly drained Tonka soils and very poorly drained Parnell soils occupy shallow depressions and potholes. The Werner soils occupy the tops of knobs and ridges. They have soft bedrock at a depth of 10 to 20 inches.

Permeability is moderately slow in the Zahl soil. It is moderate in the subsoil of the Williams soil and moderately slow in the substratum. Available water capacity is high. Surface runoff is medium to rapid. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used as rangeland. Some small areas are used for cultivated crops. The potential for rangeland is good. The potential for sanitary facilities, windbreaks, most engineering uses, most recreation uses, and rangeland wildlife habitat is fair. The potential for cultivated crops is poor.

These soils are generally unsuited to wheat, barley, oats, and grasses and legumes because of slope and an erosion hazard.

The use of these soils as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates, uniform grazing distribution, and a planned grazing system keep the pasture and the soil in good condition.

These soils are suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soils are used as building sites, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. The slope is a limitation for most uses, but this limitation can be overcome by cutting and filling. Alternative sites should be selected for playgrounds. Capability subclass VIe; Zahl soil in Thin Upland range site, Williams soil in Silty range site.

38E—Zahl loam, 15 to 35 percent slopes. This deep, well drained, hilly and moderately steep to steep soil is on hillsides and ridges and along incised drainageways. Slopes are mostly short and smooth. Individual areas are mostly long and narrow or irregularly shaped and range from about 5 to 60 acres in size.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is clay loam glacial till. It is light brownish gray in the upper part and light yellowish brown in the lower part. Scattered pebbles, cobbles, and stones are on the surface. In some places a transitional layer of grayish brown loam is between the surface layer and the substratum, in others the surface is very stony, and in a few soft bedrock is at a depth of about 35 inches.

Included with this soil in mapping are small areas of Cabba and Werner soils on the crests of ridges and along drainageways, Williams soils on broad ridgetops and at mid slope, and Arnegard soils in swales. These soils make up 5 to 20 percent of the unit. The Cabba and Werner soils have soft bedrock at a depth of 10 to 20 inches. The Williams soils have a subsoil. The Arnegard soils have a thicker, dark colored surface layer.

Permeability is moderately slow, and available water capacity is high. Surface runoff is rapid. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used almost exclusively as rangeland. The potential for rangeland is good, and the potential for windbreaks, cultivated crops, sanitary facilities, some engineering uses, and most recreation uses is poor. The potential for openland and rangeland wildlife habitat is fair.

This soil is generally unsuited to wheat, oats, barley, and grasses and legumes because of slope and a severe erosion hazard.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and protecting the soil. Proper stocking rates, uniform grazing distribution, and a planned grazing system keep the soil and the pasture in good condition.

This soil is generally unsuited to trees and shrubs grown as windbreaks and environmental plantings. It is suited to scalp plantings or special plantings for esthetic or wildlife purposes, but intensive management is needed.

This soil is generally poorly suited to most building site developments because of slope. Alternative sites should be selected. Capability subclass VIe; Thin Upland range site.

40—Shambo loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and fans. Runoff from surrounding uplands crosses this soil in shallow drainageways, but the drainage pattern is indistinct in places. Slopes are long and smooth. Individual areas are commonly irregular in shape and range from 5 to more than 150 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is loam about 16 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum to a depth of about 60 inches is light brownish gray, stratified loam, silt loam, and silty clay loam. In some places the surface layer is thicker, in others it is silt loam, and in some the subsoil is silt loam.

Included with this soil in mapping are small areas of Belfield and Daglum soils. These soils make up about 5 to 10 percent of the unit. They have more clay and more sodium in the subsoil than this Shambo soil.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are cultivated. Some are in native grass and are used as rangeland or hayland. The potential for rangeland, windbreaks, cultivated crops, sanitary facilities, most engineering uses, recreation uses, and openland wildlife habitat is good. The potential for rangeland wildlife habitat is fair.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. The hazard of water erosion is slight in most areas, but on long slopes it is moderate. Minimum tillage, crop residue management, and grassed waterways help to control erosion and maintain the organic-matter content, fertility, and tilth.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform grazing distribution keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and most engineering uses. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Capability subclass IIc; Silty range site.

40B—Shambo loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on terraces and fans. Runoff from surrounding uplands crosses this soil in shallow drainageways, but the drainage pattern is indistinct in places. Slopes are long and smooth. Individual areas are commonly irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is loam about 14 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum to a depth of about 60 inches is light brownish gray, stratified loam, silt loam, and silty clay loam. In some places the surface layer is thicker, in others it is silt loam, and in a few the subsoil is silt loam.

Included with this soil in mapping are small areas of Belfield and Daglum soils. These soils make up about 5 to 10 percent of the unit. They have more clay and more sodium in the subsoil than this Shambo soil.

Permeability is moderate, and available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are cultivated. Some are in native grasses and are used as rangeland or hayland. This soil has good potential for rangeland, windbreaks, cultivated crops, sanitary facilities, most engineering uses, recreation uses, and openland wildlife habitat. The potential for rangeland wildlife habitat is fair.

This soil is well suited to wheat, barley, oats, and grasses and legumes. The hazard of soil blowing is slight. The hazard of water erosion is slight in most areas, but on long slopes it is moderate. Minimum tillage, crop residue management, and grassed waterways help to control erosion and maintain fertility, organic-matter content, and tilth.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform grazing distribution keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and most engineering uses. If the soil is used as a building site, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Capability subclass IIe; Silty range site.

41B—Parshall loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on stream terraces, outwash plains, and valley fans and in upland swales. It is crossed by shallow drainageways in most places, but the drainage pattern fans out and is indistinct in places. In some cultivated areas, drainageways are gullied. Individual areas are irregular in shape and range from about 10 to 100 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is very dark grayish brown loam about 17 inches thick. The subsoil is dark grayish brown fine sandy loam about 13 inches thick. The substratum to a depth of about 60 inches is grayish brown and light brownish gray loamy fine sand and fine sandy loam. In places the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Arnegard soils in swales and Flaxton and Vebar soils on convex slopes. These soils make up 5 to 20 percent of the unit. The Arnegard soils are loam throughout. The Flaxton soils have loam or clay loam in the lower part of the subsoil and in the substratum. The Vebar soils have soft bedrock at a depth of 20 to 40 inches.

Permeability is moderately rapid, and available water capacity is high. Surface runoff is slow. Much of the runoff from higher lying soils is absorbed by this soil. The soil can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are used for cultivated crops. A few are used as rangeland. The potential for cultivated crops, rangeland, windbreaks, most engineering uses, recreation uses, and openland wildlife habitat is good, and the potential for rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is moderate. Stubble mulch, crop residue management, stripcropping, and windbreaks help to control erosion and soil blowing and maintain organic-matter content and tilth. Grassed waterways help to control water erosion in drainageways.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion. Proper stocking rates, uniform distribution of grazing, pasture rotation, and a planned grazing system keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and septic tank absorption fields. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. More suitable sites should be selected for sanitary landfills and sewage lagoons. Capability unit IIe; Sandy range site.

43—**Colvin silt loam.** This deep, level, poorly drained soil is in shallow basins, in swales, and along streams. Unless drained, it is flooded for a long period in spring. Individual areas are irregular in shape and range from about 5 to 30 acres in size. Slopes are slightly concave.

Typically, the surface layer is black silt loam about 7 inches thick. The substratum to a depth of about 60 inches is dark gray and gray silt loam over mottled, grayish brown silt loam with thin layers of very fine sandy loam. In some places a transitional layer is below the surface layer. In others the soil is dark colored to a greater depth.

Included with this soil in mapping are small areas of the poorly drained Harriet Variant silt loam and well drained Grassna soils. These soils make up less than 15 percent of the unit. The Harriet Variant contains excess salts. It is on plane or slightly concave slopes. The Grassna soils are dark colored to a greater depth than this Colvin soil.

Permeability is moderate, and available water capacity is high. Surface runoff is very slow. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The water table is at a depth of about 1 foot during part of the year. The shrink-swell potential is moderate. Potential frost action is high.

Most areas are in native grasses and are used as rangeland or hayland. Some have been drained and are used for cultivated crops. This soil has good potential for rangeland, windbreaks, and wetland wildlife habitat. It has fair potential for crops. The potential for sanitary facilities and community development is poor.

Drained areas are suited to wheat, oats, barley, and grasses. Adequate outlets for drainage are difficult to locate in some areas. The hazard of soil blowing is moderate. Stubble mulch, windbreaks, and minimum tillage help to control erosion and soil blowing. Undrained areas are generally unsuited to crops because of the high water table and ponding.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Overgrazing or grazing when the soil is wet results in surface compaction and poor tilth. Proper stocking rates and timely deferment of grazing during wet periods keep the pasture and the soil in good condition.

Undrained areas are generally unsuited to windbreaks and environmental plantings because of the high water table and ponding. Drained areas are well suited; all climatically suited trees and shrubs can grow well.

This soil is generally unsuited to building site development and onsite waste disposal. As a result of the seasonal high water table and flooding, design, installation, and maintenance are costly. In this survey area, Colvin soils generally are not used as building sites. More desirable sites are generally nearby. Capability subclass IVw; Wet Meadow range site.

44—**Arnegard loam, 1 to 3 percent slopes.** This deep, nearly level, well drained soil is in upland swales and on terraces, valley fans, and foot slopes. Areas are crossed by fairly well defined, shallow drainageways, but the drainage pattern fans out and is indistinct in places. Individual areas are irregular in shape and range from 3 to more than 100 acres in size. Slopes are long and smooth.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is loam about 29 inches thick. The upper part is dark grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is grayish brown, stratified fine sandy loam and loam over light brownish gray clay loam. In places the surface layer is silt loam.

Included with this soil in mapping are small areas of Amor, Vebar, and Williams soils on convex slopes and poorly drained Tonka soils in shallow depressions. These soils make up less than 15 percent of the unit. The Amor soils are moderately deep over soft bedrock. The Williams soils have more clay in the subsoil than this Arnegard soil and are not dark colored to so great a depth. The Vebar soils are moderately deep over soft bedrock and are fine sandy loam.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. Except for periods when it receives heavy rainfall or is frozen, the soil usually absorbs runoff from surrounding soils. It can be easily tilled throughout a wide range in moisture content. Potential frost action is moderate. The shrink-swell potential also is moderate.

Most areas are cultivated. Some are in native grasses. The potential for cultivated crops, recreation uses, range grasses, windbreaks, openland and rangeland wildlife habitat, and most engineering uses is good.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are slight. Stubble mulch and minimum tillage help to control erosion and soil blowing and maintain organic-matter content, fertility, and tilth. Grassed waterways help to control erosion where runoff water concentrates in drainageways.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform grazing distribution keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and is suited to onsite waste disposal. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. Capability subclass IIc; Overflow range site.

44B—Arnegard loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is in upland swales and on terraces, valley fans, and foot slopes. It is crossed by fairly well defined drainageways in most places, but the drainage pattern is indistinct on some valley fans and foot slopes. Areas are irregular in shape and are mostly less than 40 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is loam about 29 inches thick. The upper part is very dark grayish brown and dark grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is grayish brown, stratified fine loam and sandy loam over light brownish gray clay loam. In some places the surface layer is silt loam, and in some the subsoil is clay loam.

Included with this soil in mapping are small areas of Amor, Vebar, and Williams soils on convex slopes and poorly drained Tonka soils in shallow depressions. These soils make up less than 15 percent of the unit. The Amor soils are moderately deep over soft bedrock. The Williams soils have more clay in the subsoil than this Arnegard soil and are not dark colored to so great a depth. The Vebar soils are moderately deep over soft bedrock and are fine sandy loam.

Permeability is moderate, and available water capacity is high. Surface runoff is medium. Except for periods when it receives heavy rainfall or is frozen, the soil usually absorbs much of the runoff from surrounding soils. It can be easily tilled throughout a wide range in moisture content. Potential frost action is moderate. The shrink-swell potential also is moderate.

Most areas are cultivated. Some are in native grasses. The potential for cultivated crops, range grasses, windbreaks, most engineering and recreation uses, and openland wildlife habitat is good. The potential for rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Stubble mulch and minimum tillage help to control erosion and maintain tilth, fertility, and organic-matter content. Grassed waterways and diversions help to control erosion where water concentrates in drainageways.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and is suited to onsite waste disposal. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIe; Silty range site.

44C—Arnegard loam, 6 to 9 percent slopes. This deep, moderately sloping, well drained soil is on the lower side slopes below steeper soils. Areas are dissected by well defined drainageways. They are long and narrow or irregularly shaped and are generally less than 20 acres in size. Slopes are short and smooth.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is about 29 inches thick. The upper part is dark grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is grayish brown, stratified fine sandy loam and loam over light brownish gray clay loam. In some places the surface layer is silt loam, and in some the subsoil is clay loam.

Included with this soil in mapping are small areas of Amor, Vebar, and Williams soils on convex slopes. These soils make up less than 15 percent of the unit.

Permeability is moderate, and available water capacity is high. Surface runoff is medium. Except for periods when it receives heavy rainfall or is frozen, the soil usually absorbs some of the runoff from surrounding soils. It can be easily tilled throughout a wide range in moisture content. Potential frost action is moderate. The shrink-swell potential also is moderate.

This soil is used mainly as rangeland. Some areas are cultivated. The soil has good potential for rangeland, windbreaks, crops, and openland wildlife habitat. It has fair potential for most engineering uses and for recreation uses and rangeland wildlife habitat.

This soil is well suited to wheat, barley, oats, and grasses and legumes. The hazard of soil blowing is slight, and the hazard of water erosion is moderate to severe. Cultivation across the slope, stubble mulch, and minimum tillage help to control erosion and maintain tilth, fertility, and organic-matter content. Grassed waterways and diversions help to control erosion caused by runoff.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is suited to building site development and onsite waste disposal. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The slope is a limitation if the soil is used as a building site, but this limitation can be overcome by cutting and filling. Alternative sites should be selected for playgrounds. Capability subclass IIIe; Silty range site.

47—**Havrelon loam.** This deep, level, well drained soil is on bottom land. It is subject to flooding in areas along the Knife River, but it is protected against flooding in the areas along the Missouri River that are below the Garrison Dam. It has an indistinct drainage pattern. Areas are mostly long and irregular in shape and range from about 50 to 300 acres in size. In a few places slopes are undulating, but in most areas they are plane or slightly concave. In places microrelief has resulted from undifferential cutting by floodwater.

Typically, the surface layer is grayish brown loam about 8 inches thick. The substratum to a depth of about 60 inches is stratified silt loam, very fine sandy loam, and very fine sand. It is grayish brown in the upper part and light brownish gray in the lower part. In a few places the surface layer is silt loam or fine sandy loam.

Included with this soil in mapping are small areas of Banks soils on low, discontinuous, narrow ridges. These soils make up less than 15 percent of the unit. They have a substratum of mostly fine sand. Also included is a soil that is dominantly fine sandy loam throughout.

Permeability and available water capacity are moderate. Surface runoff is slow. This soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low to moderate. Potential frost action is moderate.

Most areas are cultivated. Some are irrigated. A few are in native grasses and trees and are used as rangeland. This soil has good potential for crops, rangeland, recreation, and windbreaks and for irrigated crops, including such specialized crops as sugar beets, potatoes, and pinto beans. Areas that are not protected against flooding have poor potential for most engineering uses. Protected areas have good potential for most engineering uses and for recreation uses. The potential for openland wildlife habitat is good, and the potential for rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is moderate. Minimum tillage, stubble mulch, and grasses and legumes in the cropping system help to control soil blowing and erosion and maintain the organic-matter content, fertility, and tilth. Leaving belts of native trees when the land is cleared also helps to control erosion and soil blowing.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion and protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is poorly suited to building site development and onsite waste disposal unless it is protected against flooding. It is protected against flooding in areas below the Garrison Dam on the Missouri River. If the protected areas are used as septic tank filter fields, the slow absorption of effluent can be overcome by enlarging the absorption field. Seepage from sewage lagoons can be prevented by sealing the lagoon with clay blankets. Onsite investigation is needed to ascertain the extent to which a given area is protected by the Garrison Dam. Capability subclass IIc; Overflow range site.

51—**Straw silt loam.** This deep, level, well drained soil is on plane terraces and fans and on bottom land. It is crossed by a few shallow drainageways that in places are gullied or fan out and are indistinct. Most areas are only rarely flooded, but some are occasionally flooded for a brief period. The areas are irregular in shape and range from about 5 to more than 300 acres is size. Slopes are mostly long and smooth.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is silt loam about 16 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is loam stratified with silt loam and silty clay loam. The upper part is grayish brown, and the lower part is light brownish gray. In most places one or more buried layers are evident. In some the dark colors do not extend to so great a depth, in others fine sand or loamy fine sand is below a depth of 40 inches, and in a few no subsoil is evident.

Included with this soil in mapping are small areas of Velva soils on low, convex ridges and Magnus soils in swales. These soils make up 5 to 20 percent of the unit. The Velva soils contain more sand and less clay than this Straw soil, and the Magnus soils contain more clay.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Many are in native grasses and are used as rangeland. Some small areas support native trees and shrubs and are used for recreation, wildlife habitat, and rangeland. This soil has good potential for rangeland, windbreaks, and crops. It has poor potential for sanitary facilities and community development unless it is protected against flooding and fair potential for those uses if it is protected. The potential for recreation uses is good if the soil is protected against flooding. The potential for openland and rangeland wildlife habitat is good.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Water erosion and the flood hazard are the main concerns of management. Stubble mulch, crop residue management, and stripcropping help to control erosion and protect the soil.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing are needed.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is suited to building site development and onsite waste disposal. Flooding is a hazard if the soil is used as a building site, but this hazard can be reduced by installing dikes and levees or by filling. Seepage from sewage lagoons can be prevented by plastic liners or clay blankets. Onsite investigation is needed to determine the frequency and duration of flooding. Capability subclass IIc; Overflow range site.

53—**Banks loam.** This deep, level, somewhat excessively drained soil is on bottom land. It has an indistinct drainage pattern. It is protected against flooding in most areas, but in some areas where the Knife River joins the Missouri River, it is subject to occasional flooding. Most areas are long and narrow and are more than 50 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is light brownish gray loam about 5 inches thick. The substratum to a depth of 60 inches is light brownish gray very fine sandy loam over light brownish gray fine sand. In a few places slopes are undulating, and in a few areas the surface layer is very fine sandy loam or fine sandy loam.

Included with this soil in mapping are small areas of Havrelon soils and a soil that is dominantly fine sandy loam throughout. These soils make up about 5 to 20 percent of the unit.

Permeability is rapid, and available water capacity is low. Runoff is slow. The soil can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is low. Potential frost action also is low.

About half of the acreage is cultivated and is used for small grain, corn, and alfalfa. The rest is in native grasses and trees and is used as rangeland. The potential for nonirrigated crops is poor. The potential for sprinkler-irrigated crops, including some specialized crops, such as sugar beets, potatoes, and pinto beans, is good to fair. This soil has good potential for community development and recreation if it is protected against flooding. It has fair potential for openland and rangeland wildlife habitat.

This soil is poorly suited to dryland wheat, oats, barley, and grasses and legumes because of the low available water capacity and the hazard of soil blowing. Irrigation improves the suitability. Minimum tillage, stubble mulch, and grasses and legumes in the cropping system help to control soil blowing and erosion and maintain the organic-matter content and fertility. Belts of native trees also help to control soil blowing and erosion.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the soil and the pasture in good condition.

This soil is poorly suited to windbreaks because of the low available water capacity. A few of the climatically suited trees and shrubs can grow fairly well as environmental and special plantings. Optimum survival and growth, however, should not be expected.

Areas that are not protected against flooding are poorly suited to building site development and onsite waste disposal. Protected areas are suited to those uses. Alternative sites should be selected for sewage lagoons. Shoring trench walls can keep cut banks in shallow excavations from caving. Onsite investigation is needed to ascertain the extent to which a given area is protected against flooding. Capability subclass IVe; Overflow range site.

54B—**Lihen fine sandy loam, 1 to 6 percent slopes.** This deep, nearly level to undulating, somewhat excessively drained soil is on terraces and uplands. Areas are crossed by a few shallow drainageways, but in most places the drainageways are indistinct. The areas are irregular in shape and range from about 10 to 80 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is dark grayish brown fine sandy loam about 17 inches thick. Below this is a transitional layer of dark brown loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is dark brown and pale brown fine sand and layers of fine sandy loam and very fine sandy loam. In some places clay loam is at a depth of about 50 inches. In others the surface layer is loam.

Included with this soil in mapping are small areas of Parshall soils in swales and Krem soils on small knobs. These soils make up 5 to 15 percent of the unit. The Parshall soils have a fine sandy loam subsoil. The Krem soils have clay loam glacial till at a depth of 16 to 40 inches.

Permeability is rapid, and available water capacity is low. Surface runoff is slow to medium. Most of the precipitation is absorbed by the soil. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is low. Potential frost action also is low.

Most areas are in native grasses and are used as rangeland and hayland. Some are cultivated. The soil has good potential for community development and rangeland and poor potential for crops and windbreaks. The potential for septic tank absorption fields is good, and the potential for most other sanitary facilities is poor. The potential for recreation uses and openland wildlife habitat is fair, and the potential for rangeland wildlife habitat is good.

This soil is poorly suited to dryland wheat, oats, barley, and grasses and legumes because the available water capacity is low and the hazard of soil blowing is severe. Stubble mulch and an adequate plant cover help to control erosion and protect the soil.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Overstocking and overgrazing reduces the plant cover and plant vigor and increases the hazard of soil blowing. Proper stocking rates, uniform distribution of grazing, timely deferment of grazing, and a planned grazing system keep the pasture and the soil in good condition.

This soil is poorly suited to windbreaks and environmental plantings. Because available water capacity is low, only a few species of trees and shrubs can grow well.

This soil is suited to building site development and onsite waste disposal. As a result of seepage, effluent can contaminate ground water. Alternative sites should be selected for sanitary landfills and sewage lagoons. Shoring trench walls can keep cutbanks in shallow excavations from caving. Establishing and maintaining lawns is difficult because the available water capacity is low. This difficulty can be overcome in part by frequent applications of fertilizer and water. Onsite investigation is needed to ascertain the suitability of specific sites for development. Capability suclass IIIe; Sands range site.

55B—Vebar fine sandy loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on residual uplands. It is dissected by shallow drainageways that are gullied in some cultivated areas. Individual areas range from about 5 to more than 40 acres in size. Slopes are long and smooth.

Typically, the surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is fine sandy loam about 19 inches thick. It is dark brown in the upper part, brown in the next part, and light olive brown in the lower part. The substratum is light yellowish brown fine sandy loam about 10 inches thick. Pale yellow soft sandstone is at a depth of about 34 inches. In some places the soft sandstone is more than 40 inches from the surface, and in some granitic stones are on the surface.

Included with this soil in mapping are small areas of Arnegard and Parshall soils in swales and Cohagen soils on ridges and knolls. These soils make up about 5 to 20 percent of the unit. The Cohagen soils have sandstone at a depth of 10 to 20 inches. The Parshall and Arnegard soils do not have sandstone within a depth of 40 inches and have a thicker dark colored surface layer than this Vebar soil. Also, the Arnegard soils have a texture of loam.

Permeability is moderately rapid, and available water capacity is low. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. Roots are restricted by the soft sandstone at a depth of about 34 inches. The shrink-swell potential is low. Potential frost action is moderate.

This soil is used for cultivated crops and range grasses. It has good potential for community development, recreation uses, and openland and rangeland wildlife habitat. It has fair potential for windbreaks and crops and fair to poor potential for sanitary facilities.

This soil is suited to wheat, barley, oats, and grasses and legumes. The hazard of soil blowing is severe. Stubble mulch, minimum tillage, grass buffer strips, stripcropping, and windbreaks help to control erosion and soil blowing, conserve moisture, and maintain the organic-matter content, fertility, and tilth. Diversions and grassed waterways help to control erosion and gullying in areas where runoff concentrates.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to trees and shrubs grown as windbreaks and environmental plantings. Only a few species, however, can grow well, because available water capacity is low.

This soil is suited to building site development and to onsite disposal of waste from septic tanks. Alternative sites should be selected for sewage lagoons and sanitary landfills. The depth to rock is a problem if the soil is used as a building site, but the rock is soft and can be easily excavated. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIIe; Sandy range site.

55C—Vebar fine sandy loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on low ridges and on long, smooth side slopes below steep ridges in the residual uplands. It is dissected by shallow drainageways that are gullied in some tilled areas. Individual areas range from about 5 to 40 acres in size. Slopes are long and smooth.

Typically, the surface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is fine sandy loam about 19 inches thick. It is dark brown in the upper part, brown in the next part, and light olive brown in the lower part. The substratum is light yellowish brown fine sandy loam. Pale yellow soft sandstone is at a depth of about 34 inches. In some places the depth to soft sandstone is more than 40 inches, and in some granitic stones are on the surface.

Included with this soil in mapping are small areas of Arnegard and Parshall soils in swales and Cohagen soils on ridges and knolls. These soils make up about 5 to 20 percent of the unit. The Cohagen soils have sandstone at a depth of 10 to 20 inches. The Arnegard and Parshall soils do not have sandstone within a depth of 40 inches and have a thicker dark colored surface layer than this Vebar soil. Also, the Arnegard soils have a texture of loam.

Permeability is moderately rapid, and available water capacity is low. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. Roots are restricted by the soft sandstone at a depth of about 34 inches. The shrink-swell potential is low. Potential frost action is moderate.

This soil is used for cultivated crops and range. It has good potential for community development, openland and rangeland wildlife habitat, and rangeland and fair potential for windbreaks and crops. It has fair to poor potential for sanitary facilities.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are severe. Stubble mulch, minimum tillage, cultivation across the slope, grassed buffer strips, stripcropping, and windbreaks help to control erosion and soil blowing and maintain fertility, organic-matter content, and tilth. Grassed waterways and diversions help to control erosion where water concentrates in drainageways.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to trees and shrubs grown as windbreaks and environmental plantings. Only a few species, however, can grow fairly well because available water capacity is low.

This soil is suited to building site development and to onsite disposal of waste from septic tanks. The depth to rock is a problem if the soil is used as a site for buildings, but the rock is soft and can be easily excavated. Alternative sites should be selected for sewage lagoons, sanitary landfills, and playgrounds. Capability subclass IVe; Sandy range site.

56B—Lefor fine sandy loam, 1 to 6 percent slopes. This moderately deep, nearly level and gently sloping, well drained soil is on residual uplands. Areas generally are dissected by shallow drainageways. They are irregular in shape and range from about 5 to 150 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 16 inches thick. The upper part is brown sandy loam, and the lower part is light yellowish brown sandy clay loam. The substratum, to a depth of about 34 inches, is pale yellow sandy clay loam. Pale yellow, soft, fine grained sandstone is at a depth of about 34 inches. In some places the surface layer is loam. In others it has been mixed with the upper part of the subsoil by plowing. In some areas the soft bedrock is at a depth of about 45 to 55 inches. In others the subsoil contains less clay.

Included with this soil in mapping are small areas of Arnegard, Belfield, Parshall, and Moreau soils in swales and on the lower side slopes. These soils make up less than 15 percent of the unit. The Arnegard and Parshall soils are dark colored to greater depth than this Lefor soil and are not underlain by soft bedrock. The Belfield soils have excess sodium and contain more clay in the subsoil than the Lefor soil, and the Moreau soils are more clayey and contain excess sodium salts.

Permeability is moderate, and available water capacity is moderate to low. Surface runoff is slow to medium. Roots are restricted by the soft bedrock at a depth of about 34 inches. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are cultivated. Some are in native grasses and are used as rangeland or hayland. This soil has fair potential for cultivated crops and windbreaks, good potential for range grasses and septic tank absorption fields, and fair to good potential for other sanitary facilities. The potential for community development and recreation uses is fair. The potential for openland wildlife hatitat is good, and the potential for rangeland wildlife habitat is fair.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is severe. Stubble mulch, minimum tillage, stripcropping, crop residue management, and windbreaks help to control soil blowing and protect the soil. Grassed waterways, cultivation across the slope, and diversions help to control water erosion.

The use of this soil as hayland, rangeland, or pastureland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to trees and shrubs grown as windbreaks and environmental plantings. Only a few species, however, can grow well because available water capacity is moderate to low.

This soil is suited to building site development, to onsite disposal of waste from septic tanks, and to sanitary landfills. The depth to rock is a problem, but the rock is soft and can be easily excavated. Alternative sites should be selected for sewage lagoons. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIIe; Sandy range site.

56D—Lefor fine sandy loam, 6 to 12 percent slopes. This moderately deep, moderately sloping and strongly sloping, well drained soil is on residual uplands. Areas are generally dissected by shallow drainageways. They are irregular in shape and range from about 5 to 150 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 16 inches thick. The upper part is brown sandy loam, and the lower part is light yellowish brown sandy clay loam. The substratum, to a depth of about 34 inches, is pale yellow sandy clay loam. Pale yellow, soft, fine grained sandstone is at a depth of about 34 inches. In some places the surface layer is loam. In others it has been mixed with the upper part of the subsoil by plowing. In some areas the soft bedrock is at a depth of about 40 to 50 inches. In others the subsoil contains less clay.

Included with this soil in mapping are small areas of Arnegard, Belfield, Parshall, and Moreau soils in swales and on the lower side slopes. These soils make up less than 15 percent of the unit. The Arnegard and Parshall soils are dark colored to a greater depth than this Lefor soil and are not underlain by soft bedrock. The Belfield soils have excess sodium and contain more clay in the subsoil than the Lefor soil. The Moreau soils are clayey and contain excess sodium salts. Also included are small areas of the steeper Cohagen soils on the convex tops of knobs, hills, and ridges. These soils are shallow over bedrock.

Permeability is moderate, and available water capacity is moderate to low. Surface runoff is medium. Roots are restricted by the soft bedrock at a depth of about 34 inches. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

This soil is used as cropland and rangeland. It has good potential for rangeland. The potential for cultivated crops is poor. The potential for recreation uses, windbreaks, sanitary facilities, building site development, and openland and rangeland wildlife habitat is fair.

This soil is poorly suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are severe. Stubble mulch, minimum tillage, stripcropping, windbreaks, and crop residue management help to control soil blowing. Grassed waterways, cultivation across the slope, and diversions help to control water erosion.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to trees and shrubs grown as windbreaks and environmental plantings. Only a few species, however, can grow well because available water capacity is moderate to low.

This soil is suited to building site development and to onsite disposal of waste from septic tanks. The slope is a limitation if the soil is used as a site for buildings, but this limitation can be overcome by cutting and filling. The depth to rock is a problem, but the rock is soft and can be easily excavated. Alternative sites should be selected for sewage lagoons and playgrounds. Capability subclass IVe; Sandy range site.

57B—Flaxton fine sandy loam, 1 to 6 percent slopes. This nearly level to undulating, deep, well drained soil is on plane and slightly concave slopes on glacial till uplands. Areas are crossed by a few shallow drainageways that in places fan out and are indistinct. In a few places where the soil is undulating, the drainageways are gullied. Individual areas are irregular in shape and range from about 20 to more than 300 acres in size. Slopes range from short and uneven to long and smooth.

Typically, the surface layer is dark grayish brown fine sandy loam about 11 inches thick. The subsoil is about 27 inches thick. It is grayish brown fine sandy loam in the upper part and grayish brown and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is light olive gray and pale olive clay loam. In a few places, the clay loam glacial till is at a depth of about 15 inches and the surface layer is not dark colored to so great a depth. In some areas soft bedrock is about 45 inches from the surface.

Included with this soil in mapping are small areas of Arnegard, Parshall, and Williams soils. These soils make up less than 15 percent of the unit. The Parshall soils lack clay loam glacial till. They are in swales and slightly concave areas. The Williams soils occupy convex knobs, mounds, and ridges. They do not have fine sandy loam deposits overlying the clay loam glacial till, but in a few small areas they have a fine sandy loam surface layer about 5 inches thick. The Arnegard soils are in swales and slightly concave areas. They are loam throughout.

Permeability is moderately rapid in the fine sandy loam and moderately slow in the clay loam. Available water capacity is high. Surface runoff is slow to medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. Potential frost action is moderate. The shrink-swell potential is low in the fine sandy loam and moderate in the clay loam.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland or hayland. This soil has good potential for cultivated crops, openland and rangeland wildlife habitat, grasses, recreation uses, and windbreaks. The potential for most sanitary facilities is fair. The potential for community development is fair to good.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is severe, and the hazard of water erosion is moderate. Minimum tillage, stubble mulch, crop residue management, stripcropping, and windbreaks help to control soil blowing and protect the soil. Grassed waterways help to control erosion where water concentrates in drainageways.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Many of the climatically suited trees and shrubs can grow well.

This soil is suited to building site development and onsite waste disposal. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. Capability subclass IIIe; Sandy range site.

57C—Flaxton fine sandy loam, 6 to 9 percent slopes. This gently rolling, deep, well drained soil is on plane and slightly convex slopes on glacial till uplands. Areas are crossed by a few shallow drainageways that in places are gullied. They are irregular in shape and range from 5 to 70 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 11 inches thick. The subsoil is about 27 inches thick. It is grayish brown fine sandy loam in the upper part and grayish brown and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is light olive gray and pale olive clay loam. In a few places, the clay loam glacial till is at a depth of about 15 inches and the surface layer is not dark colored to so great a depth. In some areas soft bedrock is about 45 inches from the surface.

Included with this soil in mapping are small areas of Arnegard, Parshall, and Williams soils. These soils make up less than 15 percent of the unit. The Parshall soils lack clay loam glacial till. They are in swales and slightly concave areas. The Williams soils occupy convex knobs, mounds, and ridges. They do not have fine sandy loam deposits overlying the clay loam glacial till, but in a few small areas they have a fine sandy loam surface layer about 5 inches thick. The Arnegard soils are in swales and slightly concave areas. They are loam throughout.

Permeability is moderately rapid in the fine sandy loam and moderately slow in the clay loam. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. Potential frost action is moderate. The shrink-well potential is low in the fine sandy loam and moderate in the clay loam.

This soil is used for cultivated crops, windbreaks, and rangeland. It has good potential for building site development, sanitary facilities, openland wildlife habitat, and rangeland and fair potential for cultivated crops, most recreation uses, and rangeland wildlife habitat.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are severe. Stubble mulch, minimum tillage, crop residue management, stripcropping, and windbreaks help to control soil blowing. Grassed waterways in areas where runoff concentrates help to control water erosion.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Many of the climatically suited trees and shrubs can grow well.

This soil is suited to building site development and to onsite disposal of waste from septic tanks. Less sloping sites should be selected for sewage lagoons. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The slope is a limitation if the soil is used as a building site, but this limitation can be overcome by cutting and filling. Alternative sites should be selected for playgrounds. Capability subclass IVe; Sandy range site.

58B—Flaxton-Williams complex, 3 to 6 percent slopes. This map unit consists of deep, undulating, well drained soils on glacial till uplands. Areas are crossed by a few shallow drainageways. They are irregular in shape and range from about 10 to 300 acres in size. Slopes range from short and uneven to long and smooth. Scattered pebbles, cobbles, and stones are on the surface of convex slopes.

Areas of this map unit are about 60 to 75 percent Flaxton soils and 20 to 40 percent Williams soils. The Flaxton soils are on the plane and slightly concave, mid and lower side slopes and in swales. The Williams soils are on the convex upper side slopes and the tops of small knobs and ridges. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Flaxton soils have a dark grayish brown fine sandy loam surface layer about 11 inches thick. The subsoil is about 27 inches thick. It is grayish brown fine sandy loam in the upper part and grayish brown and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is light olive gray and pale olive clay loam. In a few places the clay loam glacial till is at a depth of about 15 inches, and the surface layer is not dark colored to so great a depth. In some areas soft bedrock is at a depth of about 45 inches. In others the surface layer is loam.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 5 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In some places the surface layer is fine sandy loam about 5 inches thick. In others it has been mixed with the upper part of the subsoil by plowing.

Included with this unit in mapping are small areas of Arnegard and Parshall soils in swales and small, slightly concave areas of those soils. The included soils make up 5 to 20 percent of the unit. The Parshall soils are fine sandy loam throughout, and the Arnegard soils are loam throughout.

Permeability is moderately rapid in the upper part of the subsoil of the Flaxton soil and moderately slow in the lower part. It is moderate in the subsoil of the Williams soil and moderately slow in the substratum. Available water capacity is high. Surface runoff is medium. Both soils can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland or hayland. These soils have good potential for crops, rangeland, windbreaks, sanitary facilities, community development, most recreation uses, and openland wildlife habitat. They have fair potential for rangeland wildlife habitat.

These soils are well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is severe on the Flaxton soil and slight on the Williams soil. Minimum tillage, stubble mulch, crop residue management, stripcropping, windbreaks, and grasses and legumes in the cropping system help to control erosion and soil blowing. Grassed waterways help to control erosion where water concentrates in drainageways.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

The Williams soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well. The Flaxton soil is suited; many species can grow well.

These soils are suited to building site development and onsite waste disposal. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soils are used as building sites, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. The slope is a limitation if the soils are used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIIe; Flaxton soil in Sandy range site, Williams soil in Silty range site.

58C—Flaxton-Williams complex, 6 to 9 percent slopes. This map unit consists of deep, gently rolling, well drained soils on glacial till uplands. Areas are crossed by a few shallow drainageways. They are irregular in shape and range from about 10 to 80 acres in size. Slopes range from short and uneven to long and smooth. Scattered pebbles, cobbles, and stones are on the surface of convex slopes.

Areas of this map unit are about 50 to 70 percent Flaxton soils and 20 to 40 percent Williams soils. The Flaxton soils are on the plane and slightly concave, mid and lower side slopes and in swales. The Williams soils are on the convex upper side slopes and the tops of small knobs and ridges. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Flaxton soils have a dark grayish brown fine sandy loam surface layer about 11 inches thick. The subsoil is about 27 inches thick. It is grayish brown fine sandy loam in the upper part and grayish brown and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is light olive gray and pale olive clay loam. In a few places, the clay loam glacial till is at a depth of about 15 inches and the surface layer is not dark colored to so great a depth. In some areas soft bedrock is about 45 inches from the surface. In others the surface layer is loam.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 5 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In some places the surface layer is fine sandy loam about 5 inches thick. In others it has been mixed with the upper part of the subsoil by plowing.

Included with this unit in mapping are small areas of Arnegard and Parshall soils in swales; small, slightly concave areas of those soils; and small areas of Zahl soils on the convex tops of knobs and the crests of ridges. The included soils make up 5 to 20 percent of the unit. The Arnegard soils lack the clay loam glacial till substratum and are loam throughout. The Parshall soils lack the clay loam glacial till and are fine sandy loam throughout. The Zahl soils are loam or clay loam throughout and lack a subsoil.

Permeability is moderately rapid in the upper part of the subsoil of the Flaxton soil and moderately slow below. It is moderate in the subsoil of the Williams soil and moderately slow in the substratum. Available water capacity is high. Surface runoff is medium. Both soils can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

These soils are used for cultivated crops, windbreaks, and rangeland. They have good potential for rangeland and openland wildlife habitat and fair potential for crops. The potential for sewage lagoons is poor, and the potential for most other sanitary facilities is fair. The potential for community development, recreation uses, and rangeland wildlife habitat is fair.

These soils are suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are severe on the Flaxton soil and slight on the Williams soil. Cultivation across the slope, minimum tillage, stubble mulch, crop residue management, and grasses and legumes in the cropping system help to control erosion and soil blowing and protect the soil. Grassed waterways help to control erosion where water concentrates in drainageways.

The use of these soils as hayland, rangeland, or pastureland is effective in controlling erosion and protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

The Williams soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well. The Flaxton soil is suited; many species can grow well.

These soils are suited to building site development and onsite waste disposal. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If the soils are used as building sites, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Alternative sites should be selected for sewage lagoons and playgrounds. Capability subclass IVe; Flaxton soil in Sandy range site, Williams soil in Silty range site.

58D—Flaxton-Williams complex, 9 to 15 percent slopes. This map unit consists of deep, rolling, well drained soils on glacial till uplands. It is crossed by shallow drainageways that in places are gullied. Scattered pebbles, cobbles, and stones are on the surface of convex slopes. Individual areas are irregular in shape and range from about 5 to 40 acres in size. They are about 50 to 65 percent Flaxton soils and 20 to 45 percent Williams soils. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Flaxton soil has a dark grayish brown fine sandy loam surface layer about 11 inches thick. The subsoil is about 27 inches thick. It is grayish brown fine sandy loam in the upper part and grayish brown and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is light olive gray and pale olive clay loam. In a few places, the clay loam glacial till is at a depth of about 15 inches and the surface layer is not dark colored to so great a depth. In some areas soft bedrock is at a depth of about 45 inches. In some the surface layer is loam.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 5 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In some places the surface layer is fine sandy loam about 5 inches thick. In others it has been mixed with the upper part of the subsoil by plowing.

Included with this unit in mapping are small areas of Arnegard and Parshall soils in swales; small, slightly concave areas of those soils; and small areas of Zahl soils on the convex tops of knobs and the crests of ridges. The included soils make up 5 to 20 percent of the unit. The Arnegard soils lack the clay loam glacial till substratum and are loam throughout. The Parshall soils lack the clay loam glacial till and are fine sandy loam throughout. The Zahl soils are loam or clay loam throughout and lack a subsoil.

Permeability is moderately rapid in the upper part of the subsoil of the Flaxton soil and moderately slow below. It is moderate in the subsoil of the Williams soil and moderately slow in the substratum. Available water capacity is high. Surface runoff is rapid. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are in native grasses and are used as rangeland. Some are used for cultivated crops. These soils have good potential for rangeland. The potential for crops and windbreaks is poor. The potential for most sanitary facilities, community development, most recreation uses, and openland and rangeland wildlife habitat is fair.

These soils are generally unsuited to wheat, oats, barley, and grasses and legumes because of the erosion hazard and the rapid surface runoff.

The use of these soils as rangeland or pastureland is effective in controlling erosion and in protecting the soil. Proper stocking rates, uniform distribution of grazing, and a planned grazing system keep the pasture and the soil in good condition. Overgrazing and overstocking reduce the vegetative cover and the plant vigor and increase the hazard of erosion.

These soils are poorly suited to windbreaks. They are suited to special environmental plantings for wildlife habitat, recreation, and beautification. All climatically suited species can grow well on the Williams soil, and many can grow well on the Flaxton soil.

These soils are suited to building site development and onsite disposal of waste from septic tanks. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Alternative sites should be selected for sewage lagoons and playgrounds. Capability subclass VIe; Flaxton soil in Sandy range site, Williams soil in Silty range site.

59B—Parshall fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on stream terraces, outwash plains, and valley fans or in upland swales. Most areas are crossed by shallow drainageways, but the drainage pattern fans out and is indistinct in places. In some cultivated areas, the drainageways are gullied. Individual areas are irregular in shape and range from 10 to 100 acres in size. Slopes are long and smooth, but in places they are undulating.

Typically, the surface layer is fine sandy loam about 17 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is fine sandy loam about 15 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is, in sequence downward, light brownish gray fine sandy loam, grayish brown fine sandy loam, and light brownish gray loamy fine sand. In a few places the surface layer is loam, and in some a dark colored, buried layer is about 50 inches from the surface.

Included with this soil in mapping are small areas of Flaxton and Lihen soils on plane and convex slopes and Arnegard soils in swales. These soils make up 5 to 20 percent of the unit. The Flaxton soils are loam or clay loam in the lower part of the subsoil and in the substratum. The Arnegard soils are loam throughout, and the Lihen soils are loamy fine sand throughout. Also included are areas of a soil that is underlain by sand and gravel at a depth of about 35 inches.

Permeability is moderately rapid, and available water capacity is moderate to high. Surface runoff is slow. The soil absorbs much of the runoff from higher lying soils. It can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are used for cultivated crops. Some are in native grasses and used as rangeland. This soil has good potential for rangeland, windbreaks, and crops. It has good potential for septic tank absorption fields and poor potential for other sanitary facilities. The potential for community development, recreation uses, and openland wildlife habitat is good. The potential for rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is severe. Minimum tillage, stubble mulch, and grasses and legumes in the cropping system help to control erosion and soil blowing and maintain the organic-matter content, fertility, and tilth. Grassed waterways help to control erosion where water concentrates in drainageways.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates, a planned grazing system, and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and to disposal of waste from septic tanks. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. More suitable sites for sanitary landfills and sewage lagoons are generally nearby. Capability subclass IIIe; Sandy range site.

62B—Velva fine sandy loam, 1 to 6 percent slopes. This deep, nearly level or gently sloping, well drained soil is on low terraces and bottom land along the major streams. It has an indistinct drainage pattern that generally parallels the stream channels. Most areas are occasionally flooded for a brief period, but some are only rarely flooded. Slopes are plane and convex and mostly long and smooth. In some areas they are undulating and short and smooth. Individual areas are irregular in shape and range from about 10 to 150 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 6 inches thick. The substratum to a depth of about 13 inches is dark grayish brown fine sandy loam and a thin, dark colored, buried layer. Between depths of 13 and 36 inches, it is grayish brown fine sandy loam stratified with loam and loamy fine sand. Below 36 inches it is grayish brown loamy fine sand over light brownish gray loam. The soil generally has one or more dark colored, buried layers. In some places the surface layer is loam. In some the soil has strata of clayey material, and in others it is dark colored to a greater depth.

Included with this soil in mapping are small areas of Straw soils on plane and convex slopes. These soils make up less than 15 percent of the unit. They contain more clay than this Velva soil.

Permeability is moderately rapid, and available water capacity is moderate. Surface runoff is slow to medium. This soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low. Potential frost action is moderate.

Most of the acreage is used for cultivated crops. The rest is in native grasses and trees and is used as rangeland, wildlife habitat, and recreation areas.

This soil has good potential for cultivated crops, range grasses, and windbreaks. Areas that are not protected against flooding have poor potential for sanitary facilities and community development. Protected areas have good to fair potential for sanitary facilities and good potential for community development. The potential for most recreation areas is good if the areas are protected against flooding. The potential for openland and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is severe. Stubble mulch, minimum tillage, crop residue management, and stripcropping help to control erosion and soil blowing and maintain the organic-matter content, tilth, and fertility. Flooding is a concern, but most floods occur before crops are seeded.

The use of this soil as pastureland, rangeland, or hayland is effective in controlling erosion and protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well. Streams meander through most areas, and the areas are therefore irregular in shape. As a result, only a few windbreaks have been planted.

This soil is poorly suited to building site development and onsite waste disposal unless it is protected against flooding. The flooding can be controlled by dikes and levees. If an area is to be developed, onsite investigation is needed to determine the frequency and duration of floods. Capability subclass IIIe; Overflow range site.

67— Straw soils, channeled. These deep, nearly level, well drained soils are on low terraces and bottom land that have been channeled by meandering streams. Most areas are in narrow valleys between steeply sloping soils, but some are on broad flood plains along streams where the interval between meanders is short. Most are occasionally flooded for a brief period, but some are only rarely flooded. Slopes are mostly short and uneven, but some are short and smooth. Individual areas are mostly long and narrow and range from 30 to more than 100 acres in size.

Any one area of this map unit is made up of Straw loam, Straw silt loam, or Straw silty clay loam or two or all three of those soils. The three soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the surface layer is loam, silt loam, or silty clay loam about 20 inches thick. It is grayish brown in the upper part and very dark grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown loam over stratified loam, silt loam, and fine sandy loam. Generally, one or more dark colored, buried layers are evident. In places the dark colors do not extend to so great a depth.

Included with these soils in mapping are small areas of Harriet, Magnus, and Velva soils. These included soils make up 10 to 30 percent of the unit. The Harriet soils are more clayey than these Straw soils, contain sodium salts, and are poorly drained. The Magnus soils contain more clay than Straw soils, and the Velva soils contain more sand and less clay. The well drained Magnus and Velva soils are on bottom land and the lower terraces, and the Harriet soils are on bottom land.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are in native grasses and trees and are used as rangeland. These soils have good potential for range grasses and poor potential for cultivated crops. Areas that are not protected against flooding have poor potential for most engineering and recreation uses. Protected areas have fair potential for most engineering uses and good potential for recreation uses. The potential for openland wildlife habitat is good, and the potential for rangeland wildlife habitat is fair.

These soils are generally unsuited to wheat, oats, barley, and grasses and legumes because of the flood hazard, the numerous stream channels, and the small size of the tillable areas.

The use of these soils as rangeland or pastureland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing help to control erosion and keep the pasture and the soil in good condition.

These soils are generally unsuited to trees and shrubs in windbreaks. They are suited to special wildlife or recreation plantings. All climatically suited species can grow well.

These soils are poorly suited to building site development because of the flooding. They are generally not used as building sites. The flooding can be controlled by dikes and levees. Onsite investigation is needed to determine the frequency and duration of floods. Capability subclass VIe; Overflow range site.

71B—Searing loam, 1 to 6 percent slopes. This nearly level, well drained soil is on glacial till and residual uplands that are crossed by a few shallow drainageways. It is moderately deep over porcelanite (scoria). Individual areas are irregular in shape and range from about 10 to 100 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is dark brown loam about 6 inches thick. The subsoil is reddish brown loam about 12 inches thick. The substratum is loam about 10 inches thick. It is yellowish red in the upper part and reddish yellow in the lower part. Reddish yellow porcelanite beds are at a depth of about 28 inches (fig. 7). In places the surface layer is silt loam or clay loam.

Included with this soil in mapping are small areas of Williams, Sen, and Amor soils on plane and convex slopes and Arnegard soils in swales. These soils make up 5 to 20 percent of the unit. The Williams and Arnegard soils are deep, and the Sen and Amor soils are moderately deep over bedded soft shale and siltstone.

Permeability is moderate in the subsoil. Available water capacity also is moderate. Surface runoff is slow to medium. Roots are restricted by the porcelanite at a depth of about 28 inches. This soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland. This soil has fair potential for cultivated crops and for range grasses. It has poor potential for windbreaks and sanitary facilities. It has good potential for recreation uses and community development and fair potential for openland and rangeland wildlife habitat.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is moderate. Crop residue management and stripcropping help to control erosion and soil blowing and maintain the organic-matter content, fertility, and tilth.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing help to keep the pasture and the soil in good condition.

This soil is poorly suited to windbreaks and environmental plantings. Trees and shrubs can be established if the proper species are selected, but survival, growth, and vigor are not optimum. Only a few of the climatically suited species can grow.

This soil is suited to building site development but is poorly suited as a site for sanitary facilities. The depth to rock is a problem, but the rock is fractured and can be excavated. Alternative sites should be selected for sanitary landfills and sewage lagoons. Effluent from septic tanks can reach ground water through the fractures in the bedrock. The slope is a limitation if the soil is used for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIIs; Silty range site.

71C—Searing-Ringling loams, 6 to 9 percent slopes. This map unit consists of moderately sloping, well drained and excessively drained soils on glacial till and residual uplands. It is crossed by well defined drainageways that are gullied in some tilled areas. These soils are moderately deep or shallow over porcelanite (scoria) beds. Individual areas are irregular in shape and range from 5 to 70 acres in size. They are about 50 to 80 percent Searing soils and 20 to 45 percent Ringling soils. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Searing soil has a surface layer of dark brown loam about 6 inches thick. The subsoil is reddish brown loam about 10 inches thick. The substratum is loam about 8 inches thick. It is yellowish red in the upper part and reddish yellow in the lower part. Reddish yellow porcelanite is at a depth of about 24 inches. In places the surface layer is silt loam or clay loam.

Typically, the Ringling soil has a surface layer of dark reddish gray channery loam about 7 inches thick. The substratum is reddish brown very channery loam about 8 inches thick. Fractured, hard, red and reddish yellow porcelanite is at a depth of about 15 inches.

Included with this soil in mapping are small areas of Williams, Sen, and Amor soils on plane and convex slopes and Arnegard soils in swales. These soils make up 5 to 20 percent of the unit. The Williams and Arnegard soils are deep, and the Sen and Amor soils are moderately deep over bedded soft shale and siltstone. Also included are a few areas of scoria outcrop on ridgetops.

Permeability is moderate in the subsoil of the Searing soil. It is very rapid in the Ringling soil. Available water capacity is moderate in the Searing soil and very low or low in the Ringling soil. Surface runoff is medium. Roots are restricted by the porcelanite. Both soils can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate in the Searing soil and low in the Ringling soil. Potential frost action is moderate in the Searing soil and low in the Ringling soil.

These soils are used for cultivated crops and rangeland. They have poor potential for cultivated crops and windbreaks and fair potential for range grasses. They have poor potential for sanitary facilities and fair potential for community development and recreation uses. The Searing soil has fair potential for openland and rangeland wildlife habitat, and the Ringling soil has poor potential for openland wildlife habitat and fair potential for rangeland wildlife habitat.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes because of the restricted rooting depth, droughtiness, and moderate hazards of soil blowing and water erosion. Stubble mulch, crop residue management, stripcropping, and grassed waterways help to control soil blowing and water erosion and maintain the organic-matter content, tilth, and fertility.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates, uniform distribution of grazing, deferred grazing, and a planned grazing system keep the pasture and the soil in good condition.

The Searing soil is suited to windbreaks and environmental plantings. Trees and shrubs can be established if the proper species are selected, but survival, growth, and vigor are not optimum. The Ringling soil is generally not suited to trees and shrubs because of the low available water capacity and the shallow root zone.

These soils are suited to building site development but are poorly suited as sites for sanitary facilities. The depth to rock is a problem, but the rock is fractured and can be excavated. Effluent from septic tanks can reach ground water through the fractures in the bedrock. Alternative sites should be selected for sanitary landfills, sewage lagoons, and playgrounds. Capability subclass IVe; Searing soil in Silty range site, Ringling soil in Very Shallow range site.

73—Belfield silt loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on uplands and terraces and in swales. Areas are crossed by fairly well defined, shallow drainageways in most places, but the drainage pattern fans out and is indistinct in some places. Individual areas are mostly irregular in shape and range from 3 to more than 200 acres in size. Slopes are long and plane or concave.

Typically, the surface layer is dark grayish brown silt loam about 13 inches thick. The subsurface layer is dark grayish brown silty clay loam about 3 inches thick. The subsoil is silty clay about 16 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is light brownish gray in the upper part and light yellowish brown in the lower part. In places the substratum is soft, partly weathered bedrock below a depth of 36 inches. In some places on terraces and in swales, it contains a dark colored, old buried surface layer. In some areas, the surface layer is loam and the subsoil contains less clay.

Included with this soil in mapping are small areas of Grail soils on concave slopes and Daglum and Rhoades soils on plane slopes. These soils make up about 5 to 20 percent of the unit. The Daglum and Rhoades soils have a denser subsoil than this Belfield soil, and the Grail soils have a less dense subsoil.

Permeability is slow, and available water capacity is high. Runoff is slow. This soil receives some runoff from higher lying surrounding soils. It can be easily tilled throughout a fairly wide range in moisture content. Roots are moderately restricted in the subsoil. The shrink-swell potential is high. Potential frost action is low. Sodium salts are in excess.

Most areas are cultivated. This soil has good potential for range grasses and most of the cultivated crops commonly grown in the county. The potential for windbreaks, most waste disposal facilities, building sites, recreation uses, and openland and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of erosion is slight. Stubble mulch, minimum tillage, and deep-rooted crops improve water intake and maintain the organic-matter content, fertility, and tilth. Grassed waterways or diversions help to control erosion where runoff concentrates. If the subsoil and the layers that have a high content of sodium are exposed when waterways are shaped, topsoil should be added to help insure that the seedbed and the plant cover are adequate.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to trees and shrubs grown as windbreaks and environmental plantings. Only a limited number of species, however, can grow well because of the clayey texture and the excess sodium.

This soil is suitable as a site for buildings and for most sanitary facilities. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIs; Clayey range site.

74B—Regent-Rhoades complex, 1 to 6 percent slopes. This map unit consists of moderately deep and deep, nearly level to gently sloping, well drained soils on residual uplands. It is crossed by a few shallow drainageways that in places are gullied. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size. Slopes are generally long and smooth.

Areas of this map unit are about 50 to 75 percent Regent soils and 20 to 45 percent Rhoades soils. The Rhoades soils are in areas where scabby spots are evident. The Regent soils are on plane or convex slopes. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Regent soils have a dark grayish brown silty clay loam surface layer about 6 inches thick. The subsoil is about 32 inches thick. It is dark grayish brown silty clay in the upper part, grayish brown silty clay in the next part, and grayish brown silty clay loam in the lower part. Pale olive, soft shale is at a depth of about 38 inches. In places the soft shale is about 45 inches from the surface. In some areas the surface layer is silt loam.

Typically, the Rhoades soils have a grayish brown silt loam surface layer about 2 inches thick. The subsoil is very firm silty clay about 19 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. It contains few to common visible salt crystals. The substratum to a depth of about 60 inches is grayish brown silty clay loam over grayish brown silt loam. In some places the surface layer is loam or very fine sandy loam. In others it is very dark grayish brown and is underlain by a grayish brown subsurface layer. In cultivated areas it has been mixed with the silty clay subsoil. In some areas soft shale is at a depth of 35 to 50 inches.

Included with this unit in mapping are small areas of Daglum and Grail soils. These soils make up 5 to 20 percent of the unit. The Daglum soils are on plane and slightly concave slopes. They are sodic and have a dense subsoil at a depth of 5 to 15 inches. The Grail soils are not underlain by soft bedrock and do not contain excess sodium. They are on plane and slightly concave slopes in swales. Also included are areas of the Savage and Rhoades soils on high terraces along the Knife River. The Savage soils are not underlain by soft bedrock.

Permeability is slow in the Regent soils and very slow in the Rhoades soils. Available water capacity is moderate in the Regent soils and low to moderate in the Rhoades soils. Both soils contain a large amount of clay, and some of the soil moisture is held under too much tension to be extracted by plant roots. The Rhoades soils contain excess sodium and other salts, which also hold some of the soil moisture under too much tension for the moisture to be extracted by plant roots. Surface runoff is slow to medium.

Roots are restricted by the dense subsoil in the Rhoades soils and the soft shale in the Regent soils. The surface layer can be easily tilled within a narrow range in moisture content. The Rhoades soils are difficult to till because the excess sodium disperses the clay particles. Both soils tend to puddle and crust following heavy rains. The shrink-swell potential is high. Potential frost action is low.

This map unit is used for cultivated crops and rangeland. It has fair potential for cultivated crops and range grasses. The potential for windbreaks is poor. The potential for sewage lagoon areas is good, and the potential for most other sanitary facilities is poor to fair. The potential for recreation uses and for urban and residential uses is fair. The Regent soils have good potential for openland wildlife habitat and fair potential for rangeland wildlife habitat. The Rhoades soils have poor to very poor potential for wildlife habitat.

The Regent soils are suited to wheat, barley, oats, and grasses and legumes. The Rhoades soils are poorly suited to crops. Stubble mulch, minimum tillage, crop residue management, stripcropping, and green manure improve tilth, maintain the organic-matter content and fertility, and help to control erosion. Grassed waterways help to control erosion where water concentrates.

The use of these soils as rangeland, hayland, or pastureland is effective in controlling erosion and in protecting the soil. Proper stocking rates, uniform distribution of grazing, and timely deferment of grazing keep the pasture and the soil in good condition.

The Rhoades soils are generally unsuited to windbreaks and environmental plantings because they are sodic. The Regent soils are suited to most trees and shrubs. Most of the climatically suited species can grow fairly well.

These soils are suited to building site development and most engineering uses. The Regent soils are better suited than the Rhoades soils. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIe; Regent soils in Clayey range site, Rhoades soils in Thin Claypan range site.

74C—Regent-Rhoades complex, 6 to 9 percent slopes. This map unit consists of moderately deep and deep, moderately sloping, well drained soils on residual uplands. It is crossed by a few shallow drainageways that in places are gullied. Individual areas are irregular in shape and range from about 10 to 80 acres in size. Slopes are generally long and smooth.

Areas of this map unit are about 50 to 70 percent Regent soils and 20 to 40 percent Rhoades soils. The Regent soils are on plane and convex slopes. The Rhoades soils are on the plane and slightly concave lower slopes and in swales. Scabby spots are evident in the areas of Rhoades soils. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Regent soils have a dark grayish brown silty clay loam surface layer about 6 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown silty clay in the upper part, grayish brown silty clay in the next part, and grayish brown silty clay loam in the lower part. Pale olive, soft shale is at a depth of about 34 inches. In places the surface layer is lighter colored.

Typically, the Rhoades soils have a grayish brown silt loam surface layer about 2 inches thick. The subsoil is silty clay about 19 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. It contains few to common visible salt crystals. The substratum to a depth of about 60 inches is grayish brown silty clay loam over grayish brown silt loam. In some places the surface layer is silt loam, loam, or very fine sandy loam. In others it is very dark grayish brown and is underlain by a grayish brown subsurface layer. In cultivated areas it has been mixed with the silty clay subsoil. In places soft shale is at a depth of 35 to 50 inches.

Included with the unit in mapping are small areas of Daglum and Grail soils. These soils make up 5 to 20 percent of the unit. The Daglum soils are on plane and slightly concave slopes. They are sodic and have a dense subsoil at a depth of 5 to 15 inches. The Grail soils are not underlain by soft bedrock and do not contain excess sodium. They are on plane and slightly concave slopes in swales.

Permeability is slow in the Regent soils and very slow in the Rhoades soils. Available water capacity is moderate in the Regent soils and low to moderate in the Rhoades soils. Both soils contain a large amount of clay, and some of the soil moisture is held under too much tension to be extracted by plant roots. The Rhoades soils contain excess sodium and other salts, which also hold some of the soil moisture under too much tension for the moisture to be extracted by plant roots. Surface runoff is medium.

Roots are restricted by the dense subsoil in the Rhoades soils and the soft shale in the Regent soils. The surface layer can be easily tilled within a narrow range in moisture content. The Rhoades soils are difficult to till because the excess sodium disperses the clay particles. Both soils tend to puddle and crust following heavy rains. The shrink-swell potential is high. Potential frost action is low.

This map unit is used for cultivated crops and rangeland. It has poor potential for cultivated crops and fair potential for range grasses. It has poor potential for windbreaks and poor to fair potential for most sanitary facilities. The potential for urban and residential uses and recreation areas is poor to fair. The Regent soils have fair potential for openland and rangeland wildlife habitat. The Rhoades soils have poor to very poor potential for wildlife habitat.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes. Grassed waterways and diversions help to control erosion where water concentrates in drainageways. Stubble mulch, minimum tillage, crop residue management, and stripcropping help to control erosion and maintain the organic-matter content, tilth, and fertility.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the soil and the pasture in good condition.

The Rhoades soils are generally unsuited to trees and shrubs grown as windbreaks and environmental plantings because they are sodic. The Regent soils are suited to most trees and shrubs. Most climatically suited species can grow fairly well.

These soils are suited to building site development and most engineering uses. The Regent soils are better suited than the Rhoades soils. The slow absorption of septic tank effluent can be overcome by enlarging the aborption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IVe; Regent soils in Clayey range site, Rhoades soils in Thin Claypan range site.

75—Belfield-Daglum silt loams, 1 to 3 percent slopes. This map unit consists of deep, nearly level, well drained soils in swales and on terraces and uplands. It is crossed by fairly well defined, shallow drainageways in most places, but the drainage pattern fans out and is indistinct in some places. Individual areas are irregular in shape and are mostly less than 40 acres in size. They are about 40 to 65 percent Belfield soils and 20 to 40 percent Daglum soils. Slopes are long and smooth. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of dark grayish brown silt loam about 13 inches thick. The subsurface layer is dark grayish brown silty clay loam about 3 inches thick. The subsoil is silty clay about 16 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is light brownish gray in the upper part and light yellowish brown in the lower part. In places the substratum is soft, partly weathered bedrock below a depth of 36 inches. In some places on terraces and in swales, it contains a dark colored, old buried surface layer. In some areas the surface layer is silty clay loam.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 9 inches thick. The substratum to a depth of about 60 inches is grayish brown silty clay loam over gray, stratified silty clay and silty clay loam. In places soft bedrock is below a depth of 36 inches. In some areas the surface layer is silty clay loam.

Included with this unit in mapping are small areas of Grail and Rhoades soils. These soils make up 5 to 20 percent of the unit. The Grail soils are on plane and concave slopes, and the Rhoades soils are in slightly concave depressions. The Grail soils have a less dense subsoil than the Belfield or Daglum soils. The Rhoades soils are shallower to a dense subsoil than the Dalgum or Belfield soils.

Permeability is slow in the Belfield soil and very slow in the Daglum soil. Available water capacity is high in the Belfield soil and moderate in the Daglum soil. Both soils contain a large amount of clay, and some of the soil moisture is held under too much tension to be extracted by plant roots. The soils also contain excess sodium salts. Surface runoff is slow, and the soils receive some runoff from the surrounding higher lying areas. The surface layer can be easily tilled throughout a fairly wide range in moisture content, but the silty clay loam surface layer that is evident in some areas and the Rhoades soil tend to crust or puddle following heavy rains. Roots are restricted by the dense subsoil. The shrink-swell potential is high. Potential frost action is low.

Most areas are cultivated. This map unit has fair potential for cultivated crops. It has good potential for range grasses. The Belfield soil has fair potential and the Daglum soil poor potential for windbreaks. The potential for septic tank absorption fields is fair, and the potential for other onsite waste disposal systems is good. The potential for residential and urban uses and for recreation uses is fair. The potential for openland and rangeland wildlife habitat is fair to poor.

These soils are suited to wheat, oats, barley, and grasses and legumes. Stubble mulch, minimum tillage, and legumes help to control soil blowing and water erosion. If topsoil in grassed waterways is replaced, seeding in the exposed sodic subsoil can be avoided. Grassed waterways and diversions help to control the runoff that sometimes concentrates and tends to gully drainageways.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

The Belfield soil is suited to windbreaks. Some of the climatically suited trees and shrubs can grow well. The Daglum soil is generally unsuited to windbreaks because of the dense, sodic subsoil.

These soils are suited to building site development and most engineering uses. The Belfield soil is generally better suited than the Daglum soil. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIs; Belfield soil in Clayey range site, Daglum soil in Claypan range site.

75B—Belfield-Daglum silt loams, 3 to 6 percent slopes. This map unit consists of deep, gently sloping, well drained soils in swales on terraces and uplands. It is crossed by fairly well defined, shallow drainageways in most places, but the drainage pattern fans out and is indistinct in some places. Individual areas are irregular in shape and are mostly less than 40 acres in size. They are 40 to 60 percent Belfield soils and 20 to 40 percent Daglum soils. Slopes are long and smooth. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of dark grayish brown silt loam about 13 inches thick. The subsurface layer is dark grayish brown silty clay loam about 3 inches thick. The subsoil is silty clay about 16 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is light brownish gray in the upper part and light yellowish brown in the lower part. In places the substratum is soft, partly weathered bedrock below a depth of 36 inches. In some places on terraces and in swales, it contains a dark colored, old buried surface layer. In some areas the surface layer is silty clay loam.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 9 inches thick. The substratum to a depth of about 60 inches is grayish brown silty clay loam over gray, stratified silty clay and silty clay loam. In places soft bedrock is below a depth of 36 inches. In some areas the surface layer is silty clay loam.

Included with this unit in mapping are small areas of Grail, Rhoades, and Moreau soils. These soils make up 5 to 20 percent of the unit. The Grail soils are on plane and concave slopes; the Rhoades soils are in small, slight depressions; and the Moreau soils are on convex slopes. The Grail soils have a less dense subsoil than the Belfield and Daglum soils. The Rhoades soils are shallower to a dense subsoil than the Daglum and Belfield soils. The Moreau soils have a less dense subsoil than Belfield or Daglum soils and are underlain by soft bedrock at a depth of 20 to 40 inches.

Permeability is slow in the Belfield soil and very slow in the Daglum soil. Available water capacity is high in the Belfield soil and moderate in the Daglum soil. Both soils contain a large amount of clay, and some of the soil moisture is held under too much tension to be extracted by plant roots. The soils also contain excess sodium salts. Surface runoff is medium, and the soils receive some runoff from the surrounding higher lying areas. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The silty clay loam surface layer that is evident in some areas and the Rhoades soil, however, tend to crust or puddle following heavy rains. Roots are restricted by the dense subsoil. Potential frost action is low. The shrink-swell potential is high.

Most areas are cultivated. This map unit has poor potential for cultivated crops. It has good potential for range grasses. The Belfield soil has fair potential and the Daglum soil poor potential for windbreaks. Both soils have fair potential for septic tank absorption fields and good to poor potential for other onsite waste disposal systems. The potential for residential and urban uses and for recreation uses is fair. The potential for pond reservoir areas is good, and the potential for other water management uses is fair to poor. The potential for openland and rangeland wildlife habitat is fair to poor.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes. Stubble mulch, deep-rooted legumes, minimum tillage, and manure help to control soil blowing and water erosion and maintain tilth, fertility, and organic-matter content. Grassed waterways and diversions help to control erosion where water concentrates in drainageways. Replacing topsoil helps to establish grasses in waterways where the dense, sodic subsoil is exposed.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

The Belfield soil is suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can grow well. The Daglum soil is generally unsuited to windbreaks because of the dense, sodic subsoil.

These soils are suited to building site development and most engineering uses. The Belfield soil is generally better suited than the Daglum soil. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIe; Belfield soil in Clayey range site, Daglum soil in Claypan range site.

75C—Belfield-Daglum silt loams, 6 to 9 percent slopes. This map unit consists of deep, moderately sloping, well drained soils in swales on uplands and on valley foot slopes. It is crossed by well defined drainageways. Individual areas are irregular in shape and are mostly less than 20 acres in size. They are about 40 to 65 percent Belfield soils and 20 to 40 percent Daglum soils. Slopes are smooth and vary greatly in length. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of dark grayish brown silt loam about 10 inches thick. The subsurface layer is dark grayish brown silty clay loam about 3 inches thick. The subsoil is silty clay about 14 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is light brownish gray in the upper part and light yellowish brown in the lower part. In places the substratum is soft, partly weathered bedrock below a depth of 36 inches. In some places in swales, the substratum contains a dark colored, old buried surface layer. In some areas the surface layer is silty clay loam.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 5 inches thick. The subsurface layer is grayish brown silt loam about 2 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of about 60 inches is grayish brown silty clay loam over gray, stratified silty clay and silty clay loam. In places soft bedrock is below a depth of 36 inches. In some areas the surface layer is silty clay loam.

Included with this unit in mapping are small areas of Grail, Regent, and Rhoades soils. These soils make up 5 to 20 percent of the unit. The Grail soils are on plane and concave slopes, the Regent soils are on convex slopes, and the Rhoades soils are in small, slight depressions. The Grail soils have a less dense subsoil than the Belfield or Daglum soils. The Rhoades soils are shallower to a dense subsoil than the Daglum or Belfield soils. The Regent soils have a less dense subsoil than the Belfield or Daglum soils and are underlain by soft bedrock at a depth of 20 to 40 inches.

Permeability is slow in the Belfield soil and very slow in the Daglum soil. Available water capacity is high in the Belfield soil and moderate in the Daglum soil. Both soils contain a large amount of clay, and some of the soil moisture is held under too much tension to be extracted by plant roots. The soils also contain excess sodium salts. Surface runoff is medium, and the soils receive some runoff from the surrounding higher lying areas. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The silty clay loam surface layer that is evident in some areas and the Rhoades soil, however, tend to crust or puddle following heavy rains. Roots are restricted by the dense subsoil. Potential frost action is low. The shrink-swell potential is high.

Most areas are used as rangeland or native hayland. The potential for range grasses is good, and the potential for most crops is poor. The Belfield soil has fair potential and the Daglum soil poor potential for windbreaks. Both soils have fair to poor potential for waste disposal facilities, most engineering uses, and recreation uses. They have fair to poor potential for openland and rangeland wildlife habitat.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes. Stubble mulch, minimum tillage, manure, and deep-rooted legumes help to control soil blowing and water erosion and maintain tilth, organic-matter content, and fertility. Grassed waterways and diversions help to control erosion where water concentrates in drainageways. Replacing topsoil helps to establish grasses in waterways where the dense, sodic subsoil is exposed.

The use of these soils as rangeland, hayland, or pastureland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

The Belfield soil is suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can grow well. The Daglum soil is generally unsuited to windbreaks because of the dense, sodic subsoil.

These soils are suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IVe; Belfield soil in Clayey range site, Daglum soil in Claypan range site.

76B—Sen-Rhoades complex, 3 to 6 percent slopes. This map unit consists of moderately deep and deep, gently sloping, well drained soils on residual uplands. It is crossed by a few shallow drainageways that in places are gullied. Individual areas are irregular in shape and range from about 10 to 100 acres in size. Slopes are mostly long and smooth.

Areas of this map unit are about 50 to 70 percent Sen soils and 20 to 40 percent Rhoades soils. The Rhoades soils are in areas where scabby spots are evident. The Sen soils are on the plane and convex upper slopes. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Sen soils have a surface layer of dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 9 inches thick. It is brown in the upper part and light olive brown in the lower part. The substratum to a depth of about 31 inches is light yellowish brown silt loam over light yellowish brown silty clay loam. Between depths of 31 and 60 inches is soft sedimentary bedrock that is light yellowish brown in the upper part and pale olive in the lower part. In places the subsoil is silty clay loam. In some areas the surface layer is lighter colored.

Typically, the Rhoades soils have a surface layer of grayish brown silt loam about 2 inches thick. The subsoil is silty clay about 19 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown silty clay loam over grayish brown silt loam. In some places the surface layer is very dark grayish brown. In others it is loam or very fine sandy loam. In tilled areas it has been mixed with the silty clay subsoil. In places on uplands, soft shale is at a depth of 35 to 50 inches.

Included with this unit in mapping are small areas of Grail soils in swales and Daglum soils on plane and slightly concave slopes. These soils make up 5 to 20 percent of the unit. The Grail soils are not underlain by soft bedrock and do not contain excess sodium. The Daglum soils have a dense subsoil at a depth of 5 to 15 inches.

Permeability and available water capacity are moderate in the Sen soils. Permeability is very slow in the Rhoades soils, and available water capacity is low to moderate. Surface runoff is medium. The Sen soils can be easily tilled throughout a fairly wide range in moisture content. The Rhoades soils are difficult to till because excess sodium salts disperse the clay particles. Because of the large amount of clay and the excess salts in the Rhoades soils, some of the soil moisture is held under too much tension to be extracted by plant roots. Roots are restricted by the soft bedrock in the Sen soils and the dense subsoil in the Rhoades soils. The shrink-swell potential is moderate in the Sen soils and high in the Rhoades soils. Potential frost action is moderate in the Sen soils and low in the Rhoades soils.

Most areas are in native grasses and are used as rangeland. Some areas are used for cultivated crops. The potential for range grasses and cultivated crops is fair. The potential for windbreaks is poor. The potential for septic tank absorption fields is fair, and the potential for other sanitary facilities is poor to fair. The soils have fair potential for community development and good to poor potential for recreation areas. The Sen soils have fair potential for openland and rangeland wildlife habitat, and the Rhoades soils have poor to very poor potential for wildlife habitat.

These soils are suited to wheat, oats, barley, and grasses and legumes. Stubble mulch, manure, crop residue management, and minimum tillage help to control soil blowing and water erosion and maintain tilth and organic-matter content. Grassed waterways and diversions help to control erosion where water concentrates in drainageways.

The use of these soils as rangeland, hayland, or pastureland is effective in controlling erosion and in protecting the soil. Proper stocking rates, timely deferment of grazing, and uniform distribution of grazing keep the pasture in good condition.

The Sen soils are suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs can grow well. The Rhoades soils are generally unsuited to windbreaks because they have a dense, sodic subsoil.

Both soils are suited to building site development and most engineering uses. The depth to rock is a problem, but the rock is soft and can be easily excavated. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. Capability subclass IIIe; Sen soils in Silty range site, Rhoades soils in Thin Claypan range site.

76C—Sen-Rhoades complex, 6 to 9 percent slopes. This map unit consists of moderately deep and deep, moderately sloping, well drained soils on residual uplands. It is crossed by a few shallow drainageways that in places are gullied. Individual areas are irregular in shape and range from about 5 to 40 acres in size. Slopes are mostly long and smooth, and scabby spots are evident in the areas of Rhoades soils.

Areas of this map unit are 50 to 70 percent Sen soils and 20 to 40 percent Rhoades soils. The Rhoades soils are on the plane and slightly concave lower slopes and in swales. The Sen soils are on the plane and convex upper slopes. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Sen soils have a surface layer of dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 9 inches thick. It is brown in the upper part and light olive brown in the lower part. The substratum to a depth of about 31 inches is light yellowish brown silt loam over light yellowish brown silty clay loam. Between depths of 31 and 60 inches is soft sedimentary bedrock that is light yellowish brown in the upper part and pale olive in the lower part. In places the subsoil is silty clay loam. In some areas the surface layer is lighter colored.

Typically, the Rhoades soils have a surface layer of grayish brown silt loam about 2 inches thick. The subsoil is silty clay about 19 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown silty clay loam over grayish brown silt loam. In some places the surface layer is very dark grayish brown. In others it is loam or very fine sandy loam. In tilled areas it has been mixed with the silty clay subsoil. In some places on uplands, soft shale is at a depth of 35 to 50 inches.

Included with this unit in mapping are small areas of Grail soils in swales and Daglum soils on plane and slightly concave slopes. These soils make up 5 to 20 percent of the unit. The Grail soils are not underlain by soft bedrock and do not contain excess sodium. The Daglum soils have a dense subsoil at a depth of 5 to 15 inches. Also included are small areas of Cabba soils on the convex tops of knobs and ridges. These soils are underlain by soft bedrock at a depth of 10 to 20 inches. They make up about 5 percent of the unit.

Permeability and available water capacity are moderate in the Sen soils. Permeability is very slow in the Rhoades soils, and available water capacity is low to moderate. Surface runoff is medium. The Sen soils can be easily tilled throughout a fairly wide range in moisture content. The Rhoades soils are difficult to till because excess sodium salts disperse the clay particles. Because of the large amount of clay and the excess salts in the Rhoades soils, some of the soil moisture is held under too much tension to be extracted by plant roots. Roots are restricted by soft bedrock in the Sen soils and the dense subsoil in the Rhoades soils. The shrink-swell potential is moderate in the Sen soils and high in the Rhoades soils. Potential frost action is moderate in the Sen soils and low in the Rhoades soils.

Most areas are in native grasses and are used as rangeland. Some are used for cultivated crops. The potential for rangeland is fair, and the potential for crops is poor. These soils have poor potential for windbreaks and fair potential for septic tank absorption fields, other sanitary facilities, community development, and recreation uses. The Sen soils have fair potential for openland and rangeland wildlife habitat. The Rhoades soils have poor to very poor potential for wildlife habitat.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes. Stubble mulch, crop residue management, minimum tillage, deep-rooted legumes, and manure help to control erosion and maintain tilth, fertility, and organic-matter content. Grassed waterways and diversions help to control erosion where water concentrates in drainageways.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates, uniform grazing distribution, and a planned grazing system keep the pasture and the soil in good condition.

The Sen soils are suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs can grow well. The Rhoades soils are generally unsuited to windbreaks because they have a dense, sodic subsoil.

Both soils are suited to building site development and most engineering uses. The depth to rock is a problem, but the rock is soft and can be easily excavated. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. Capability subclass IVe; Sen soils in Silty range site, Rhoades soils in Thin Claypan range site.

77—Bowdle loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and glacial outwash plains. It is moderately deep over sand and gravel. Areas are crossed by a few indistinct drainageways. Most are irregular in shape and less than 40 acres in size. Slopes are long and smooth.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is grayish brown loam about 12 inches thick. The substratum is light brownish gray and grayish brown loam about 5 inches thick. Below this to a depth of about 60 inches is pale brown, stratified sand and gravel. In some areas along the Missouri River, the surface layer and subsoil are silt loam. In places the depth to sand and gravel is about 15 inches. In some areas the dark colors do not extend to so great a depth.

Included with this soil in mapping are small areas of Arnegard soils in swales. These soils make up about 5 to 15 percent of the unit. They do not have sand and gravel within a depth of 60 inches.

Permeability is moderate in the subsoil and rapid in the sand and gravel. Available water capacity is moderate, and surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. Roots are restricted by the sand and gravel at a depth of about 24 inches. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are used for cultivated crops. Some are in native grasses and used as rangeland. This soil has fair potential for crops, good potential for range grasses, and poor potential for windbreaks. It has good potential for septic tank absorption fields and poor potential for most other sanitary facilities. The potential for urban, residential, and recreation uses is good. The potential for openland wildlife habitat is fair, and the potential for rangeland wildlife habitat is good.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is moderate. Stripcropping, stubble mulch, crop residue management, and minimum tillage help to control erosion and soil blowing and maintain the organic-matter content and tilth.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is poorly suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can be grown, but survival, growth, and vigor are not optimum.

This soil is well suited to building site development and to onsite disposal of waste from septic tanks. Seepage is a problem, and effluent can contaminate ground water. Shoring trench walls can keep cutbanks in shallow excavations from caving. Capability subclass IIIs; Silty range site.

77B—Bowdle loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on terraces and glacial outwash plains. It is moderately deep over sand and gravel. Areas are crossed by a few indistinct drainageways. Most are irregular in shape and less than 40 acres in size. Slopes are mostly long and smooth.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is grayish brown loam about 12 inches thick. The substratum is light brownish gray and grayish brown loam about 5 inches thick. Below this to a depth of about 60 inches is pale brown, stratified sand and gravel. In some areas along the Missouri River, the surface layer and subsoil are silt loam. In places the depth to sand and gravel is about 15 inches. In some areas the dark colors do not extend to so great a depth.

Included with this soil in mapping are small areas of Arnegard soils in swales. These soils make up about 5 to 15 percent of the unit. They do not have sand and gravel within a depth of 60 inches.

Permeability is moderate in the subsoil and rapid in the sand and gravel. Available water capacity is moderate, and surface runoff is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. Roots are restricted by the sand and gravel at a depth of about 24 inches. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are used for cultivated crops. The rest are in native grasses and are used as rangeland. This soil has fair potential for crops, good potential for rangeland, and poor potential for windbreaks. It has good potential for septic tank absorption fields and poor potential for most other sanitary facilities. The potential for urban, recreation, and residential uses is good. The potential for openland wildlife habitat is fair, and the potential for rangeland wildlife habitat is good.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are moderate. Stripcropping, stubble mulch, crop residue management, and minimum tillage help to control erosion and soil blowing and maintain the organic-matter content and tilth. Grassed waterways help to control erosion where water concentrates in drainageways.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is poorly suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can be grown, but survival, growth, and vigor are not optimum.

This soil is well suited to building site development and to onsite disposal of waste from septic tanks. Seepage is a problem, and effluent can contaminate ground water. Shoring trench walls can keep cutbanks in shallow excavations from caving. The slope is a limitation if the soil is used as a site for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIIe; Silty range site.

77C—Bowdle-Wabek complex, 6 to 9 percent slopes. This map unit consists of deep, gently rolling, well drained and excessively drained soils on terraces and outwash plains. In most areas it is dissected by shallow drainageways. These soils are moderately deep and shallow over sand and gravel. Individual areas are mostly long and narrow and are less than 20 acres in size. Slopes are mostly short and smooth.

Areas of this map unit are about 55 to 70 percent Bowdle soils and 25 to 40 percent Wabek soils. The Bowdle soils are on the plane or slightly concave, mid and lower side slopes. The Wabek soils are on the tops of convex ridges and knobs and on the upper side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Bowdle soils have a dark grayish brown loam surface layer about 5 inches thick. The subsoil is grayish brown loam about 12 inches thick. The substratum is light brownish gray and grayish brown loam about 5 inches thick. Below this to a depth of about 60 inches is pale brown, stratified sand and gravel. In some areas along the Missouri River, the surface layer and subsoil are silt loam. In places the depth to sand and gravel is about 15 inches. In some areas the dark colors do not extend to so great a depth.

Typically, the Wabek soils have a dark grayish brown gravelly sandy loam surface layer about 7 inches thick. Below this to a depth of about 13 inches is grayish brown gravelly coarse loamy sand. Between depths of about 13 and 60 inches is light brownish gray, stratified sand and gravel. The surface layer varies in texture, particularly if the soil has been plowed. In places the depth to sand and gravel is about 14 to 20 inches.

Included with this unit in mapping are small areas of Arnegard soils in swales. These soils make up 5 to 15 percent of the unit. They do not have sand and gravel within a depth of 60 inches.

Permeability is moderate in the subsoil of the Bowdle soils and rapid in the sand and gravel. It is moderately rapid in the surface layer of the Wabek soils and very rapid in the sand and gravel. Available water capacity is moderate in the Bowdle soils and low in the Wabek soils. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. Roots are restricted by the sand and gravel at a depth of about 22 inches in the Bowdle soils and 13 inches in the Wabek soils. The shrink-swell potential is moderate in the Bowdle soils and low in the Wabek soils. Potential frost action is low in both soils. Surface runoff is medium.

Most areas are in native grass and used as rangeland. Some are used for the cultivated crops commonly grown in the county. These soils have fair potential for rangeland and poor potential for crops and windbreaks. They have good potential for septic tank absorption fields and poor potential for most other sanitary facilities. The potential for recreation, urban, and residential uses is good. The potential for openland wildlife habitat is fair to poor, and the potential for rangeland wildlife habitat is good to poor.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes because of the droughtiness resulting from the low available water capacity. The hazard of soil blowing is moderate. Stripcropping, crop residue management, and grasses in the cropping system help to control erosion and soil blowing and maintain the organic-matter content and tilth.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

The Bowdle soils are poorly suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can be grown, but survival, growth, and vigor are not optimum. The Wabek soils are generally unsuited to trees and shrubs because of the low available water capacity and droughtiness.

These soils are well suited to building site development and to onsite disposal of waste from septic tanks. Seepage is a problem, and effluent can reach ground water supplies. Shoring trench walls can keep cutbanks in shallow excavations from caving. Alternative sites should be selected for playgrounds. Capability subclass IVe; Bowdle soils in Silty range site, Wabek soils in Very Shallow range site.

78B—Noonan-Flaxton fine sandy loams, 1 to 6 percent slopes. This map unit consists of deep, nearly level to undulating, well drained soils on glacial till plains that are generally dissected by a few shallow drainageways. Individual areas are irregular in shape and range from 10 to 150 acres in size. Slopes are mostly short and smooth.

Areas of this map unit are about 50 to 75 percent Noonan soils and 20 to 40 percent Flaxton soils. The Noonan soils are on plane and convex slopes. The Flaxton soils are on plane and slightly concave slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Noonan soils have a dark grayish brown fine sandy loam surface layer about 6 inches thick. The subsurface layer is gray fine sandy loam about 3 inches thick. The subsoil is clay loam about 20 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum, to a depth of about 50 inches, is light brownish gray clay loam glacial till. Light olive gray, soft shale is at a depth of about 50 inches. In places the shale is at a depth of about 35 inches. In some areas the subsoil is at a depth of about 15 inches, and the subsurface layer is loamy fine sand.

Typically, the Flaxton soils have a dark grayish brown fine sandy loam surface layer about 11 inches thick. The subsoil is about 27 inches thick. It is grayish brown fine sandy loam in the upper part and grayish brown and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is light olive gray and pale olive clay loam glacial till. In places light olive gray shale is about 50 inches from the surface.

Included with this unit in mapping are small areas of Williams soils on the convex tops of knobs and ridges and Rhoades soils on plane and slightly concave slopes and in swales. These soils make up 5 to 20 percent of the unit. The Williams soils do not have a fine sandy loam surface layer. The Rhoades soils contain excess sodium and have a dense subsoil at a depth of 2 to 5 inches. Also included are a few severely eroded areas and a few areas where slopes are more than 9 percent.

Permeability is moderately rapid in the surface layer of the Noonan soils and slow in the subsoil and substratum. It is moderately rapid in the fine sandy loam of the Flaxton soils and moderately slow in the subsoil. The Noonan soils contain excess sodium. Roots are restricted in the Noonan soils by the dense subsoil at a depth of about 9 inches. The surface layer of both soils is friable and can be easily tilled throughout a wide range in moisture content. Surface runoff is slow to medium. The shrink-swell potential is moderate. Potential frost action also is moderate. Available water capacity is moderate in the Noonan soils and high in the Flaxton soils.

Most areas are in native grasses and are used as rangeland. Some are used for cultivated crops. These soils have fair potential for rangeland, recreation uses, community development, and most sanitary facilities. They have poor potential for windbreaks and most crops. The Noonan soils have poor potential for openland wildlife habitat and very poor potential for rangeland wildlife habitat. The Flaxton soils have good potential for openland wildlife habitat and fair potential for rangeland wildlife habitat.

These soils are suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is severe. Stripcropping, crop residue management, and minimum tillage help to control erosion and soil blowing and keep the soil in good condition.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the pasture and the soil in good condition.

The Flaxton soils are suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can grow well. The Noonan soils generally are unsuited to trees and shrubs because they have a sodic subsoil.

Both soils are suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IVe; Noonan soils in Claypan range site, Flaxton soils in Sandy range site.

79B—Moreau silty clay, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on residual uplands. Slopes are plane or convex and mostly long and smooth. Areas are crossed by a few shallow drainageways that in places are gullied. They are irregular in shape and range from about 10 to 80 acres in size.

Typically, the surface layer is dark grayish brown silty clay about 7 inches thick. The subsoil is silty clay about 14 inches thick. The upper part is dark grayish brown, and the lower part is light brownish gray and light yellowish brown. The substratum is light yellowish brown and light olive gray silty clay about 7 inches thick. Light olive gray, soft shale is at a depth of about 28 inches. In some places the surface layer is silty clay loam. In others it is lighter colored.

Included with this soil in mapping are small areas of Grail soils in swales, Rhoades soils on plane and slightly concave slopes, and Wayden soils on convex knobs, hills, and ridges. These soils make up 5 to 20 percent of the unit. The Grail soils are not underlain by soft bedrock and are dark colored to a greater depth than this Moreau soil. The Rhoades soils contain excess sodium and have a dense subsoil at a depth of 2 to 5 inches. The Wayden soils have soft bedrock within a depth of 20 inches.

Permeability is slow, and available water capacity is low to moderate. Runoff is medium. Because this soil contains a large amount of clay, some of the moisture is held under too much tension to be extracted by plant roots. The surface layer is firm and is difficult to till unless it is at the optimum moisture content. Roots are restricted by the soft shale at a depth of about 28 inches. The shrink-swell potential is high. Potential frost action is low.

Most areas are cultivated. Some are in native grass and are used as rangeland. This soil has fair potential for crops, rangeland, recreation uses, and windbreaks. The potential for sanitary facilities and most community developments is poor to fair. The potential for openland wildlife habitat is fair, and the potential for rangeland wildlife habitat is poor.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are moderate. Stripcropping, stubble mulch, crop residue management, windbreaks, and grassed waterways help to control soil blowing and water erosion. They also maintain tilth, organic-matter content, and fertility.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Many of the climatically suited trees and shrubs can grow well.

This soil is poorly suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The depth to rock is a problem, but the rock is soft and can be easily excavated. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIe; Clayey range site.

79C—Moreau silty clay, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on residual uplands. Slopes are plane or convex and mostly long and smooth. Areas are crossed by shallow drainageways that in places are gullied. They are irregular in shape and range from about 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown silty clay about 7 inches thick. The subsoil is silty clay about 14 inches thick. The upper part is dark grayish brown, and the lower part is light brownish gray and light yellowish brown. The substratum is light yellowish brown and light olive gray silty clay about 7 inches thick. Light olive gray, soft shale is at a depth of about 28 inches. In some places the surface layer is silty clay loam. In others it is lighter colored.

Included with this soil in mapping are small areas of Grail soils in swales, Rhoades soils on plane and slightly concave slopes, and Wayden soils on convex knobs, hills, and ridges. These soils make up 5 to 20 percent of the unit. The Grail soils are not underlain by soft bedrock and are dark colored to a greater depth than this Moreau soil. The Rhoades soils contain excess sodium and have a dense subsoil at a depth of 2 to 5 inches. The Wayden soils have soft bedrock within a depth of 20 inches.

Permeability is slow, and available water capacity is low to moderate. Runoff is medium. Because this soil contains a large amount of clay, some of the moisture is held under too much tension to be extracted by plant roots. The surface layer is firm and is difficult to till unless it is at the optimum moisture content. Roots are restricted by the soft shale at a depth of about 28 inches. The shrink-swell potential is high. Potential frost action is low.

Some areas are cultivated, and the rest are in native grasses and are used as rangeland. This soil has poor potential for crops and fair potential for rangeland, recreation uses, and windbreaks. It has poor potential for sanitary facilities and for urban and residential uses. The potential for openland wildlife habitat is fair and the potential for rangeland wildlife habitat is poor.

This soil is poorly suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are severe. Stripcropping, cultivation across the slope, stubble mulch, crop residue management, windbreaks, and grassed waterways help to control erosion and soil blowing.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Overgrazing reduces the plant cover and increases the risk of erosion. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the range and the pasture in good condition.

This soil is suited to windbreaks and environmental plantings. Many of the climatically suited trees and shrubs can grow well.

This soil is poorly suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The depth to rock is a problem, but the rock is soft and can be easily excavated. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IVe; Clayey range site.

79D—Wayden-Moreau silty clays, 9 to 15 percent slopes. This map unit consists of shallow and moderately deep, strongly sloping, excessively drained and well drained soils on residual uplands. It is dissected by shallow drainageways that in places are gullied. Individual areas are about 50 to 75 percent Wayden soils and 20 to 40 percent Moreau soils. The Wayden soils are on the convex tops of ridges, knobs and hills. The Moreau soils are on the plane and convex, mid and lower side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Wayden soils have a grayish brown and pale olive silty clay surface layer about 3 inches thick. The substratum, to a depth of about 12 inches, is pale olive silty clay over light olive gray silty clay. Light gray, soft shale is at a depth of about 12 inches. In places the surface layer is silty clay.

Typically, the Moreau soils have a dark grayish brown silty clay surface layer about 7 inches thick. The subsoil is silty clay about 14 inches thick. The upper part is dark grayish brown, and the lower part is light brownish gray and light yellowish brown. The substratum is light yellowish brown and light olive gray silty clay about 7 inches thick. Light olive gray, soft shale is at a depth of about 28 inches. In some places the surface layer is silty clay loam. In others it is lighter colored.

Included with this unit in mapping are small areas of Grail soils in swales and Rhoades soils in swales and on plane slopes. These soils make up 5 to 20 percent of the unit. The Grail soils are not underlain by soft bedrock and are dark colored to a greater depth than the Wayden or Moreau soils. The Rhoades soils contain excess sodium and have a dense subsoil at a depth of 2 to 5 inches.

Permeability is slow in the Wayden and Moreau soils. Available water capacity is low or moderate in the Moreau soils and very low or low in the Wayden soils. Surface runoff is rapid. Because both soils contain a large amount of clay, some of the soil moisture is held under too much tension to be extracted by plant roots. Roots are restricted by the soft bedrock at a depth of about 12 inches in the Wayden soils and 28 inches in the Moreau soils. The surface layer is firm. The shrink-swell potential is high. Potential frost action is low.

Most areas are in native grasses and are used as rangeland. These soils have fair potential for range grasses. The Wayden soils have poor potential and the Moreau soils fair potential for windbreaks. The potential for cultivated crops, sanitary facilities, community development, recreation areas, and openland and rangeland wildlife habitat is poor.

These soils generally are unsuited to cultivated crops because available water capacity is very low or low, and the root zone is limited.

The use of these soils as rangeland is effective in controlling erosion and in protecting the soil. Maintaining an adequate plant cover and ground mulch helps to prevent excessive soil losses and improves the moisture supplying capacity by reducing runoff.

The Wayden soils generally are unsuited to windbreaks and environmental plantings because of the shallowness to soft bedrock and the very low or low available water capacity. The Moreau soils are suited to windbreaks and environmental plantings. Many of the climatically suited trees and shrubs can grow well.

Both soils are poorly suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The depth to rock is a problem, but the rock is soft and can be easily excavated. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass VIe; Wayden soils in Shallow range site, the Moreau soils in Clayey range site.

81D—Cabba loam, 9 to 15 percent slopes. This shallow, strongly sloping, well drained soil is on residual uplands. Most areas are dissected by drainageways that in places are gullied. The areas are mostly irregular in shape and range from about 10 to more than 200 acres in size. Slopes are mostly long and smooth, but some are short and uneven.

Typically, the surface layer is grayish brown loam about 4 inches thick. Beneath this is a transitional layer of light brownish gray loam or silt loam about 6 inches thick. The substratum to a depth of 18 inches is pale yellow loam or silt loam. Between depths of 18 and 60 inches is stratified, soft sedimentary bedrock that is pale yellow in the upper part and light gray in the lower part. In places the surface layer is silty clay loam, silt loam, or very fine sandy loam. In some areas it is dark colored to a greater depth. In some places the soft bedrock is at a depth of about 20 to 25 inches, and in others it is within a depth of 10 inches.

Included with this soil in mapping are small areas of Arnegard and Grail soils in drainageways. These soils make up 5 to 15 percent of the unit. They are dark colored to a greater depth than this Cabba soil, have a subsoil, and are not underlain by soft bedrock. Also included are small areas of deep Straw soils on very narrow flood plains along streams; sodic Belfield, Daglum, and Rhoades soils in swales and on the lower side slopes; and Badland, which is exposed soft bedrock. These included areas make up 5 to 15 percent of the unit.

Permeability is moderate, and available water capacity is low. Surface runoff is rapid. The surface layer is friable. Roots are restricted by the soft bedrock at a depth of about 18 inches. The shrink-swell potential is moderate. Potential frost action is moderate.

Most areas are used as rangeland. Some small areas are used for cultivated crops. This soil has fair potential for range grasses and for openland and rangeland wildlife habitat. It has poor potential for cultivated crops and windbreaks and for sanitary facilities and community development. The potential for recreation uses is fair to poor.

This soil generally is unsuited to cultivated crops because it is shallow and because available water capacity is low.

The use of this soil as rangeland is effective in controlling erosion and in protecting the soil. Overstocking and overgrazing reduces the protective plant cover and causes deterioration of the plant community. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the range grasses and the soil in good condition.

This soil generally is unsuited to windbreaks and environmental plantings because of the low available water capacity and the shallowness.

This soil is moderately well suited to building site development and most engineering uses. The depth to rock is a problem, but the rock is soft and can be easily excavated. The slope is a limitation, but it can be overcome by cutting and filling. Capability subclass VIe; Shallow range site.

81E—Cabba loam, 15 to 35 percent slopes. This shallow, moderately steep or steep, well drained soil is on residual uplands. Most areas are dissected by drainageways that are gullied in places. The areas are mostly irregular in shape and range from about 50 to 1,000 acres in size. Slopes are mostly long and smooth, but some are short and uneven.

Typically, the surface layer is grayish brown loam about 2 inches thick. Beneath this is a transitional layer of light brownish gray loam or silt loam about 6 inches thick. The substratum to a depth of 16 inches is pale yellow loam or silt loam. Between depths of about 16 and 60 inches is stratified, soft sedimentary bedrock that is pale yellow in the upper part and light gray in the lower part. In places the surface layer is silty clay loam, silt loam, or very fine sandy loam. In some areas it is dark colored to a greater depth. In some places the soft bedrock is at a depth of about 20 to 25 inches, and in others it is within a depth of 10 inches.

Included with this soil in mapping are small areas of Arnegard and Grail soils in drainageways. The soils make up 5 to 15 percent of the unit. They are dark colored to a greater depth than this Cabba soil, have a subsoil, and are not underlain by soft bedrock. Also included, are small areas of deep Straw soils on very narrow flood plains along streams; sodic Belfield, Daglum, and Rhoades soils in swales and on the lower side slopes; and Badland, which is exposed soft bedrock. These included areas make up 5 to 15 percent of the unit.

Permeability is moderate, and available water capacity is low. Surface runoff is rapid. The surface layer is friable. Roots are restricted by the soft bedrock at a depth of about 16 inches. The shrink-swell potential is moderate. Potential frost action also is moderate.

Nearly all of the acreage is in native grasses and is used as rangeland. This soil has fair potential for rangeland wildlife habitat and range grasses. It has poor potential for cultivated crops and windbreaks. The potential for most recreation uses and for sanitary facilities and community development is poor. The potential for openland wildlife habitat is very poor.

This soil generally is unsuited to cultivated crops because of the shallowness, the low available water capacity, and the slope.

The use of this soil as rangeland is effective in controlling erosion and in protecting the soil. This soil generally is fairly well suited to range grasses, but on steep, south-facing slopes it is poorly suited. Cattle trails and overgrazed areas are subject to gullying. Overstocking and overgrazing reduce the protective plant cover and cause deterioration of the plant community. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the range grasses and the soil in good condition. Diversions and grassed waterways help to control gullying.

This soil generally is unsuited to windbreaks and environmental plantings because of the low available water capacity and the shallowness.

This soil generally is unsuited to building site development and most engineering uses. The depth to rock is a problem, but the rock is soft and can be easily excavated. The slope is a limitation, but it can be overcome by cutting and filling. Capability subclass VIIe; Shallow range site.

82E—Cabba-Badland complex, 15 to 50 percent slopes. This map unit consists of moderately steep to very steep, shallow, well drained Cabba soils and Badland on residual uplands. Slopes are mostly long and smooth in the areas of Cabba soils and short and uneven slopes in the areas of Badland (fig. 8). Most areas are irregular in shape, but some are long and narrow. The areas range from about 50 to 500 acres in size. They are about 50 to 70 percent Cabba soils and 20 to 35 percent Badland. The Cabba soils are on the convex upper side slopes, the crests of ridges, and the tops of narrow ridges. Badland is exposed soft bedrock that occupies the steeper points, breaks, side slopes, and slumps.

Typically, the Cabba soils have a grayish brown loam surface layer about 2 inches thick. Beneath this is a transitional layer of light brownish gray loam or silt loam about 6 inches thick. The substratum to a depth of about 16 inches is pale yellow loam or silt loam. Between depths of about 16 and 60 inches is stratified, soft sedimentary bedrock that is pale yellow in the upper part and light gray in the lower part. In places, the dark colors extend to a greater depth, and the surface layer is silty clay loam, silt loam, or very fine sandy loam. In some areas the soft bedrock is at a depth of about 20 to 25 inches, and in others it is within a depth of 10 inches.

Included with this unit in mapping are small areas of Cherry soils directly below Cabba and Grail soils in swales and drainageways, Straw soils on very narrow bottom land along streams, and the sodic Daglum and Rhoades soils in swales and on the lower side slopes. These included areas make up 5 to 20 percent of the unit. The Grail soils are dark colored to a greater depth than the Cabba soils and are not underlain by soft bedrock. The Cherry soils are not underlain by soft bedrock. The Straw soils are deep, are not underlain by soft bedrock, and are subject to stream overflow. The Daglum and Rhoades soils do not have soft bedrock within a depth of 40 inches and contain more clay than the Cabba soils.

Permeability is moderate in the Cabba soils, and available water capacity is low. Surface runoff is rapid or very rapid. The surface layer is friable. Roots are restricted by the soft bedrock at a depth of about 16 inches in the Cabba soils. The shrink-swell potential is moderate. Potential frost action also is moderate.

This map unit is used as rangeland. It has fair potential for range grasses and rangeland wildlife habitat. It has poor potential for cultivated crops, windbreaks, sanitary facilities, community development, most recreation uses, and openland wildlife habitat.

This map unit is generally unsuited to cultivated crops because of the shallowness, the low available water capacity, and the slope.

The use of the Cabba soils as rangeland is effective in controlling erosion and in protecting the soil. The Cabba soils generally are fairly well suited to range grasses, but on the steeper south-facing slopes it is poorly suited. Badland is very poorly suited. Cattle trails, overgrazed areas, and the areas of Badland are subject to gullying. Overstocking and overgrazing reduce the protective plant cover and cause deterioration of the plant community. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the range grasses and the soil in good condition. Diversions and grassed waterways help to control gullying in some areas.

This map unit generally is unsuited to windbreaks and environmental plantings because of the low available water capacity, the shallowness, and the slope.

This map unit generally is unsuited to building site development and most engineering uses. The depth to rock is a problem, but the rock is soft and can be easily excavated. The slope is a limitation, but it can be overcome by cutting and filling. Capability subclass VIIe; Cabba soils in Shallow range site, Badland not assigned to a range site.

83C—Vebar-Cohagen fine sandy loams, 3 to 9 percent slopes. This map unit consists of gently sloping to moderately sloping, well drained and somewhat excessively drained soils on residual uplands that are dissected by shallow drainageways. The Vebar soils are on plane and convex slopes. The Cohagen soils are on knolls and ridge crests. Individual areas are irregular in shape and range from 5 to more than 50 acres in size. They are about 50 to 80 percent Vebar soils and 20 to 50 percent Cohagen soils.

Typically, the Cohagen soils have a surface layer of dark grayish brown fine sandy loam about 3 inches thick. The substratum is fine sandy loam about 11 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. Light gray, soft sandstone is at a depth of about 14 inches. On some ridgetops the depth to sandstone is less than 10 inches.

Typically, the Vebar soils have a surface layer of very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is fine sandy loam about 14 inches thick. It is dark brown in the upper part, brown in the next part, and light olive brown in the lower part. The substratum is light yellowish brown, massive fine sandy loam about 6 inches thick. Pale yellow, soft sandstone is at a depth of about 25 inches. In places the depth to soft sandstone is more than 40 inches.

Included with this unit in mapping are small areas of Arnegard and Parshall soils in swales and on the lower side slopes and Rock outcrops on ridges and hilltops. These included areas make up 5 to 15 percent of the unit. Arnegard and Parshall soils do not have sandstone within a depth of 40 inches and have a thicker dark colored surface layer than the Vebar and Cohagen soils. Also, the Arnegard soils have a texture of loam.

Permeability is moderately rapid. Available water capacity is low in the Vebar soils and very low in the Cohagen soils. Surface runoff is medium. The surface layer is very friable. Roots are restricted by the soft sandstone at a depth of about 25 inches in the Vebar soils and 14 inches in the Cohagen soils. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are in native grasses and are used as rangeland. Some are cultivated and used for small grain. These soils have good potential for most recreation uses, range grasses, and openland and rangeland wildlife habitat. They have fair potential for windbreaks and community development. The Cohagen soils have fair potential for openland wildlife habitat and poor potential for rangeland wildlife habitat. Both soils have poor potential for small grain and for most sanitary facilities.

These soils are poorly suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are severe. Stubble mulch, minimum tillage, cultivation across the slope, grassed buffer strips, grass-legume rotations, stripcropping, and windbreaks help to control soil blowing and erosion.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform grazing distribution keep the soil and the range grasses in good condition.

The Vebar soils are suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can grow well. The Cohagen soils generally are unsuited to trees and shrubs because they are droughty and have a shallow root zone.

These soils are suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. Alternative sites, such as the included Arnegard and Parshall soils, should be selected as absorption fields. The depth to rock is a limitation if the soils are used as building sites, but the rock is soft and can be easily excavated. Capability subclass IVe; Vebar soil in Sandy range site, Cohagen soil in Shallow range site.

83E—Cohagen-Vebar fine sandy loams, 9 to 35 percent slopes. This map unit consists of strongly sloping to steep, somewhat excessively drained and well drained soils on residual uplands. It is dissected by shallow drainageways. Slopes are mostly long and smooth. Individual areas are irregular in shape and range from 20 to more than 200 acres in size. They are about 45 to 70 percent Cohagen soils and 20 to 35 percent Vebar soils.

The moderately steep and steep Cohagen soils are on ridges and the upper side slopes. The strongly sloping Vebar soils are on broad ridgetops and the mid and lower side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Cohagen soil has a surface layer of dark grayish brown fine sandy loam about 3 inches thick. The substratum is fine sandy loam about 11 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. Light gray, soft sandstone is at a depth of about 14 inches. In some places on ridgetops, the depth to sandstone is less than 10 inches.

Typically, the Vebar soil has a surface layer of very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is fine sandy loam about 14 inches thick. It is dark brown in the upper part, brown in the next part, and light olive brown in the lower part. The substratum is light yellowish brown, massive fine sandy loam about 6 inches thick. Pale yellow, soft sandstone is at a depth of about 25 inches. In places the depth to soft sandstone is more than 40 inches.

Included with this unit in mapping are small areas of Arnegard and Parshall soils in swales and on the lower side slopes and Rock outcrop on ridges and hilltops. These included areas make up 5 to 15 percent of the unit. The Arnegard and Parshall soils do not have sandstone within a depth of 40 inches and have a thicker dark colored surface layer than the Cohagen and Vebar soils. Also, the Arnegard soils have a texture of loam.

Permeability is moderately rapid. Available water capacity is very low in the Cohagen soil and low in the Vebar soil. Surface runoff is medium to rapid. The surface layer is very friable. Roots are restricted by the soft sandstone at a depth of about 14 inches in the Cohagen soil and 25 inches in the Vebar soil. The shrink-swell potential is low. Potential frost action is moderate.

Nearly all areas are in native grasses and are used as rangeland. Some areas on the lower side slopes and in swales are used for hay. These soils have good potential for range grasses. They have poor potential for cultivated crops, windbreaks, sanitary facilities, community development, recreation uses, and openland and rangeland wildlife habitat.

These soils generally are unsuited to cultivated crops because of the shallowness and the slope.

The use of these soils as rangeland is effective in controlling erosion and in protecting the soil. Overgrazing and overstocking increase the risks of soil blowing and water erosion. Proper stocking rates, uniform distribution of livestock, deferred grazing, and a planned grazing system keep the range and the soil in good condition.

The Cohagen soil generally is unsuited to trees and shrubs because it is droughty and has a shallow root zone. The Vebar soil is suited to trees and shrubs; some of the climatically suited species can grow well.

These soils generally are unsuited to most engineering uses because the Cohagen soil is moderately steep and steep and is shallow over rock. Capability subclass VIIe; Cohagen soil in Shallow range site, Vebar soil in Sandy range site.

84E—Cohagen-Vebar-Rock outcrop complex, 9 to 50 percent slopes. This strongly sloping to very steep map unit consists of Rock outcrop and somewhat excessively drained and well drained soils on residual uplands. It is dissected by shallow drainageways. Individual areas are irregular in shape and range from 20 to more than 200 acres in size. They are about 40 to 70 percent Cohagen soils, 10 to 30 percent Vebar soils, and 10 to 30 percent Rock outcrop.

The moderately steep to very steep Cohagen soils are on ridges and the upper side slopes. The strongly sloping Vebar soils are on broad ridgetops and the mid and lower side slopes. The Rock outcrop, which is hard sandstone, is on the tops and crests of ridges and on the upper side slopes (fig. 9). The two soils and the Rock outcrop are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Cohagen soil has a surface layer of dark grayish brown fine sandy loam about 3 inches thick. The substratum is fine sandy loam about 11 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. Light gray, soft sandstone is at a depth of about 14 inches. In some places on ridgetops, the depth to sandstone is less than 10 inches.

Typically, the Vebar soil has a surface layer of very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is fine sandy loam about 14 inches thick. It is dark brown in the upper part, brown in the next part, and light olive brown in the lower part. The substratum is light yellowish brown, massive fine sandy loam about 6 inches thick. Pale yellow, soft sandstone is at a depth of about 25 inches. In places the depth to soft sandstone is more than 40 inches.

Included with this unit in mapping are small areas of Arnegard and Parshall soils in swales and on the lower side slopes. These soils make up 5 to 15 percent of the unit. The Arnegard and Parshall soils do not have sandstone within a depth of 40 inches and have a thicker dark colored surface layer than the Vebar and Cohagen soils. Also, the Arnegard soils have a texture of loam.

Permeability is moderately rapid. Available water capacity is very low in the Cohagen soil and low in the Vebar soil. Surface runoff is medium to rapid. The surface layer is very friable. Roots are restricted by the soft sandstone at a depth of about 14 inches in the Cohagen soil and 25 inches in the Vebar soil. The shrink-swell potential is low. Potential frost action is moderate.

All areas remain in native grass and are used as rangeland. These soils have fair potential for range grasses and poor potential for crops, windbreaks, recreation uses, wildlife habitat, and most engineering uses.

These soils generally are unsuited to cultivated crops because of steep slopes and shallowness.

The use of these soils as rangeland is effective in controlling erosion and in protecting the soil unless the rangeland is overgrazed. Gullying is a hazard in cattle trails and drainageways. Proper stocking rates, uniform distribution of grazing, and a planned grazing system keep the range grasses and the soil in good condition.

The Cohagen soil generally is unsuited to trees and shrubs because it is droughty and has a shallow root zone. The Vebar soil is suited to trees and shrubs; some climatically suited species can grow well.

These soils generally are unsuited to most engineering uses because the Cohagen soil is moderately steep to very steep and shallow over rock. Capability subclass VIIe; Cohagen soil in Shallow range site, Vebar soil in Sandy range site, Rock outcrop not assigned to a range site.

85—**Harriet Variant silt loam.** This level, deep, poorly drained, strongly saline soil is on low terraces and bottom land. Most areas are crossed by a few shallow to well defined drainageways. Some are occasionally flooded for a brief period. Slopes are long and smooth. White saline patches that are bare of vegetation are common. Individual areas are mostly long and narrow and range from about 5 to more than 80 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 13 inches thick. It is mottled, dark grayish brown silt loam in the upper part and mottled, olive gray silty clay loam in the lower part. The substratum to a depth of about 60 inches is olive gray silty clay loam. It has thin strata of silty clay in the upper part and olive clay loam in the lower part. When the soil is dry, many salt crystals are evident in the surface layer and the subsoil. In places the soil contains more clay or more sand throughout. In some areas in upland swales, the upper part is dark colored.

Included with this soil in mapping are small areas of other poorly drained Harriet soils and well drained Straw soils. These soils make up 5 to 15 percent of the unit. The included Harriet soils contain more clay than this Harriet soil and have a dense subsoil at a depth of 1 inch to 5 inches. The Straw soils are dark colored. They are on plane slopes and are higher on the landscape than this Harriet soil.

Permeability is slow, and available water capacity is low. Surface runoff is slow. The soil is strongly saline and contains excess sodium. As a result, much of the soil moisture is unavailable to plant roots. The water table is within a depth of 1 foot during most of the year. The shrink-swell potential is high. Potential frost action also is high.

Most areas are used as rangeland. Some small areas are cultivated. This soil has good potential for salt-tolerant range grasses and for wetland wildlife habitat. The potential for sanitary facilities, recreation uses, crops, windbreaks, and community development is poor.

This soil is generally unsuited to cultivated crops and to windbreaks and environmental plantings because of the high salinity and the seasonal high water table.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Bare areas are subject to soil blowing. Proper stocking rates, deferment of grazing during wet periods, uniform grazing distribution, and a planned grazing system keep the pasture and the soil in good condition.

This soil is generally unsuited to most engineering uses. In this survey area it is generally not used as a building site. Better suited sites are nearby. Capability subclass VIs; Saline Lowland range site.

86E—Wabek soils, 3 to 25 percent slopes. These deep, gently sloping to moderately steep, excessively drained soils are on terrace edges and in glacial outwash areas. They are shallow over sand and gravel. Most areas are crossed by well defined, shallow drainageways. The areas are mostly long and narrow or irregularly shaped and range from about 10 to 40 acres in size. Slopes are mostly short and smooth. These soils are so intricately mixed, are in areas so small, and are used so similarly that it is not practical to separate them in mapping.

Typically, the surface layer is dark grayish brown gravelly sandy loam about 7 inches thick. The substratum is grayish brown gravelly coarse loamy sand between depths of 7 and 13 inches and light brownish gray, stratified sand and gravel between depths of 13 and 60 inches. In some places on convex slopes, few to many cobbles and stones are on the surface. In any one area of this unit, the surface layer is gravelly sandy loam, sandy loam, loamy sand, gravelly loamy sand, loam, gravelly loam, or a combination of these textures.

Included with this unit in mapping are small areas of Parshall and Bowdle soils on the lower plane and convex slopes. These soils make up less than 10 percent of the unit. The Bowdle soils are moderately deep over sand and gravel. The Parshall soils are fine sandy loam throughout.

Permeability is moderately rapid in the upper part of these Wabek soils and very rapid in the lower part. Available water capacity is very low. Surface runoff is slow. Roots are restricted by the sand and gravel. The shrink-swell potential is low. Potential frost action also is low.

Nearly all areas are in native grasses and used as rangeland. These soils have fair potential for range grasses and poor potential for most engineering and recreation uses if slopes are less than 15 percent. The potential for all sanitary waste disposal systems but septic tank absorption fields is poor. The potential for wildlife habitat is poor.

These soils are generally unsuited to cultivated crops and to windbreaks and environmental plantings because of the low available water capacity and the resultant droughtiness.

The use of these soils as rangeland is effective in controlling erosion and in protecting the soil. The native climax vegetation is easily deteriorated by overgrazing. Proper stocking rates, uniform grazing distribution, deferred grazing, and a planned grazing system keep the pasture and the soil in good condition.

These soils are suited to most engineering uses and to building site development. They are among the best sources of sand and gravel in the county. Effluent from septic tanks can seep into ground water. The slope is a limitation if buildings are constructed on these soils, but this limitation can be overcome by cutting and filling. Capability subclass VIs; Very Shallow range site.

87C—**Rhoades-Daglum complex, 1 to 9 percent slopes.** This map unit consists of deep, nearly level to moderately sloping, well drained soils on uplands, terraces, and foot slopes and in swales, generally on plane or slightly concave slopes. It is crossed by shallow drainageways that are indistinct in places and by gullied drainageways. Slopes are long and smooth, and scabby spots that are almost bare of vegetation are evident. Individual areas are irregular in shape and range from about 5 to more than 500 acres in size. They are about 40 to 70 percent Rhoades soils and 5 to 30 percent Daglum soils. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Rhoades soil has a surface layer of grayish brown silt loam about 2 inches thick. The subsoil is silty clay about 19 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown silty clay loam over grayish brown silt loam. In places the surface layer is loam or very fine sandy loam. In tilled areas it has been mixed with the silty clay subsoil. In some places on uplands, soft shale is at a depth of 35 to 50 inches.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 6 inches thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 9 inches thick. The substratum to a depth of about 60 inches is grayish brown silty clay loam. In places the surface layer is silty clay loam. In some areas soft bedrock is below a depth of 36 inches.

Included with this unit in mapping are small areas of Regent and Moreau soils on the convex knobs and ridges and Belfield and Savage soils on plane slopes. These soils make up 0 to 30 percent of the unit. The Regent and Moreau soils have soft shale at a depth of 20 to 40 inches. The Savage and Regent soils do not contain excess sodium. The Belfield soils generally lack the strong columnar structure characteristic of the Rhoades and Daglum soils.

Permeability is very slow, and available water capacity is low to moderate. Surface runoff is slow to medium. The soils contain excess sodium. They can be easily tilled within a very narrow range in moisture content. Soil aggregates are dispersed by the sodium, and the surface layer puddles and crusts following heavy rains. The dense subsoil and high salinity below the subsoil restrict plant roots. The soils contain too much clay and sodium for soil moisture to be readily available to plants. The shrink-swell potential is high. Potential frost action is low.

Most areas are in native grasses and are used as rangeland (fig. 10). Some are used for cultivated crops. These soils have good potential for sewage lagoons in the less sloping areas and good potential for area type sanitary landfills. The potential for range grasses, cultivated crops, windbreaks, septic tank absorption fields, building site development, recreation areas, and most wildlife habitats is poor.

These soils generally are unsuited to cultivated crops and to windbreaks and environmental plantings because they have a high content of sodium.

The use of these soils as rangeland and pastureland is effective in controlling erosion and in protecting the soil unless the pasture or range is overgrazed. Proper stocking rates, uniform distribution of grazing, deferred grazing, and a planned grazing system keep the range grasses and the soil in good condition.

These soils are poorly suited to building site development and most other engineering uses. The slow absorption of septic tank effluent is difficult to overcome by enlarging the absorption field. Strengthening structural material, backfilling the trenches on which footings are placed, and installing drainage systems around footings and foundations help to overcome the instability and slippage caused by shrinking and swelling and low strength. Capability subclass VIs; Rhoades soil in Thin Claypan range site, Daglum soil in Claypan range site.

88—**Harriet clay.** This deep, level, poorly drained soil is on bottom land and low terraces. It is occasionally flooded for long periods. Some areas are crossed by a few fairly well defined drainageways, but in many places the drainage pattern is indistinct. A few white saline patches are bare of vegetation. This soil is very shallow to a dense claypan. Individual areas range from 5 to more than 100 acres in size, and most are irregular in shape. Slopes are plane or slightly concave and are long and smooth.

Typically, the surface layer is very dark gray loam about 1 inch thick. The subsoil is very dark gray clay about 19 inches thick. The substratum to a depth of about 60 inches is clay loam and stratified loam, silty clay loam, and very fine sandy loam. It is dark olive gray in the upper part and olive brown in the lower part and has a thin layer that is very dark gray. In places the subsoil contains less clay. Some areas are somewhat poorly drained.

Included with this soil in mapping are small areas of Heil and Straw soils and the Harriet Variant. These soils make up 5 to 15 percent of the unit. The Heil soils do not have a high concentration of lime in the upper part. The Harriet Variant does not have a dense subsoil at a depth of about 1 inch to 5 inches and contains less clay than this Harriet soil. The Straw soils are well drained and are higher lying than this Harriet soil.

Permeability is slow, and available water capacity is moderate. Surface runoff is slow. This soil contains excess sodium and is highly saline. The seasonal high water table is within a depth of 1 foot. The restrictive effects of the dense subsoil and the high salinity on plant roots is partly offset by the extra moisture available from the seasonal high water table. The shrink-swell potential is high. Potential frost action also is high.

Most areas are used as rangeland and late-season hayland. Some small areas are cultivated. This soil has good potential for salt-tolerant range grasses. It has poor potential for all sanitary facilities but sewage lagoons and for community development, crops, windbreaks, and recreation uses. The potential for wetland wildlife habitat is good.

This soil is generally unsuited to cultivated crops because of the salinity, the high content of sodium, and the seasonal high water table.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling erosion and in protecting the soil. The hazard of soil blowing is severe where the salt content is sufficently high to prevent plant growth. Proper stocking rates, uniform distribution of grazing, deferred grazing during wet periods, and a planned grazing system keep the pasture and the soil in good condition.

This soil is generally unsuited to trees and shrubs grown as windbreaks and environmental plantings because of the salinity, the high content of sodium, and the wetness.

This soil is poorly suited to building site development and most engineering uses. As a result of flooding, wetness, salinity, and slow permeability, design and maintenance are costly. In this survey area, Harriet soils are generally not used as building sites. Better suited sites are generally nearby. Capability subclass VIs; Saline Lowland range site.

89E—Ustorthents. These deep, well drained, nearly level to very steep soils are on residual uplands. In most areas they are steep or very steep, but they are nearly level on ridgetops and pit bottoms. They are affected by recent stripmining for lignite coal (fig. 11) and, in some nearly level to rolling areas, by cutting and filling adjacent to construction sites. Most areas have very little or no plant cover. Drainage terminates in the pit bottoms and the areas between spoil piles. On some pit bottoms the soils are ponded for long periods and have a high water table.

Typically, the surface is crusted and dispersed and is pale yellow. The surface layer is pale olive silty clay about 3 inches thick. The substratum to a depth of about 60 inches is pale olive silty clay. The soils generally contain shale fragments. In some areas they contain lignite coal fragments. In places the texture is clay. In some areas undisturbed bedrock is below a depth of 40 inches.

Included with these soils in mapping is a poorly drained soil on pit bottoms. This soil makes up less than 10 percent of the unit.

Permeability is very slow, and available water capacity is low. The soils generally contain excess sodium. Because they also contain a fine, elastic type of clay, some of the soil moisture is held under too much tension to be extracted by plant roots. The surface layer is very hard when dry and puddles easily following heavy rains. Runoff is very rapid to rapid. Subsurface subsidence is evident in places. The shrink-swell potential is high. Potential frost action is low.

Most areas are used for wildlife habitat and limited grazing. The potential for farming, engineering uses, and trees and shrubs and for most wildlife habitats that require plants for food and cover is poor.

These soils generally are unsuited to most uses unless they are extensively reclaimed. Some weeds, sweet clover, and other grasses are established. Areas used for grazing have little value as rangeland and generally are adjacent to some other soil that is used as rangeland. These soils are occasionally used by wildlife for water on the pit bottoms and as a hiding place. They are generally unsuited to engineering uses because of the steepness of slopes, the instability, the shrink-swell potential, and the excess sodium. Onsite investigation is necessary to properly plan the use and development of specific sites. Capability subclass VIIIe; not assigned to a range site.

90C—Williams loam, mine sink, 1 to 9 percent slopes. This deep, nearly level to gently rolling, well drained soil is on glacial till uplands. As a result of underground mining for lignite coal, rows of mine sinks are evident. Following the underground mining, the overlying material lacked the necessary support to remain in place. Most drainageways are intercepted by the mine sinks. In most places, the interval between the rows of mine sinks is 100 to 400 feet and the interval between the mine sinks is 0 to 100 feet. Slopes between the mine sinks are short and smooth. Scattered pebbles, cobbles, and stones are on the surface.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsoil is clay loam about 19 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In a few places the surface layer is silt loam, and in a few it is very stony. In places it is thicker.

Included with this unit in mapping are small areas of Cabba, Ringling, and Zahl soils along drainageways. These soils make up 5 to 15 percent of the unit. The Cabba soils have soft bedrock at a depth of 10 to 20 inches. The Ringling soils have porcelanite (scoria) beds at a depth of 5 to 20 inches. Whereas clay has accumulated in the subsoil of the Williams soil, the Zahl soils lack a subsoil. Also included are small areas that are strongly sloping to moderately steep.

Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is high. Surface runoff is medium. The surface layer is friable.

This soil is used as rangeland. It has good potential for range grasses and poor potential for windbreaks, crops, sanitary facilities, and community development. The potential for openland wildlife habitat is good, and the potential for rangeland wildlife habitat is fair.

This soil is generally unsuited to crops because the mine sinks are numerous and the surface can collapse under the weight of machinery.

The use of this soil as rangeland is effective in controlling erosion and in protecting the soil. There is a danger of losing livestock because of the mine sinks and the possible collapse of the surface. Proper stocking rates and uniform distribution of grazing keep the range and the soil in good condition.

This soil is generally unsuited to trees and shrubs in windbreaks because of the hazard in the use of machinery. Specialized plantings for wildlife habitat or esthetic purposes can be made by hand. All species can grow well. Native trees and shrubs are established in some of the shallow mine sinks.

This soil is poorly suited to building site development and most engineering uses because of the mine sinks and the possible collapse of the surface. Better suited sites are nearby. Capability subclass VIe; Silty range site.

91—Straw loam, 0 to 3 percent slopes. This deep, level or nearly level, well drained soil is on low terraces and bottom land along the major streams and on fans in glacial outwash trenches. In most areas it is occasionally flooded for a brief period, but in some it is only rarely flooded. Areas are crossed by a few shallow drainageways that in places are gullied or are indistinct. They are mostly long and irregularly shaped and range from about 10 to more than 300 acres in size. Slopes are plane and smooth. Most are long, but some are short.

Typically, the surface layer is about 20 inches thick. It is grayish brown loam in the upper part and very dark grayish brown silt loam in the lower part. It generally has one or more dark colored, buried layers. The substratum to a depth of about 60 inches is grayish brown loam stratified with silt loam and fine sandy loam over grayish brown fine sandy loam stratified with loam. In some places it has dark buried layers. In some a subsoil is evident. In some areas the substratum is fine sand or loamy fine sand below a depth of 40 inches. In some the dark colors do not extend to so great a depth.

Included with this soil in mapping are small areas of Velva soils on low, convex ridges and Magnus soils in swales. These soils make up 5 to 20 percent of the unit. The Velva soils contain more sand and less clay and the Magnus soils more clay than this Straw soil.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. This soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops (fig. 12). Many are in native grasses and are used as rangeland. Some small areas support native trees and shrubs and are used as recreation areas, wildlife habitat, and rangeland. This soil has good potential for range grasses, windbreaks, cultivated crops, and openland and rangeland wildlife habitat. It has good potential for recreation areas if it is protected against flooding. It has poor potential for sanitary facilities and community development unless it is protected against flooding.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Water erosion and the hazard of flooding are the main concerns of management. Stubble mulch, crop residue management, and stripcropping help to control erosion and protect the soil.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil unless the pasture or range is overgrazed. Proper stocking rates and uniform distribution of grazing protect the soil and help to control erosion.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is poorly suited to sanitary facilities and community development unless it is protected against flooding. Also, sealing to prevent seepage is needed in sewage lagoon areas and sanitary landfills. Onsite investigation is needed to determine the frequency and duration of floods. Capability subclass IIc; Overflow range site.

91B—Straw loam, 3 to 6 percent slopes. This deep, gently sloping or undulating, well drained soil is on low terraces and bottom land along the major streams and on fans in glacial outwash trenches. Slopes are plane, convex, and slightly concave. This soil is undulating generally on bottom land where a series of old stream meanders are evident. In most areas it is occasionally flooded for a brief period, but in some areas it is only rarely flooded. Areas are crossed by a few drainageways that in places are gullied or indistinct. They are irregular in shape and range from about 5 to 40 acres in size. In the undulating areas slopes are short and smooth, and in the gently sloping areas they are long and smooth.

Typically, the surface layer is about 20 inches thick. It is grayish brown loam in the upper part and very dark grayish brown silt loam in the lower part. It generally has one or more dark colored, buried layers. The substratum to a depth of about 60 inches is grayish brown loam stratified with silt loam and fine sandy loam over fine sandy loam stratified with loam. In some places it has dark buried layers. In some a subsoil is evident. In some areas the substratum is fine sand or loamy fine sand below a depth of 40 inches. In some the dark colors do not extend to so great a depth.

Included with this soil in mapping are small areas of Velva soils on low, convex ridges and Magnus soils in swales. These soils make up 5 to 20 percent of the unit. The Velva soils contain more sand and less clay and the Magnus soils more clay than this Straw soil.

Permeability is moderate, and available water capacity is high. Surface runoff is medium. This soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Many are in native grasses and are used as rangeland. Some small areas support native trees and shrubs and are used as recreation areas, wildlife habitat, and rangeland. This soil has good potential for range grasses, windbreaks, cultivated crops, and openland and rangeland wildlife habitat. It has good potential for recreation areas if it is protected against flooding. It has poor potential for sanitary facilities and community development unless it is protected against flooding.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Water erosion and the hazard of flooding are the main concerns of management. Stubble mulch, crop residue management, and stripcropping help to control erosion and protect the soil.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil unless the range or pasture is overgrazed. Proper stocking rates and uniform distribution of grazing protect the soil and help to control erosion.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well. The number of plantings, however, is few because the areas along meandering streams are irregularly shaped.

This soil is poorly suited to sanitary facilities and community development unless it is protected against flooding. Also, sealing to prevent seepage is needed in sewage lagoon areas and sanitary landfills. Onsite investigation is needed to determine the frequency and duration of floods. Capability subclass IIe; Silty range site.

92B—Noonan-Williams loams, 1 to 6 percent slopes. This map unit consists of nearly level to undulating, deep, well drained soils on glacial till uplands. Most areas are crossed by a few shallow drainageways. Slopes are mostly short and smooth. Individual areas range from about 10 to 80 acres in size and are about 50 to 70 percent Noonan soils and 20 to 40 percent Williams soils. The Noonan soils are on plane and slightly concave slopes and in swales. The Williams soils are on convex knolls and ridges. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Noonan soils have a surface layer of very dark grayish brown loam about 7 inches thick. The subsoil is clay loam about 23 inches thick. It is very dark grayish brown in the upper part, dark grayish brown in the next part, and grayish brown in the lower part. The substratum to a depth of about 60 inches is light brownish gray and light gray clay loam glacial till. In some places the surface layer is silt loam. In others it has been mixed with the upper part of the subsoil by plowing. In some areas soft bedrock is at a depth of about 50 inches.

Typically, the Williams soils have a dark grayish brown loam surface layer about 7 inches thick. The subsoil is clay loam about 19 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is light brownish gray clay loam glacial till. In some places the surface layer has been mixed with the upper part of the subsoil by plowing. In others it is dark colored to a greater depth.

Included with this unit in mapping are small areas of Daglum, Rhoades, and Zahl soils. These soils make up 5 to 20 percent of the unit. The Daglum and Rhoades soils contain excess sodium and also contain more clay in the subsoil than the Noonan and Williams soils. They are on plane or slightly concave slopes. The Zahl soils are on convex knobs, hills, and ridges. They lack a subsoil and do not contain excess sodium.

Permeability is slow in the Noonan soils and moderately slow in the Williams soils. Available water capacity is moderate in the Noonan soils and high in the Williams soils. Surface runoff is slow to medium. The surface layer, particularly that of the Noonan soils, is friable and can be easily tilled within a fairly narrow range in moisture content. The Noonan soils contain excess sodium. Roots are restricted by the dense subsoil in the Noonan soils. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are in native grasses and are used as rangeland. Some areas are used for cultivated crops. These soils have generally good potential for recreation areas; fair potential for cultivated crops, range grasses, sanitary facilities, and community development; and poor potential for windbreaks. The Williams soils have good potential for openland wildlife habitat and fair potential for rangeland wildlife habitat. The Noonan soils have poor potential for openland wildlife habitat and very poor potential for rangeland wildlife habitat.

These soils are suited to wheat, oats, barley, and grasses and legumes. The major concerns of management are related to the excess sodium in the Noonan soils, which reduces the availability of water. Both soils are slightly susceptible to soil blowing and moderately susceptible to water erosion. Stubble mulch, crop residue management, stripcropping, and grassed waterways help to control erosion and soil blowing.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil unless the range or pasture is overgrazed. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system keep the plants and the soil in good condition.

The Noonan soils generally are unsuited to trees and shrubs grown as windbreaks and environmental plantings because they have a high content of sodium. The Williams soils are suited to trees and shrubs; most of the climatically suited species can grow well.

These soils are suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IVe; Noonan soils in Claypan range site, Williams soils in Silty range site.

93—Falkirk loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is in swales and on outwash terraces on glacial till uplands. It formed in glacial outwash over glacial till. A few shallow drainageways dissect areas of this soil. A few stones and cobbles are on the surface. Individual areas range from about 5 to 70 acres in size, and most are irregular in shape. Slopes are long and smooth or slightly undulating.

Typically, the surface layer is very dark grayish brown loam about 13 inches thick. The subsoil is dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is light brownish gray gravelly loam over light brownish gray clay loam. Depth to the clay loam part of the substratum generally ranges from 20 to 40 inches. In some areas, however, the clay loam part of the substratum is not evident within a depth of 40 inches.

Included with this soil in mapping are areas of Williams soils on slightly convex slopes. These soils make up 5 to 15 percent of the unit. They have a clay loam subsoil.

Permeability is moderately slow, and available water capacity is high. Runoff is slow. The surface layer can be easily tilled throughout a fairly wide range in moisture content. Potential frost action is moderate. The shrink-swell potential also is moderate.

Most areas are used as cropland. Some are in native grasses. This soil has good potential for rangeland, windbreaks, crops, waste disposal, and most engineering and recreation uses. It has good potential for openland and rangeland wildlife habitat.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Stubble mulch, minimum tillage, and stripcropping help to control soil blowing and maintain the organic-matter content and fertility.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling soil blowing and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Nearly all of the climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and most engineering uses. The slow absorption of septic tank absorption fields can be overcome by enlarging the filter field. Capability subclass IIc; Silty range site.

94—Makoti silt loam. This deep, level, moderately well drained soil is on lake plains in the uplands. The surface drainage pattern is indistinct. Individual areas are mostly circular and range from 10 to 150 acres in size. Slopes are long and smooth.

Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsoil is grayish brown silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is mottled, light brownish gray silty clay loam over mottled, light yellowish brown clay loam. In some places the subsoil is not dark colored to so great a depth. In a few the subsoil and substratum contain less silt and more sand.

Included with this soil in mapping are small areas of well drained Grassna soils on the outer edges of the unit and poorly drained Tonka soils and very poorly drained Parnell soils in slight depressions and potholes. These soils make up less than 10 percent of the unit.

Permeability is moderately slow, and available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Nearly all areas are used for cultivated crops. This soil has good potential for crops, rangeland, windbreaks, sanitary facilities, community development, and recreation areas. It has good potential for openland wildlife habitat and fair potential for rangeland wildlife habitat.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of soil blowing is slight. Stripcropping, crop residue management, and windbreaks help to control soil blowing and protect the soil.

The use of this soil as rangeland, hayland, or pastureland is effective in controlling soil blowing and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIc; Silty range site.

95—Flaxton-Williams loams, 1 to 3 percent slopes. This map unit consists of deep, nearly level, well drained soils on glacial till uplands. Areas are crossed by a few shallow drainageways that fan out and are indistinct in places. They are irregular in shape and range from about 20 to 80 acres in size. Slopes are short and smooth. A few pebbles, cobbles, and stones are on the surface of convex slopes.

Areas of this map unit are about 60 to 75 percent Flaxton soils and 20 to 40 percent Williams soils. The Flaxton soils are on the slightly concave and plane, mid and lower side slopes and in swales. The Williams soils are on the convex upper side slopes and the tops of small knobs and ridges. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Flaxton soils have a dark grayish brown loam surface layer about 11 inches thick. The subsoil is about 24 inches thick. It is grayish brown fine sandy loam in the upper part and grayish brown and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is grayish brown and light brownish gray clay loam over light olive gray and pale olive clay loam. In a few places the clay loam glacial till is at a depth of about 15 inches, and the surface layer is not dark colored to so great a depth. In places soft bedrock is at a depth of about 45 inches. In some areas the surface layer is fine sandy loam.

Typically, the Williams soils have a surface layer of dark grayish brown loam about 5 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is clay loam glacial till. It is light gray in the upper part and light yellowish brown in the lower part. In some places the surface layer is fine sandy loam about 5 inches thick. In others it has been mixed with the upper part of the subsoil by plowing.

Included with this unit in mapping are small areas of Arnegard and Parshall soils in swales and slightly concave positions. These soils make up 5 to 20 percent of the unit. They do not have clay loam glacial till. The Parshall soils are fine sandy loam throughout, and the Arnegard soils are loam throughout.

Permeability is moderately rapid in the upper part of the subsoil of the Flaxton soils and moderately slow in the lower part of the subsoil and the substratum. It is moderate in the subsoil of the Williams soils and moderately slow in the substratum. Available water capacity is high. Surface runoff is slow. Both soils can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland or hayland. These soils have good potential for most of the cultivated crops commonly grown in the county and for range grasses, windbreaks, most recreation uses, and openland wildlife habitat. The potential for most sanitary facilities, community development, and rangeland wildlife habitat is fair.

These soils are well suited to wheat, oats, barley, and grasses and legumes. They are moderately susceptible to soil blowing and slightly susceptible to water erosion. Minimum tillage, stubble mulch, crop residue management; grass-legume rotations, stripcropping, grassed waterways, and windbreaks help to control soil blowing and water erosion.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil unless the range or pasture is overgrazed. Proper stocking rates and uniform distribution of grazing keep the range grasses and the soil in good condition.

These soils are suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

These soils are suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIe; Flaxton soils in Sandy range site, Williams soils in Silty range site.

96—Grassna silt loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is in upland swales and on terraces, valley fans, and foot slopes. Most areas are crossed by fairly well defined, shallow drainageways, but the drainage pattern fans out and is indistinct in places. Individual areas are irregular in shape and range from 3 to 100 acres in size. Most are less than 40 acres. Slopes are long and smooth.

Typically, the surface layer is silt loam about 17 inches thick. The upper part is very dark grayish brown, and the lower part is very dark gray. The subsoil is dark grayish brown silt loam about 12 inches thick. The substratum to a depth of 60 inches is silt loam. The upper part is light gray, and the lower part is light brownish gray. In some areas thin, dark buried layers are at a depth of about 55 inches.

Included with this soil in mapping are small areas of poorly drained Tonka soils in potholes and shallow depressions and well drained Wilton soils on the upper side slopes. These soils make up less than 15 percent of the unit. The Wilton soils have clay loam glacial till at a depth of 26 to 40 inches.

Permeability is moderate, and available water capacity is high. Runoff is slow. Except for periods when it receives heavy rainfall or is frozen, this soil absorbs most of the runoff from the higher lying surrounding soils. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Nearly all areas are farmed. This soil has good potential for crops, rangeland, windbreaks, sanitary facilities, building site development, and recreation uses. It has good potential for openland wildlife habitat and fair potential for rangeland wildlife habitat.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are slight. Stubble mulch, minimum tillage, and tillage across the slope help to control soil blowing and water erosion and maintain the organic-matter content, fertility, and tilth.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIc; Overflow range site.

96B—Grassna silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is in upland swales and on valley fans and foot slopes. Most areas are crossed by fairly well defined, shallow drainageways, but the drainage pattern is indistinct in places. The size and shape of individual areas vary greatly, but most areas are less than 40 acres in size and irregular in shape. Slopes are long and smooth.

Typically, the surface layer is silt loam about 17 inches thick. The upper part is very dark grayish brown, and the lower part is very dark gray. The subsoil is dark grayish brown silt loam about 12 inches thick. The substratum to a depth of about 60 inches is silt loam. The upper part is light gray, and the lower part is light brownish gray. In places the texture is silty clay loam throughout. In some areas thin, dark buried layers are at a depth of about 55 inches.

Included with this soil in mapping are small areas of poorly drained Tonka soils in potholes and shallow depressions and well drained Wilton soils on the upper side slopes. These soils make up less than 15 percent of the unit. The Wilton soils have clay loam glacial till at a depth of 26 to 40 inches.

Permeability is moderate, and available water capacity is high. Runoff is medium. Except for periods when it receives heavy rainfall or is frozen, this soil absorbs most of the runoff from the surrounding higher lying soils. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Nearly all areas are farmed. This soil has good potential for crops, rangeland, windbreaks, sanitary facilities, building site development, and recreation uses. It has good potential for openland wildlife habitat and fair potential for rangeland wildlife habitat.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Grassed waterways and diversions help to control erosion where water concentrates in drainageways. Stubble mulch, minimum tillage, and tillage across the slope help to control erosion, protect the soil, and maintain the organic-matter content, tilth, and fertility.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is well suited to building site development and most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. The slope is a limitation if the soil is used as a site for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIe; Silty range site.

97B—Sen silt loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on residual uplands. Slopes are mostly long and smooth and are dissected by shallow drainageways. Individual areas are irregular in shape and are mostly less than 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 9 inches thick. It is brown in the upper part and light olive brown in the lower part. The substratum is light yellowish brown silt loam and silty clay loam about 17 inches thick. Below this to a depth of about 60 inches is light yellowish brown and pale olive, soft bedrock. In places the subsoil contains more clay. In some areas the surface layer is loam or silty clay loam.

Included with this soil in mapping are small areas of Arnegard, Werner, and Williams soils. These soils make up 5 to 20 percent of the unit. The Arnegard soils are in swales. They have a thicker dark colored surface layer than this Sen soil and have a loam subsoil. The Werner soils are on convex slopes. They have soft bedrock at a depth of 10 to 20 inches. The Williams soils have a clay loam subsoil and are not underlain by soft bedrock.

Permeability and available water capacity are moderate. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Roots are restricted by the soft bedrock at a depth of about 31 inches. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses. This soil has good potential for rangeland, windbreaks, and crops. It has mostly fair potential for community development and recreation uses. The potential for openland and rangeland wildlife habitat is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Stubble mulch, minimum tillage, and crop residue management help to control erosion and protect the soil. Grassed waterways and diversions help to control erosion where water concentrates in drainageways.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Nearly all climatically suited trees and shrubs can grow well.

This soil is suited to building site development and most engineering uses. The depth to rock is a problem, but the rock is soft and can be easily excavated. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. The slope is a limitation if the soil is used as a site for playgrounds, but this limitation can be overcome by cutting and filling. Capability subclass IIe; Silty range site.

97C—Sen silt loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on residual uplands. Slopes are mostly long and smooth and are dissected by well defined drainageways. The drainageways are gullied in some cultivated areas. Individual areas are irregular in shape and range from about 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 9 inches thick. It is brown in the upper part and light olive brown in the lower part. The substratum is light yellowish brown silt loam and silty clay loam about 12 inches thick. Below this to a depth of about 60 inches are light yellowish brown and pale olive, soft sedimentary beds. In places the subsoil contains more clay. In some areas the surface layer is loam or silty clay loam.

Included with this soil in mapping are small areas of Arnegard, Werner, and Williams soils. These soils make up 10 to 25 percent of the unit. The Arnegard soils are in swales. They have a thicker, dark colored surface layer than this Sen soil and have a loam subsoil. The Werner soils are on convex slopes. They have soft bedrock at a depth of 10 to 20 inches. The Williams soils have a clay loam subsoil and are not underlain by soft bedrock.

Permeability and available water capacity are moderate. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Roots are restricted by the soft bedrock at a depth of about 26 inches. The shrink-swell potential is moderate. Potential frost action also is moderate.

This soil is used as cropland and rangeland. The potential for rangeland and windbreaks is good. The potential for crops, most community development and recreation uses, and openland and rangeland wildlife habitat is fair.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is severe, and the hazard of soil blowing is slight. Minimum tillage, crop residue management, and stubble mulch help to control erosion and soil blowing and maintain the organic-matter content, tilth, and fertility. Grassed waterways and diversions help to control erosion where water concentrates in drainageways.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. Nearly all of the climatically suited trees and shrubs can grow well.

This soil is suited to building site development and most engineering uses. The depth to rock is a problem, but the rock is soft and can be easily excavated. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening basement walls and foundations. Alternative sites should be selected for playgrounds. Capability subclass IIIe; Silty range site.

98E—Ringling-Cabba complex, 9 to 35 percent slopes. This map unit consists of shallow, strongly sloping to steep, excessively drained and well drained soils on residual uplands. It is dissected by incised drainageways. Outcrops of porcelanite (scoria), clinker rock, or slag rock are on the crests of hills and the tops of ridges. Slopes are mostly long and smooth. Individual areas are mostly long and irregularly shaped and range from about 40 to 250 acres in size. They are about 50 to 70 percent Ringling soils and 20 to 45 percent Cabba soils.

The Ringling soils are on convex hilltops and ridgetops and the upper side slopes. The Cabba soils are on the mid and lower side slopes. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Ringling soil has a surface layer of dark reddish gray channery loam about 7 inches thick. The substratum to a depth of about 15 inches is reddish brown very channery loam. Fractured, hard, red and reddish yellow porcelanite (scoria) beds are at a depth of about 15 inches (fig. 13).

Typically, the Cabba soil has a surface layer of grayish brown loam or silt loam about 2 inches thick. Below this is a transitional layer of light brownish gray loam or silt loam about 6 inches thick. The substratum is pale yellow loam about 8 inches thick. Stratified, pale yellow and light gray bedrock is at a depth of about 16 inches. In a few places the soft bedrock is at a depth of about 30 inches.

Included with this unit in mapping are small areas of Arnegard and Grail soils in swales, Searing soils on broad ridgetops and the lower side slopes, and Rhoades soils in swales and on the lower side slopes. These soils make up 5 to 20 percent of the unit. The Arnegard and Grail soils are not underlain by bedrock and are dark colored to a greater depth than the Ringling and Cabba soils. The Searing soils have fractured porcelanite beds at a depth of 20 to 40 inches. The Rhoades soils contain excess sodium and have a dense subsoil at a depth of 2 to 5 inches.

Permeability is very rapid in Ringling soil and moderate in the Cabba soil. Available water capacity is very low or low in the Ringling soil and low in the Cabba soil. Surface runoff is rapid. The surface layer is friable. Roots are restricted by the bedrock in both soils. The shrink-swell potential is low in the Ringling soil and moderate in the Cabba soil. Potential frost action is low in the Ringling soil and moderate in the Cabba soil.

These soils are in native grasses and are used as rangeland. Some areas are mined for porcelanite, which is a substitute for gravel as a road topping. The potential for recreation areas and rangeland wildlife habitat is fair. The potential for range grasses, cultivated crops, windbreaks, sanitary facilities, community development, and openland wildlife habitat is poor.

These soils generally are unsuited to cultivated crops because of the limited root zone and the slope.

The use of these soils as rangeland is effective in controlling erosion and in protecting the soil unless the range is overgrazed. Proper stocking rates, uniform grazing distribution, deferred grazing, and a planned grazing system maintain the plant cover and therefore help to control runoff and erosion and maintain the maximum forage production.

These soils are generally unsuited to trees and shrubs grown as windbreaks and environmental plantings because of the limited root zone.

These soils are suited to some building site development if slopes are less than 15 percent. They generally are poorly suited to most other engineering uses because of the depth to rock and the slope. Suitable building sites can be located on some of the included soils. Capability subclass VIe; Ringling soil in Very Shallow range site, Cabba soil in Shallow range site.

100B—Amor loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is in the residual uplands. Slopes are plane and convex, mostly long and smooth, and are dissected by shallow drainageways. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum is light brownish gray loam about 12 inches thick. Below this to a depth of about 60 inches is pale olive, soft sandstone. In places the subsoil is silt loam. In some areas the dark colors extend to a greater depth, and the soft sandstone is not evident within a depth of 40 inches.

Included with this soil in mapping are small areas of Vebar and Werner soils. These soils make up 5 to 20 percent of the unit. The Vebar soils have a texture of fine sandy loam. The Werner soils have soft sandstone at a depth of 10 to 20 inches. The Werner soils are on the tops of knobs and ridges.

Permeability and available water capacity are moderate. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Roots are restricted by the soft bedrock at a depth of about 32 inches. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland. This soil has good potential for range grasses, windbreaks, and most of the cultivated crops commonly grown in the county. It has good potential for most recreation uses. The potential for openland wildlife habitat is good, and the potential for rangeland wildlife habitat is fair. The potential for septic tank absorption fields, for most other sanitary facilities, and for community development is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. Most areas are slightly susceptible to soil blowing and water erosion, but some are moderately susceptible to water erosion. Minimum tillage, crop residue management, stubble mulch, grassed waterways, and diversions help to prevent excessive soil and water losses. They also maintain fertility, organic-matter content, and tilth.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the soil and the range grasses in good condition.

This soil is suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs can grow well.

This soil is suited to building site development and to most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The depth to rock is a problem, but the rock is soft and can be easily excavated. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIe; Silty range site.

100C—Amor loam, 6 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on residual uplands. Slopes are mostly convex and long and smooth. Areas are dissected by shallow to well defined drainageways. They are irregular in shape and are mostly less than 50 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is loam about 12 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum is light brownish gray loam about 12 inches thick. Below this to a depth of about 60 inches is pale olive, soft sandstone. In places the subsoil is silt loam. In some areas the dark colors extend to a greater depth, and the soft sandstone is not evident within a depth of 40 inches.

Included with this soil in mapping are small areas of Vebar and Werner soils. These soils make up 5 to 20 percent of the unit. The Vebar soils have a texture of fine sandy loam. The Werner soils have soft sandstone at a depth of 10 to 20 inches. The Werner soils are on the tops of knobs and ridges.

Permeability and available water capacity are moderate. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Roots are restricted by the soft bedrock at a depth of about 32 inches. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland. This soil has good potential for range grasses, windbreaks, most recreation uses, and openland wildlife habitat. It has fair potential for most cultivated crops and for sanitary landfill areas, community development, and rangeland wildlife habitat. It has poor potential for sewage disposal.

The soil is suited to wheat, oats, barley, and grasses and legumes. It is slightly susceptible to soil blowing and moderately susceptible to water erosion. Minimum tillage, crop residue management, stubble mulch, grassed waterways, and diversions help to prevent excessive soil and water losses. They also maintain fertility, organic-matter content, and tilth.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the soil and the range grasses in good condition.

This soil is suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs can grow well.

This soil is suited to building site development and to most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. The depth to rock is a problem, but the rock is soft and can be easily excavated. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIe; Silty range site.

101C—Parshall fine sandy loam, 6 to 9 percent slopes. This deep, moderately sloping, well drained soil is on the edges of stream terraces and outwash plains. Areas are crossed by a few shallow drainageways. They are irregular in shape and range from 10 to 50 acres in size. Slopes are plane or convex and are short and smooth.

Typically, the surface layer is fine sandy loam about 17 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is fine sandy loam about 15 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum is, in sequence downward, light brownish gray fine sandy loam, grayish brown fine sandy loam, and light brownish gray loamy fine sand. In a few places the surface layer is loam, and in some a dark colored, buried layer is at a depth of about 50 inches. In some areas the dark colors do not extend to so great a depth.

Included with this soil in mapping are small areas of Lihen and Flaxton soils. These soils make up 5 to 15 percent of the unit. The Lihen soils are sandy throughout. They are on plane and convex slopes. The Flaxton soils have clay loam glacial till at a depth of 20 to 40 inches. They are on the convex tops of knobs and ridges. Also included in places is a soil having sand and gravel at a depth of about 35 inches.

Permeability is moderately rapid, and available water capacity is moderate to high. Surface runoff is medium. This soil can be easily tilled throughout a wide range in moisture content. The shrink-swell potential is low. Potential frost action is moderate.

Most areas are in native grasses and are used as rangeland. Some are used for cultivated crops. This soil has good potential for range grasses, windbreaks, recreation areas, openland wildlife habitat, and septic tank absorption fields. It has fair potential for cultivated crops, community development, and rangeland wildlife habitat. The potential for sewage lagoons is poor.

This soil is suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are severe. Cultivation across the slope, stubble mulch, minimum tillage, crop residue management, stripcropping, and windbreaks help to control erosion and soil blowing, maintain the organic-matter content and fertility, and improve the water-supplying capacity.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Many of the climatically suited trees and shrubs can grow well.

This soil is suited to building site development and to most engineering uses. Contamination of ground water, however, can result from the use of this soil as a septic tank absorption field. Seepage from sanitary landfills and sewage lagoons can be prevented if proper lining is used. Capability subclass IVe; Sandy range site.

102—Bowbells loam, 1 to 3 slopes. This nearly level, well drained soil has plane and slightly concave slopes. Areas are crossed by a few shallow drainageways that fan out and are indistinct in places. A few pebbles, cobbles, and stones are on the surface. Individual areas are irregular in shape and range from about 40 to 500 acres in size. Slopes are short and smooth.

Typically, the surface layer is very dark grayish brown loam about 11 inches thick. The subsoil is about 23 inches thick. The upper part is dark grayish brown loam, the next part is dark grayish brown clay loam, and the lower part is grayish brown clay loam. The substratum to a depth of about 60 inches is mottled, light yellowish brown clay loam. In some places the surface layer is silt loam. In others the texture is loam throughout, and the clay loam glacial till substratum is not evident. In some areas the dark colors do not extend to so great a depth.

Included with this soil in mapping are small areas of poorly drained Tonka soils and very poorly drained Parnell soils. These soils make up 0 to 10 percent of the unit. They occupy shallow depressions and potholes.

Permeability is moderate in the subsoil and moderately slow in the substratum. Available water capacity is high. Surface runoff is slow. This soil can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate. Potential frost action also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland and hayland. This soil has good potential for range grasses, windbreaks, most of the cultivated crops commonly grown in the county, openland and rangeland wildlife habitat, sewage lagoons, sanitary landfills, and recreation uses. The potential for septic tank absorption fields and community development is fair.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazards of soil blowing and water erosion are slight. Stubble mulch, minimum tillage, stripcropping, and windbreaks help to control soil blowing and erosion and maintain the organic-matter content, fertility, and tilth.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling soil blowing and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the soil and the grasses in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is suited to building site development and to most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIc; Overflow range site.

104—**Magnus silty clay loam.** This level, deep, well drained soil is on bottom land and low terraces. It is rarely or commonly flooded. Most drainageways are indistinct. Slopes are mostly long and smooth. Individual areas are mostly irregular in shape and range from 10 to 80 acres in size.

Typically, the surface layer is about 16 inches thick. The upper part is very dark grayish brown silty clay loam, and the lower part is very dark grayish brown silty clay. The subsoil is about 13 inches of dark grayish brown silty clay that has thin strata of silty clay loam. The substratum to a depth of about 60 inches is grayish brown and dark grayish brown silty clay loam that has thin strata of silt loam and silty clay. One or more dark colored, buried layers are evident in most places. In places the surface layer is silty clay. In some areas it is not so dark colored.

Included with this soil in mapping are small areas of Straw soils. These soils make up 5 to 15 percent of the unit. The Straw soils contain less clay and more sand than this Magnus soil.

Permeability is slow or moderately slow, and available water capacity is high. Surface runoff is slow. The surface layer can be easily tilled within a fairly narrow range in moisture content. It tends to puddle and crust following heavy rains. The shrink-swell potential is high. Potential frost action is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland and hayland. This soil has good potential for most of the cultivated crops commonly grown in the county and for range grasses, windbreaks, and openland wildlife habitat. If protected against flooding, it has good potential for sewage lagoon areas. The potential for recreation areas and rangeland wildlife habitat is fair. The potential for septic tank absorption fields and sanitary landfills is fair if the soil is protected against flooding.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The main concerns of management are the flood hazard and the hazard of erosion. Crop residue management, stubble mulch, minimum tillage, stripcropping, and windbreaks reduce the erosion hazard.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil unless the pasture or range is overgrazed. Proper stocking rates and uniform distribution of grazing keep the range grasses and the soil in good condition.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well.

This soil is poorly suited to sanitary facilities and community development unless it is protected against flooding. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Onsite investigation is needed to determine the frequency and duration of floods. Capability subclass IIc; Overflow range site.

108—**Belfield-Straw silt loams, 1 to 3 percent slopes.** This map unit consists of deep, nearly level, well drained soils on bottom land and low terraces. Most areas are only rarely flooded, but some are occasionally flooded for a brief period. Most are crossed by shallow drainageways, but in places the drainage pattern fans out and is indistinct. Slopes are plane and are mostly long and smooth. Individual areas are irregular in shape and range from about 20 to 80 acres in size. They are about 50 to 70 percent Belfield soils and 15 to 35 percent Straw soils. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown clay loam about 4 inches thick. The subsoil is about 18 inches thick. It is grayish brown silty clay loam in the upper part, grayish brown clay loam in the next part, and light brownish gray clay loam in the lower part. The substratum to a depth of about 60 inches is stratified clay loam and silty clay loam. It has thin strata of loam and silt loam below a depth of 40 inches. It is light gray in the upper part and light yellowish brown in the lower part. In places the surface layer is loam. In some areas a dark colored, old buried surface layer is evident.

Typically, the Straw soil has a surface layer of very dark grayish brown silt loam about 8 inches thick. The subsoil is silt loam about 16 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The substratum to a depth of about 60 inches is loam stratified with silt loam and fine sandy loam. The upper part is grayish brown, and the lower part is light brownish gray. In places the surface layer is loam. In some areas a dark, old buried surface layer is evident.

Included with this unit in mapping are small areas of Harriet soils. These soils make up 0 to 10 percent of the unit. They are wetter than the Belfield and Straw soils and are shallower to soluble salts.

Permeability is slow in the Belfield soil and moderate in the Straw soil. Available water capacity is high in both soils. The Belfield soil contains excess sodium salts. Both soils can be easily tilled throughout a fairly wide range in moisture content. Roots are moderately restricted by the moderately dense subsoil in the Belfield soil. The shrink-swell potential is high in the Belfield soil and moderate in the Straw soil. Potential frost action is moderate in both soils.

Most areas are cultivated. These soils have good potential for range grasses and most of the cultivated crops commonly grown in the county. The Straw soil has good potential and the Belfield soil fair potential for windbreaks. The potential for openland and rangeland wildlife habitat is fair. The potential for most engineering and recreation uses is poor unless the soils are protected against flooding.

These soils are well suited to wheat, oats, barley, and grasses and legumes. The hazard of erosion is slight. The main concerns of management are the moderate restriction of root growth and the slow permeability in the Belfield soil. Flooding is also a concern, but it can be beneficial to range grasses and to hay and pasture plants. Deep-rooted crops in the cropping system, stubble mulch, and minimum tillage improve root growth and permeability and help to control soil blowing and water erosion.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform grazing distribution keep the range grasses in good condition.

These soils are suited to windbreaks and environmental plantings. Most of the climatically suited trees and shrubs can grow well.

Unless protected against flooding, these soils are poorly suited to building site development and other engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIs; Belfield soil in Clayey range site, Straw soil in Overflow range site.

109B--Bowbells-Zahl loams, 3 to 6 percent slopes. This map unit consists of deep, undulating, well drained soils on glacial till uplands. It is crossed by a few shallow drainageways in some places, but the drainage pattern is indistinct in most places. A few pebbles, cobbles, and stones are on the surface. Slopes are short and smooth. Individual areas are irregular in shape and range from 10 to more than 100 acres in size. They are about 45 to 75 percent Bowbells soils and 20 to 40 percent Zahl soils.

The Bowbells soils are on plane and concave slopes. The Zahl soils are on convex slopes above the Bowbells soils. The two soils are so intricately mixed and are in areas so small that it is not practical to separate them in mapping.

Typically, the Bowbells soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is dark grayish brown loam, the next part is dark grayish brown clay loam, and the lower part is grayish brown clay loam. The substratum to a depth of about 60 inches is mottled, light yellowish brown clay loam. In some places the surface layer is silt loam. In some the dark colors do not extend to so great a depth. In some areas the texture is loam throughout, and the clay loam glacial till substratum is not evident.

Typically, the Zahl soil has a surface layer of dark grayish brown loam about 5 inches thick. The substratum to a depth of about 60 inches is clay loam glacial till. It is light brownish gray in the upper part and light yellowish brown in the lower part. In tilled areas the lighter colored clay loam substratum is mixed with the surface layer. In places a grayish brown loam transitional layer is between the surface layer and the substratum.

Included with this unit in mapping are small areas of poorly drained Tonka soils and very poorly drained Parnell soils. These soils make up 0 to 10 percent of the unit. They occupy shallow depressions and potholes.

Permeability is moderate in the subsoil of the Bowbells soil and moderately slow in the substratum. It is moderately slow in the Zahl soil. Available water capacity is high, and surface runoff is medium. The Bowbells soil can be easily tilled throughout a fairly wide range in moisture content. The Zahl soil is more difficult to till, especially when too wet or too dry. Potential frost action is moderate. The shrink-swell potential also is moderate.

Most areas are used for cultivated crops. Some are in native grasses and are used as rangeland and hayland. These soils have good potential for range grasses, windbreaks, most of the cultivated crops commonly grown in the county, openland wildlife habitat, and recreation uses. They have fair potential for septic tank absorption fields, sewage lagoons, community development, and rangeland wildlife habitat.

These soils are well suited to wheat, oats, barley, and grasses and legumes. The main concerns of management are controlling soil blowing and erosion and maintaining the organic-matter content and fertility. The Bowbells soil is slightly susceptible and the Zahl soil moderately susceptible to soil blowing. Stubble mulch, minimum tillage, stripcropping, grassed waterways, and windbreaks help to control soil blowing and erosion and maintain the organic-matter content, fertility, and tilth.

The use of these soils as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil unless the range or pasture is overgrazed. Proper stocking rates and uniform distribution of grazing keep the soil and the plants in good condition.

These soils are suited to windbreaks and environmental plantings. All of the climatically suited trees and shrubs can grow well on the Bowbells soil, and most of the climatically suited species can grow well on the Zahl soil.

These soils are suited to building site development and to most engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on these soils, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIe; Bowbells soil in Silty range site, Zahl soil in Thin Upland range site.

110B—Belfield silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands and terraces and in swales. Fairly well defined, shallow drainageways cross most areas, but the drainage pattern is entrenched or fans out and is indistinct in places. A moderately dense subsoil is at a depth of 7 to 20 inches. Individual areas are mostly irregular in shape and are less than 80 acres in size. Slopes are long and plane or concave.

Typically, the surface layer is dark grayish brown silt loam about 13 inches thick. The subsurface layer is dark grayish brown silty clay loam about 3 inches thick. The subsoil is silty clay about 16 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is silty clay loam. It is light brownish gray in the upper part and light yellowish brown in the lower part. In places soft, partly weathered bedrock is below a depth of 36 inches. In some places on terraces and in swales, the substratum has a dark colored, old buried surface layer. In places, the surface layer is loam and the subsoil contains less clay.

Included with this soil in mapping are small areas of Grail soils on concave slopes and Daglum and Rhoades soils on plane slopes. These soils make up about 5 to 20 percent of the unit. The Daglum and Rhoades soils have a denser subsoil and the Grail soils a less dense subsoil than this Belfield soil.

Permeability is slow, and available water capacity is high. This soil receives some runoff from the higher lying surrounding soils. It can be easily tilled throughout a wide range in moisture content. Roots are restricted somewhat in the subsoil. The shrink-swell potential is high. Potential frost action is low. The subsoil contains a large amount of sodium.

Most areas are cultivated. This soil has good potential for rangeland, crops, waste disposal facilities, and recreation uses. It has fair potential for windbreaks, most community development uses, and openland and rangeland wildlife habitat.

This soil is well suited to wheat, oats, barley, and grasses and legumes. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Stubble mulch, minimum tillage, and crop residue management help to control erosion and soil blowing. Deep-rooted legumes and manure maintain the organic-matter content, tilth, and fertility and improve moisture intake. Grassed waterways and diversions help to control erosion where water concentrates in drainageways. If the dense subsoil is exposed during construction of waterways and diversions, recovering the surface with topsoil provides a good seedbed.

The use of this soil as rangeland, pastureland, or hayland is effective in controlling erosion and in protecting the soil. Proper stocking rates and uniform distribution of grazing keep the pasture and the soil in good condition.

This soil is suited to windbreaks and environmental plantings. Some of the climatically suited trees and shrubs can grow well.

This soil is suited to building site development and to most other engineering uses. The slow absorption of septic tank effluent can be overcome by enlarging the absorption field. If buildings are constructed on this soil, the effects of shrinking and swelling can be overcome by strengthening foundations and basement walls. Capability subclass IIIe; Clayey range site.

111—Pits, gravel. This map unit is in areas from which the soil material has been removed in order to mine the underlying sand and gravel. Most areas are used only for mining of the remaining sand and gravel. The potential for most farming and engineering uses is poor. The potential for trees and shrubs, wildlife habitat, and recreation areas also is poor.

This map unit generally is unsuited to farming unless it is leveled and top dressed with suitable topsoil. It is difficult to revegetate unless it is reclaimed with topsoil. In unreclaimed areas, climatically suited trees and shrubs can be planted on pit bottoms for wildlife habitat and for esthetic value.

This map unit generally is unsuited to sanitary facilities and building site development unless it is leveled and reclaimed. Drainage outlets should be provided in ponded areas and in areas where the water table is seasonally high. Onsite investigation is needed to predict the behavior of this unit for such uses as sanitary facilities and building sites. Capability subclass VIIIs; not assigned to a range site.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

EDWARD R. WEIMER, agronomist, Soil Conservation Service, helped prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; 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 presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

About 282,000 acres in Mercer County was used for crops and pasture in 1975, according to the Agricultural Stabilization and Conservation Service. Of this total, about 100,000 acres was used for hard red spring wheat; 30,000 acres for oats; 15,000 acres for corn, mostly silage; 6,000 acres for barley; 5,000 acres for flax; 51,000 acres for hayland, mostly an alfalfa-grass mixture; and 4,000 acres for tame pasture. About 71,000 acres was summer fallow.

The acreage of a close-grown crop, such as wheat, has increased, whereas the acreage of tame pasture, row crops, hayland, and summer fallow has decreased. The shift in cropland use is a result of economic factors and changes in agricultural programs.

The total acreage of cropland is gradually decreasing as a result of mining for lignite coal and, to a minor extent, urbanization. Many mined areas were once cropland. Approximately 4,000 acres has been mined, and the mined acreage is expected to increase at a higher rate in the future. The use of this soil survey to help make land-use decisions that will influence the future role of farming in the county is described under the heading "General soil map for broad land-use planning."

The potential of the soils in Mercer County for increased production of cultivated grain crops is good. About 20,000 acres of potentially good cropland is rangeland; 4,000 acres, tame pasture; 51,000 acres, hayland; and 71,000 acres, summer fallow. Almost 20 percent of the acreage used as cropland, however, is marginal and is best suited as pastureland and rangeland. Production can be increased by using continuous cropping systems, applying fertilizer, and extending the latest crop production technology to all cropland in the county. The information contained in this soil survey report can greatly facilitate the application of such technology.

Soil erosion is the major soil problem on much of the cropland in Mercer County. Other concerns of management are excess sodium salts, clayey or sandy textures, conservation of soil moisture, and maintenance of fertility and tilth.

Nearly all of the cropped soils are subject to soil blowing. Those that are highly susceptible are the Flaxton, Lihen, Vebar, Velva, Krem, Lefor, Parshall, and Noonan fine sandy loams. These soils have a high percentage of sand in the surface layer. Other cropped soils that are subject to soil blowing are Lawther, Lohler, Havrelon, Banks, Colvin, Mandan, Moreau, and Zahl soils. They are subject to soil blowing because they have a high content of lime, clay, or very fine sand. They are easily damaged by strong winds, if they are dry and are bare of vegetation and surface mulch.

Among the measures that are effective in controlling soil blowing are wind stripcropping, buffer strips, minimum tillage, continuous cropping, windbreaks, cover crops, timely tillage, and crop residue management. A combination of these methods generally is most effective.

Water erosion is a major problem on most of the cropland in the survey area. Some of the soils that are subject to soil blowing are also subject to water erosion. Generally, soils having slopes that are more than 3 percent and are long and smooth are highly susceptible to water erosion. Even some nearly level soils receiving runoff from higher lying soils are subject to gullying. Soil erosion on cropland lowers the productivity of the soil and results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Many soils used as cropland have long and smooth slopes. Such soils, for example, Amor-Werner loams, 6 to 9 percent slopes, are subject to gullying in drainageways. Gullying can be controlled by reducing runoff and establishing and maintaining grassed waterways. Contour tillage, terraces and diversions, contour stripcropping, crop residue management, cover crops, and grasses and legumes in the cropping system also help to control erosion. Contour stripcropping and tillage are not practical on some soils having short and smooth slopes, for example, Williams loam, 3 to 6 percent slopes. Minimum tillage, grassed waterways, crop residue management, and other measures minimize soil losses.

Conservation practices that control soil blowing and water erosion provide protective surface cover, reduce runoff, increase infiltration of water, and maintain and improve fertility, water-holding capacity, and tilth. Applying commercial fertilizers, plowing green manure and barnyard manure under, and including cover crops and grasses and legumes in the cropping system also maintain fertility and tilth.

Many soils used as cropland contain excess sodium salts. Belfield, Daglum, Noonan, and Moreau soils are examples. Because sodium disperses the clay particles, the subsoil is dense and a crust forms on the surface. Permeability in these soils is slow or very slow. Preparation of a good seedbed is difficult. Yields of grain crops range from fair to poor. Conservation measures are needed because the slow infiltration rate results in excess runoff. Crop residue management, manure, and deep-rooted crops, such as alfalfa and sweet clover, can improve the infiltration rate and reduce crust formation. Fall plowing prepares a good seedbed, but conservation measures, such as grassed waterways and contour stripcropping, are needed to minimize water erosion.

Soil moisture is conserved generally by reducing evaporation, minimizing runoff losses, increasing the infiltration rate, and controlling weeds and soil blowing and water erosion. Crop residue management, windbreaks, minimum tillage, chemicals that control weeds, and summer fallow, which also controls weeds, conserve soil moisture.

Maintaining tilth is important in good seed germination and in the infiltration of water into the soil. Maintaining good tilth is an important management concern for soils containing a high percentage of clay in the surface layer and for soils containing excess sodium salts. Regent, Grail, Savage, Lawther, Magnus, and Lohler are some of the soils requiring management to maintain good tilth. Incorporation of green manure or livestock manure, crop residue management, tillage at the proper moisture content, and fall plowing help to prepare a good seedbed. If the soil is plowed in the fall, conservation measures that control soil blowing and water erosion are needed. Stripcropping, grassed waterways, windbreaks, and contour farming minimize soil losses.

Some soils have unfavorable characteristics, such as stones and poor drainage, that must be overcome before maximum production can be obtained. Removal of stones generally is necessary on soils formed on the glacial till plain. Williams, Bowbells, and Zahl soils are examples. Drainage is needed on Parnell, Tonka, Colvin, and Dimmick soils, but suitable outlets are lacking in many areas.

Field crops suited to the soils and the climate of the survey area include some that are not commonly grown. These crops include sunflower, pinto beans, safflower, mustard, buckwheat, sugar beets, potatoes, durum, rye, millet, and grass or legume seed.

Irrigation has been of great interest in the survey area in recent years, but only about 2,000 acres is currently irrigated. Soils suitable for irrigation have good internal drainage and a good infiltration rate and respond well to irrigation. An important factor in determining the feasibility of irrigation is the quality of water. Water spreading is an alternative to irrigation. It is particularly suitable in areas that are too small or irregular in shape for sprinkler systems or gravity systems.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service. The latest information and suggestions about the crops commonly grown in the county and about special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

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. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils 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 included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

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 few 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 landforms 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 too cold or too 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, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability subclass is identified in the description of each soil map unit in the section "Soil maps for detailed planning."

Rangeland

JAMES L. KRAMER, range conservationist, Soil Conservation Service, helped prepare this section.

About 46 percent of Mercer County is rangeland. About half of the total farm income is derived from livestock, principally cattle. Cow-calf operations are dominant. The size of ranches ranges from about 1,000 to 15,000 acres.

On many ranches the forage produced on rangeland is supplemented by crop stubble and small grain. In winter the native forage is often supplemented with protein concentrate. Creep feeding of calves and yearlings to increase market weight is practiced on some ranches.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 6 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community of predominately grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in table 6.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Depth to bedrock, sodium salt content, and slope are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of brush and of soil blowing and erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources. Soil survey information and rangeland inventories can greatly facilitate the proper management of rangeland.

Many soils in the southwestern part of the county are shallow over soft bedrock and generally are moderately steep to very steep. They support short grasses, and potential productivity is low because of the excess runoff and the shallow root zone. Many soils in the southwestern part contain excess sodium salts. Roots are restricted by a dense subsoil in many of these soils. Also, they are unable to extract some of the soil moisture because of the sodium salts and a high content of clay, which holds some of the soil moisture under tension. In the southeastern part of the county are large areas of sandy soils where blowouts and sand dunes are evident. These soils are very droughty and are highly susceptible to soil blowing.

Windbreaks and environmental plantings

ELMER R. UMLAND, forester, Soil Conservation Service, helped prepare this section.

Approximately 13,000 acres in Mercer County is native woodland. Most of the native trees and shrubs grow on Havrelon, Lohler, and Banks soils on bottom land along the Missouri River; on Arnegard, Grail, Parshall, and Grassna soils in adjacent swales and on terraces; and on Straw, Velva, and Magnus soils on bottom land along the Knife River and other major creeks.

The chief trees and shrubs are American elm, eastern cottonwood, green ash, bur oak, boxelder, native plum, Woods rose, juneberry, chokecherry, western snowberry, and shrub willow.

The early settlers used trees for lumber, fence posts, and fuel. Currently, the trees and shrubs are used chiefly for erosion control, wildlife habitat, recreation, esthetic purposes, and protection of livestock, watersheds, homes, gardens, and crops.

Windbreaks have been planted in Mercer County since the days of the early settlers. Most have provided protection for farmsteads and livestock. Trees are still needed around many farmsteads, but the major need is for windbreaks in cultivated areas where the hazard of soil blowing is serious.

Windbreaks provide many environmental benefits. They reduce the risk of soil blowing; protect crops, gardens, and orchards from wind damage and from moisture loss through evaporation; keep dust away from farmsteads and roads; provide food, cover, and nests for wildlife; protect homes; reduce fuel needs, livestock feed requirements, and noise; purify the air; provide a cooling effect during summer; and beautify the countryside.

The establishment of a windbreak depends upon the careful selection of trees and shrubs that are suited to the soil, on suitable preparation of the site, on the location and design of the windbreak, and on adequate maintenance after the trees are planted. Grasses and weeds must be eliminated before the planting is made and should be controlled for the entire life of the windbreak. Some replanting is likely to be needed during the first and second years after the initial planting.

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species 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 depending on erodibility of the soil. They 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. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 7 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 7, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

Engineering

RICHARD S. BERGANTINE, engineer, Soil Conservation Service, helped prepare this section.

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 8 shows, for each kind of soil, the degree and kind of limitations for building site development; and table 9, for sanitary facilities. Table 11 shows the kind of limitations for water management. Table 10 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 8. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 8 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 8 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 9 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 9 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 10 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor.*

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 11 the soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

ERLING B. PODOLL, biologist, Soil Conservation Service, helped prepare this section.

Most of the recreation developments in Mercer County are along Lake Sakakawea and on the flood plains adjacent to Beulah and Hazen. About 1,300 acres along Lake Sakakawea has been developed. About half of this acreage is under Federal management and half under State management. Beulah and Hazen each manage a tract along the lake. All of this land is under Corps of Engineers title.

City developments, mostly on the flood plain along the Knife River, total about 150 acres. They provide play areas and facilities for picnicing, camping, swimming, and golfing.

The State Game and Fish Department manages and the Corps of Engineers and a mining company own three areas totaling 2,260 acres, most of which is open to the public for hunting. This acreage is more than half of the 4,300 acres of land available for public use.

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the 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 12 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 9, and interpretations for dwellings without basements and for local roads and streets, given in table 8.

Camp areas require such site preparation as shaping and leveling for 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 for this use have gentle 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. Steep slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have level to moderately steep slopes and have few or no stones or boulders on the surface.

Wildlife habitat

ERLING B. PODOLL, biologist, Soil Conservation Service, helped prepare this section.

Wildlife and fish provide an opportunity for outdoor activities and enjoyment. An average of one person or more from each household takes part in outdoor activities related to fish and wildlife in Mercer County.

Because of an increase in farming and ranching, the wildlife population has been reduced to less than 5 percent of that before settlement, mostly by the removal of the large animals. Most of the bird species that inhabited the survey area before settlement still inhabit the area. Some of the river fishing has been converted to reservoir fishing. In recent years Mercer County has been the location for about 4 percent of the statewide sharp-tailed grouse harvest, 2 percent of the statewide partridge harvest, and 4 percent of the statewide pheasant harvest. It provides opportunities for less than 1 percent of the statewide waterfowl hunting.

Fishing is largely limited to the Missouri River and Lake Sakakawea. Popular species are northern pike, walleye, sauger, trout, blackbass, crappie, and catfish. Public access to Lake Sakakawea is good, but public access to the Missouri River is very limited.

The 13,000 acres of trees and shrubs in the county is very important to the wildlife. Dozens of bird species common to the eastern deciduous forests inhabit the wooded areas. Most prairie wildlife depend on woody plants during some part of the year for food or cover. Soils with the best potential for woodland wildlife habitat are on bottom land, in some of the drainageways, and on north-facing slopes. Wildlife using woody plants as habitat are mule deer and white-tailed deer, brown bat, white-footed mouse, porcupine, raccoon, Swainson's hawk, red-tailed hawk, mourning dove, kingbirds, brown thrasher, sharp-tailed grouse, yellow warbler, woodpeckers, and least flycatcher.

The wildlife that inhabit areas of the map units described under the heading 'General soil map for broad land-use planning" are specified in the following paragraphs. Use and management of the soils in these map units are similar.

The soils in the Williams-Zahl, Williams-Bowbells, and Williams-Wilton-Temvik map units formed in glacial till. Many areas are cultivated. Pheasants are numerous. Rangeland wildlife, such as sharp-tailed grouse and white-tailed deer, are few because the amount of native grasses and the number of wooded areas is limited. The areas of natural wetland provide good waterfowl habitat and hunting opportunities.

The soils in the Flaxton-Williams and Lihen-Seroco-Telfer map units are mantled with loamy and sandy material. About 50 percent of the acreage of the Flaxton-Williams map unit is cultivated, and some is natural wetland. As a result, this unit provides habitat for openland and wetland wildlife, such as pheasants and ducks. The Lihen-Seroco-Telfer map unit has a good sharp-tailed grouse population and a low pheasant population because the amount of cropland is small.

The Belfield-Williams-Vebar, Williams-Cabba, Cabba-Williams-Temvik, and Williams-Belfield-Amor map units formed in glacial and residual material. The population of pheasant, sharp-tailed grouse, or deer varies depending on the location of a land use that favors these kinds of wildlife.

The Cabba-Cohagen, Cabba-Rhoades, and Rhoades-Belfield-Moreau map units are on residual plains. The wildlife population tends to be lower than the average for the county because the soils are shallower and less productive. The habitat for deer is fair.

The Straw-Velva and Havrelon-Lohler map units are on flood plains along rivers and streams. Cleared and farmed areas have a good pheasant population. These map units provide the bulk of the winter habitat for sharp-tailed grouse and for deer.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water (fig. 14). If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 13, the soils in the survey area are rated according to their potential for supporting the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties 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, rye, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties 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 wheatgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties 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, wheatgrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are silverberry, chokecherry, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat 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 kinds of wildlife attracted to these areas include gray partridge, pheasant, horned lark, meadowlark, grasshopper sparrow, vesper sparrow, cottontail rabbit, badger, and red fox.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, herons, redwing blackbird, shore birds, muskrat, and mink.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include antelope, white-tailed deer, mule deer, meadowlark, lark bunting, jackrabbit, coyote, horned lark, sharp-tailed grouse, and chestnut-collared longspur.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features.

Engineering properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 14 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*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, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging 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. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 15 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 15. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing 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, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing 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, but crops can be grown if measures to control soil blowing 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, and 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, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils 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 is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. 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. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*7*). Unless otherwise noted, colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Amor series

The Amor series consists of moderately deep, well drained, moderately permeable soils on residual uplands. These soils formed in material weathered from soft, fine grained sandstone. Slope ranges from 3 to 15 percent.

Amor soils are similar to Sen soils and are commonly adjacent to Cabba, Sen, Vebar, Werner, and Williams soils. Cabba soils lack a mollic epipedon and have soft bedrock at a depth of 10 to 20 inches. Sen soils have a fine-silty control section, and Vebar soils have a coarse-loamy control section. Werner soils lack a B2 horizon and have soft bedrock at a depth of 10 to 20 inches. They are on ridges and hilltops above the Amor soils. Williams soils formed in material weathered from glacial till, have an argillic horizon, and are not underlain by soft bedrock within a depth of 60 inches.

Typical pedon of Amor loam, in an area of Amor-Werner loams, 6 to 9 percent slopes, 1,350 feet north and 100 feet east of the southwest corner of sec. 34, T. 145 N., R. 86 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine pores; 2 percent coarse fragments; neutral; abrupt smooth boundary.

B2—8 to 14 inches; dark grayish brown (2.5Y 4/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure parting to medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; slight effervescence below 10 inches; few fine soft lime masses below 10 inches; mildly alkaline; gradual wavy boundary.

B3—14 to 20 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; slight effervescence; common fine soft lime masses; mildly alkaline; gradual wavy boundary.

C1ca—20 to 32 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; violent effervescence; many fine soft lime masses; moderately alkaline; gradual wavy boundary.

Cr—32 to 60 inches; pale olive (5Y 6/3) stratified soft fine grained sandstone, olive (5Y 5/3) moist; massive; few fine roots in upper part; slight effervescence; few fine soft lime masses; moderately alkaline.

Depth to soft sandstone ranges from 20 to 40 inches. Depth to free carbonates ranges from 10 to 20 inches. The thickness of the solum ranges from 15 to 25 inches. The thickness of the mollic epipedon ranges from 7 to 16 inches. In some pedons the content of coarse fragments is as much as 10 percent.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The B2 horizon has hue of 2.5Y or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is dominantly loam, but the range includes light clay loam. Some pedons lack a B3 horizon. The C1ca horizon has color value of 6 or 7 (4 to 6 moist) and chroma of 2 to 4. The Cr horizon is dominantly soft, fine grained sandstone, but in some pedons it is soft siltstone or soft shale.

Arnegard series

The Arnegard series consists of deep, well drained, moderately permeable soils on fans, terraces, and foot slopes and in swales. These soils formed in material weathered from loamy alluvium. Slope ranges from 1 to 9 percent.

Arnegard soils are similar to Grassna soils and are commonly adjacent to Bowbells, Vebar, and Williams soils. Bowbells soils have an argillic horizon. Grassna soils have a fine-silty control section. Vebar soils have a mollic epipedon that is less than 16 inches thick and a coarse-loamy control section and are underlain by soft bedrock at a depth of 20 to 40 inches. Williams soils have an argillic horizon and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Arnegard loam, 3 to 6 percent slopes, 1,385 feet west and 1,485 feet north of the southeast corner of sec. 32, T. 145 N., R. 87 W.

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse and medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B1—10 to 21 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse and medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B21—21 to 35 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse and medium prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; few very dark brown (10YR 2/2 moist) coatings on faces of peds; neutral; gradual wavy boundary.

B22—35 to 39 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; moderate coarse and medium prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, slightly sticky and plastic; common fine roots; common fine pores; few thin clay films on faces of peds; neutral; gradual wavy boundary.

C1—39 to 55 inches; grayish brown (2.5Y 5/2) stratified loam and fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; soft, friable; slightly sticky and slightly plastic; few fine roots; few fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

C2ca—55 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak very coarse prismatic structure; hard, firm, sticky and plastic; very few fine pores; strong effervescence; common fine soft lime masses; moderately alkaline.

The thickness of the solum is typically 30 to 40 inches but ranges from 25 to 40 inches. Depth to free carbonates ranges from 30 to 60 inches.

The A horizon has color value of 3 or 4 (2 or 3 moist). It is dominantly loam, but the range includes silt loam. The B1 horizon does not occur in some pedons. The B2 horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam and light clay loam. Some pedons have a B3 horizon. The C horizon has color value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes fine sandy loam and clay loam.

Banks series

The Banks series consists of deep, somewhat excessively drained, rapidly permeable soils on bottom land. These soils formed in material weathered from recent sandy alluvium. Slope is 0 to 1 percent.

Banks soils are similar to Seroco soils and are commonly adjacent to Havrelon and Lohler soils. Havrelon soils have a coarse-silty control section. Lohler soils have a fine-textured control section. Seroco soils lack free carbonates within a depth of 60 inches and also lack fine stratification. They are on uplands.

Typical pedon of Banks loam 720 feet north and 170 feet east of the southwest corner of NW1/4 sec. 8, T. 144 N., R. 84 W.

Ap—0 to 5 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; strong effervescence; mildly alkaline; clear smooth boundary.

C1—5 to 10 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak fine platy structure; soft, very friable, nonsticky and nonplastic; common fine roots; common fine pores; strong effervescence; mildly alkaline; abrupt wavy boundary.

C2—10 to 60 inches; light brownish gray (2.5Y 6/2) fine sand having a 2-inch stratum of silty clay loam in the upper part, grayish brown (2.5Y 5/2) moist; single grained; loose, nonsticky and nonplastic; very few roots in the upper part; slight effervescence; mildly alkaline.

Most pedons have one or more thin layers of finer textured material. Some pedons have a thin buried A horizon.

Hue is 10YR or 2.5Y, typically 2.5Y below the A horizon. Value is 5 or 6 dry (4 or 5 moist). The A horizon is dominantly loam, but the range includes very fine sandy loam. Some pedons have a dark colored A horizon that is less than 3 inches thick. The C horizon averages fine sand, but the range includes loamy fine sand.

Belfield series

The Belfield series consists of deep, well drained, slowly permeable soils on uplands and terraces and in swales. These soils have a natric horizon. They formed in material weathered from alkaline residuum or old alluvium. Slope ranges from 1 to 9 percent.

Belfield soils are similar to Daglum soils and are commonly adjacent to Daglum, Grail, Regent, and Rhoades soils. Daglum soils have a more abrupt boundary between the A and B2t horizons than Belfield soils. Grail soils lack a natric horizon. Regent soils lack a natric horizon and have soft shale at a depth of 20 to 40 inches. Rhoades soils have a natric horizon at a depth of 2 to 5 inches.

Typical pedon of Belfield silt loam, in an area of Belfield-Daglum silt loams, 1 to 3 percent slopes, 315 feet west and 190 feet south of the northeast corner of sec. 33, T. 144 N., R. 88 W.

A1—0 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; few uncoated sand grains on faces of peds; slighty acid; clear wavy boundary.

B&A—13 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; (B2); interfingering of gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist (A2); weak medium prismatic structure parting to strong fine and very fine angular blocky; very hard, friable, sticky and plastic; many fine roots; many fine pores; common light gray (10YR 7/1) uncoated sand grains on faces of peds; slightly acid; clear wavy boundary.

B21t—16 to 20 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong medium and fine angular blocky; extremely hard, firm, very sticky and very plastic; many fine roots; many fine pores; thin continuous clay films on faces of peds; few clean sand grains on faces of peds; neutral; clear wavy boundary.

B22t—20 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate medium and fine angular blocky; extremely hard, firm, very sticky and very plastic; common fine roots; many fine pores; thin continuous clay films on faces of peds; mildly alkaline; clear wavy boundary.

B3ca—24 to 32 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to weak medium subangular blocky; very hard, firm, very sticky and very plastic; common fine roots; many fine pores; strong effervescence; few medium soft lime masses; moderately alkaline; clear wavy boundary.

C1ca—32 to 52 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; violent effervescence; many fine and medium soft lime masses; strongly alkaline; gradual wavy boundary.

C2—52 to 60 inches; light yellowish brown (2.5Y 6/4) silty clay loam, olive brown (2.5Y 4/4) moist; massive; hard, friable, sticky and plastic; few fine roots; many fine pores; violent effervescence; few fine soft lime masses; strongly alkaline.

Depth to free carbonates ranges from 20 to 30 inches. The thickness of the solum ranges from 20 to 35 inches.

The A1 horizon has color value of 3 or 4 (2 or 3 moist). It is dominantly silt loam, but the range includes loam and silty clay loam. Some pedons have an A2 or A&B horizon. The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 5 moist), and chroma of 2 or 3. It is silty clay or silty clay loam. Below a depth of 36 inches, the C horizon is mainly alkaline alluvium or partly weathered soft shale.

The Belfield soil in map unit 108 lacks the strong prismatic structure characteristic of the Belfield series and contains less clay. In addition, it is subject to stream overflow and in places irregularly decreases in content of organic matter with increasing depth. These differences, however, do not alter the use or behavior of the soil.

Bowbells series

The Bowbells series consists of deep, well drained, moderately slowly permeable soils on glaciated uplands. These soils formed in material weathered from calcareous loamy glacial till. Slope ranges from 1 to 6 percent.

Bowbells soils are similar to Williams soils and are commonly adjacent to Parnell, Tonka, Williams, and Zahl soils. The very poorly drained Parnell soils and poorly drained Tonka soils are in shallow depressions. Williams soils have a mollic epipedon that is less than 16 inches thick. Zahl soils lack an argillic horizon and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Bowbells loam, 1 to 3 percent slopes, 95 feet south and 110 feet east of the northwest corner of SW1/4 sec. 12, T. 145 N., R. 86 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, friable slightly sticky and slightly plastic; many fine roots; many fine pores; 1 percent pebbles; slightly acid; abrupt smooth boundary.

A12—7 to 11 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 1 percent pebbles; slightly acid; clear wavy boundary.

B21t—11 to 17 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to medium and fine subangular blocky; hard, friable, sticky and plastic; common fine roots; many fine pores; common thin clay films on faces of peds; 1 percent pebbles; neutral; clear wavy boundary.

B22t—17 to 22 inches; dark grayish brown (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, sticky and plastic; common fine roots; many fine pores; thin continuous clay films on faces of peds; 2 percent pebbles; neutral; gradual wavy boundary.

B23t—22 to 34 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/8 moist) mottles; moderate medium prismatic structure parting to moderate medium and fine angular blocky; hard, firm, sticky and plastic; thin continuous clay films on faces of peds; 2 percent pebbles; mildly alkaline; clear wavy boundary.

C1ca—34 to 53 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine distinct yellowish brown and red (10YR 5/8 and 2.5Y 4/8 moist) mottles; weak coarse and medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; violent effervescence; many fine soft lime masses; 2 percent pebbles; moderately alkaline; gradual wavy boundary.

C2—53 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine distinct red (2.5Y 4/8 moist) mottles; weak laminar and weak medium subangular blocky structure; very hard, firm, sticky and plastic; very few fine roots; few fine pores; strong effervescence; many fine soft lime masses; 2 percent pebbles; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 24 to more than 36 inches. The mollic epipedon typically is more than 20 inches thick but ranges from 16 to 25 inches.

The A horizon has color value of 3 or 4 (2 or 3 moist). The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. The C horizon is dominantly clay loam, but the range includes loam.

Bowdle series

The Bowdle series consists of deep, well drained soils on terraces and outwash plains. These soils are moderately permeable in the upper part and rapidly permeable in the lower part. They formed in material weathered from loamy sediments that are 20 to 40 inches deep over sand and gravel. Slope ranges from 1 to 9 percent.

Bowdle soils are commonly adjacent to Arnegard, Falkirk, Shambo, and Wabek soils. Arnegard soils are not underlain by sand and gravel at a depth of 20 to 40 inches. Falkirk soils formed in loamy outwash sediments that are 20 to 40 inches deep over glacial till. Shambo soils are not underlain by sand and gravel at a depth of 20 to 40 inches and have a mollic epipedon that is less than 16 inches thick. Wabek soils have sand and gravel within a depth of 20 inches.

Typical pedon of Bowdle loam, 1 to 3 percent slopes, 825 feet west and 345 feet south of the northeast corner of sec. 8, T. 144 N., R. 89 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure parting to moderate medium and fine granular; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 1 percent pebbles; neutral; abrupt smooth boundary.

B2—7 to 19 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 2 percent pebbles; slight effervescence in the lower 1 inch; few lime-coated pebbles in the lower part; neutral; clear wavy boundary.

C1ca—19 to 24 inches; light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2) loam, grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; 10 percent pebbles; violent effervescence; many fine and medium soft lime masses; pebbles coated with lime; moderately alkaline; abrupt wavy boundary.

IIC2—24 to 60 inches; pale brown (10YR 6/3) stratified sand and gravel, brown (10YR 5/3) moist; single grained; loose, nonsticky and nonplastic; slight effervescence; 35 percent gravel; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 16 to 30 inches. The depth to loose sand and gravel typically is about 24 inches but ranges from 20 to 40 inches. The mollic epipedon is 16 to 24 inches thick.

The A horizon has color value of 3 or 4 (2 or 3 moist). The B2 horizon has color value of 4 or 5 (2 or 3 moist). Some pedons have a B3ca horizon. The C1ca and IIC2 horizons have hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4.

Cabba series

The Cabba series consists of shallow, well drained, moderately permeable soils on residual uplands. These soils formed in material weathered from soft loamy bedrock. Slope ranges from 9 to 50 percent.

Cabba soils are similar to Werner soils and are commonly adjacent to Badland and to Cherry, Cohagen, Ringling, and Werner soils. Badland is a miscellaneous area of exposed soft bedrock. Cherry soils have a B2 horizon, do not have soft bedrock within a depth of 40 inches, and formed in alluvium. Cohagen soils have a coarse-loamy control section. Ringling soils have porcelanite beds at a depth of 5 to 20 inches and have a mollic epipedon. Werner soils also have a mollic epipedon.

Typical pedon of Cabba loam, in an area of Cabba-Badland complex, 15 to 50 percent slopes, 990 feet west and 1,010 feet south of the northeast corner of NW1/4 sec. 12, T. 146 N., R. 85 W.

A1—0 to 2 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

AC—2 to 8 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

C1—8 to 16 inches; pale yellow (5Y 7/3) loam, pale olive (5Y 6/3) moist; weak coarse platy structure and evidence of rock structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; slight effervescence; common medium yellowish brown (10YR 5/8 moist) iron stains; mildly alkaline; clear smooth boundary.

Cr1ca—16 to 24 inches; pale yellow (5Y 7/3) soft sedimentary bedrock, pale olive (5Y 6/3) moist; coarse and medium laminar rock structure; few fine roots, most matted along bedrock fractures; strong effervescence; common medium soft lime masses along bedrock fractures; common medium yellowish brown (10YR 5/8 moist) iron stains; moderately alkaline; gradual wavy boundary.

Cr2—24 to 60 inches; light gray (5Y 7/2) soft sedimentary bedrock, light olive gray (5Y 6/2) moist; laminar rock structure; few fine roots along bedrock fractures in the upper 6 inches; slight effervescence; few medium yellowish brown (10YR 5/8 moist) iron stains; mildly alkaline.

Depth to soft sedimentary bedrock ranges from 10 to 20 inches. The A1 horizon has hue of 2.5Y or 10YR and value of 5 or 6 (3 or 4 moist). It is dominantly loam, but the range includes silt loam. The C horizon has hue of 2.5Y or 5Y, value of 6 to 8 (5 or 6 moist), and chroma of 2 or 3.

Cherry series

The Cherry series consists of deep, well drained, moderately slowly permeable soils on fans and foot slopes. These soils formed in material weathered from calcareous silty alluvium. Slope ranges from 3 to 9 percent.

Cherry soils are commonly adjacent to Badland and to Cabba and Rhoades soils. Badland is a miscellaneous area of exposed soft bedrock above the Cherry soils on the landscape. It is steeper than those soils. Cabba soils have soft bedrock at a depth of 10 to 20 inches and are steeper than the Cherry soils. They are above those soils on the landscape. Rhoades soils have a natric horizon at a depth of 2 to 5 inches and have a fine-textured control section.

Typical pedon of Cherry silty clay loam, gullied, 3 to 9 percent slopes, 1,155 feet north and 100 feet west of the southeast corner of sec. 19, T. 141 N., R. 89 W.

A1—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium and coarse subangular blocky structure parting to moderate medium and fine granular; hard, friable, sticky and plastic; many fine roots; many fine pores; very slight effervescence; mildly alkaline; clear smooth boundary.

B21—4 to 15 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; many fine roots; many fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

B22—15 to 36 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to strong fine subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; strong effervescence; common fine soft lime masses; few fine brownish yellow (10YR 6/8) iron stains; moderately alkaline; gradual wavy boundary.

C1—36 to 60 inches; light brownish gray (2.5Y 6/2) stratified silty clay loam and clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; few fine roots; few fine pores; violent effervescence; common fine soft lime masses; few fine gypsum crystals; clay loam strata are 10 percent pebbles; few fine dark yellowish brown and brownish yellow (10YR 4/6 and 10YR 6/8) iron stains; moderately alkaline.

The thickness of the solum ranges from 25 to 40 inches. The A1 horizon has hue of 2.5Y or 10YR, value of 5 or 6 (3 or 4 moist), and chroma of 2 or 3. It is dominantly silty clay loam, but in some pedons it is silt loam. The B2 horizon has hue of 2.5Y or 10YR. The C horizon has hue of 2.5Y or 5Y, value of 6 or 7 (4 or 5 moist), and chroma of 2 to 4. Coarser or finer material is below a depth of 40 inches in some pedons.

Cohagen series

The Cohagen series consists of shallow, somewhat excessively drained, moderately rapidly permeable soils on residual uplands. These soils formed in material weathered from soft sandstone. Slope ranges from 3 to 50 percent.

Cohagen soils are similar to Vebar soils and are commonly adjacent to Cabba and Vebar soils and Rock outcrop. Cabba soils contain more clay in the control section than Cohagen soils. Rock outcrop is hard sandstone. Vebar soils have soft sandstone at a depth of 20 to 40 inches and have a B horizon and a mollic epipedon.

Typical pedon of Cohagen fine sandy loam, in an area of Cohagen-Vebar fine sandy loams, 9 to 35 percent slopes, 45 feet south and 90 feet west of the northeast corner of NW1/4 sec. 22, T. 144 N., R. 87 W.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak medium granular; soft, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

C1—3 to 8 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium and fine subangular blocky structure parting to weak medium and fine granular; soft, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—8 to 14 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; strong effervescence; many fine soft lime masses; moderately alkaline; clear wavy boundary.

Cr—14 to 60 inches; light gray (2.5Y 7/2) soft sandstone, light brownish gray (2.5Y 6/2) moist; massive; slightly hard and brittle, soft and easily crushed; few fine roots along bedrock fractures in the upper part; very few pores; strong effervescence; common fine and medium soft lime masses along rock fractures in the upper part; mildly alkaline.

The depth to soft sandstone ranges from 10 to 20 inches. The control section is dominantly fine sandy loam, but the range includes sandy loam.

The A1 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. The C horizon has hue of 2.5Y or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. The Cr horizon is massive or platy, weakly consolidated, soft, calcareous sandstone that crushes to fine sandy loam or loamy fine sand.

Colvin series

The Colvin series consists of deep, poorly drained, moderately permeable soils in shallow basins, in swales, and along streams. These soils formed in material weathered from calcareous silty alluvium. Slope is 0 to 1 percent.

Colvin soils are commonly adjacent to Arnegard, Bowbells, Parnell, Tonka, and Williams soils. Arnegard soils are well drained, have a cambic horizon, and have a mollic epipedon that is more than 16 inches thick. Bowbells soils are well drained, have an argillic horizon, and have a mollic epipedon that is more than 16 inches thick. Parnell soils are very poorly drained and have an argillic horizon. Tonka soils have an A2 horizon and an argillic horizon. Williams soils are well drained and have an argillic horizon.

Typical pedon of Colvin silt loam 1,120 feet south and 825 feet east of the center of sec. 1, T. 45 N., R. 85 W.

A1—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; few fine salt crystals; strong effervescence; common fine soft lime masses; mildly alkaline; clear wavy boundary.

C1ca—7 to 30 inches; dark gray and gray (5Y 4/1 and 5/1) silt loam, gray and light gray (5Y 5/1 and 6/1) dry; weak coarse subangular blocky structure parting to weak fine subangular blocky and weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; violent effervescence; common large soft lime masses; moderately alkaline; clear wavy boundary.

C2g—30 to 60 inches; grayish brown (2.5Y 5/2) silt loam with thin strata of very fine sandy loam below 40 inches; light brownish gray (2.5Y 6/2) dry; common fine and medium distinct gray (5Y 5/1) mottles; massive; very hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; strong effervescence; moderately alkaline.

The mollic epipedon is 7 to 16 inches thick. The A1 horizon has color value of 2 or 3 (3 or 4 dry) and chroma of 1 or less. Some pedons have an ACca horizon. The Cca horizon has hue of 5Y or 2.5Y, value of 4 to 6 (5 to 8 dry), and chroma of 2 or less. The C2g horizon has hue of 2.5Y or 5Y. Some pedons have coarser textured or finer textured material below a depth of 40 inches.

Daglum series

The Daglum series consists of deep, well drained, very slowly permeable soils on uplands, in swales, and on terraces. These soils have a natric horizon. They formed in material weathered from alkaline alluvium or residuum.

Daglum soils are similar to Belfield soils and are commonly adjacent to Belfield, Grail, and Rhoades soils. In Belfield soils, interfingering of the A2 horizon into the B2 horizon is evident and strong columnar structure generally is lacking. Grail soils lack a natric horizon. Rhoades soils have a natric horizon at a depth of 2 to 5 inches.

Typical pedon of Daglum silt loam in an area of Belfield-Daglum silt loams, 1 to 3 percent slopes, 115 feet east and 500 feet south of the northwest corner of SW1/4 sec. 18, T. 145 N., R. 86 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, sticky and slightly plastic; many fine roots; many fine pores; neutral; clear irregular boundary.

A2—6 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium and coarse platy and fine and medium subangular blocky; hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; common uncoated sand grains on faces of peds; neutral; abrupt wavy boundary.

B21t—9 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong medium and fine columnar structure parting to strong fine and angular blocky; extremely hard, firm, very sticky and very plastic; many fine roots along faces of peds; many fine pores; many thin clay films on faces of peds; light gray (10YR 7/1) on tops of columns; neutral; gradual wavy boundary.

B22t—13 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; coarse and medium prismatic structure parting to strong medium and fine angular blocky; extremely hard, firm, sticky and plastic; many fine roots along faces of peds; common fine pores; many thin clay films on faces of peds; common uncoated sand grains on faces of peds; mildly alkaline; clear wavy boundary.

C1ca—18 to 23 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and fine subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; many fine pores; common fine salt crystals; strong effervescence; few fine soft lime masses; strongly alkaline; gradual wavy boundary.

C2—23 to 29 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium and fine subangular blocky structure; very hard, friable, sticky and plastic; common fine roots; many fine pores; strong effervescence; common fine soft lime masses; common fine gypsum crystals; strongly alkaline; gradual wavy boundary.

C3—29 to 51 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium and fine subangular blocky structure; hard, friable, sticky and plastic; few fine roots; few fine pores; strong effervescence; common fine soft lime masses; common medium gypsum crystals; strongly alkaline; clear smooth boundary.

A1b—51 to 60 inches; gray (10YR 5/1) stratified silty clay and silty clay loam, very dark gray (10YR 3/1) moist; massive; very hard, firm, sticky and plastic; few fine roots; few fine pores; strong effervescence; common fine soft lime masses; common medium and large gypsum crystals; moderately alkaline.

The thickness of the solum ranges from 15 to 30 inches. Depth to free carbonates is 15 to 25 inches.

The A1 horizon has color value of 4 or 5 (2 or 3 moist). It is dominantly silt loam or silty clay loam, but the range includes loam, silty clay loam, and clay loam. The A2 horizon has color value of 5 or 6 (3 or 4 moist). It is dominantly silt loam or loam. The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is silty clay loam, clay loam, silty clay, or clay that is 35 to 60 percent clay. Some pedons contain salt crystals in the lower part of the B2t horizon. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. Some pedons do not have an A1b horizon.

Dimmick Series

The Dimmick series consists of deep, very poorly drained, very slowly permeable soils in basins on uplands and in oxbows on flood plains. These soils formed in material weathered from clayey sediments. Slope is 0 to 1 percent.

Dimmick soils are similar to Parnell soils and are commonly adjacent to Lohler, Lawther, and Savage soils. Lohler soils are moderately well drained and lack a mollic epipedon. Lawther soils are well drained. Parnell soils have an argillic horizon. Savage soils are well drained and have an argillic horizon.

Typical pedon of Dimmick silty clay 495 feet east and 825 feet north of the southwest corner of NW1/4 sec. 9, T. 144 N., R. 86 W.

A11g—0 to 9 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; many coarse distinct strong brown (7.5YR 5/6) mottles; strong fine and very fine angular blocky structure parting to very fine granular; hard, firm, very sticky and very plastic; thin layer of partly decomposed stems and leaves at the surface; many fine roots; many fine pores; neutral; gradual wavy boundary.

A12g—9 to 18 inches; very dark gray (5Y 3/1) silty clay, gray (5Y 5/1) dry; many fine distinct brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to moderate fine angular blocky and granular; hard, firm, very sticky and very plastic; common fine roots; many fine pores; neutral; gradual wavy boundary.

C1g—18 to 40 inches; dark gray (5Y 4/1) clay, gray (5Y 5/1) dry; many medium distinct olive brown (2.5Y 4/4) mottles; weak coarse prismatic structure parting to moderate fine and very fine angular blocky; very hard, very firm, very sticky and very plastic; few fine roots; common fine pores; neutral; gradual wavy boundary.

C2g—40 to 51 inches; dark gray (5Y 4/1) clay, light gray (5Y 6/1) dry; many large prominent dark brown (7.5YR 4/4) mottles; moderate fine and very fine angular blocky structure; very hard, very firm, very sticky and very plastic; few fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

C3g—51 to 60 inches; dark gray (5Y 4/1) clay, light gray (5Y 6/1) dry; many medium and coarse distinct brown and olive brown (7.5YR 4/4 and 2.5Y 4/4) mottles; weak fine and very fine angular blocky structure; very hard, very firm, very sticky and very plastic; few fine pores; slight effervescence; few fine soft lime masses; mildly alkaline.

Depth to free carbonates ranges from 25 to 50 inches. The mollic epipedon is 16 to 24 inches thick. Mottles are few to many, fine to coarse, and faint to prominent.

The A1 horizon has hue of 10YR to 5Y. It is silty clay or clay. It has weak to strong structure. An O1 horizon is in some pedons. It is less than 4 inches thick. The Cg horizon is dominantly clay, but in some pedons it is silty clay.

Falkirk series

The Falkirk series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in material weathered from loamy outwash over glacial till. Slopes range from 1 to 3 percent.

Falkirk soils are similar to Arnegard soils and are commonly adjacent to Arnegard, Bowbells, Bowdle, and Williams soils. Arnegard soils lack the glacial till substratum characteristic of Falkirk soils. Bowbells soils have an argillic horizon. Bowdle soils have sand and gravel at a depth of 20 to 40 inches. Williams soils have an argillic horizon and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Falkirk loam, 1 to 3 percent slopes, 45 feet north and 150 feet east of the southwest corner of sec. 6, T. 145 N., R. 84 W.

A1—0 to 13 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slightly acid, clear wavy boundary.

B2—13 to 18 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; few thin very dark brown (10YR 2/2 moist) clay films on faces of prisms; 1 percent pebbles coated with lime on the underside; neutral; abrupt wavy boundary.

IIC1—18 to 26 inches; light brownish gray (10YR 6/2) gravelly loam, dark grayish brown (10YR 4/2) moist; very weak medium and fine subangular blocky structure parting to weak medium and fine granular; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; pebbles coated with lime on the underside; strong effervescence; moderately alkaline; abrupt wavy boundary.

IIIC2ca—26 to 46 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, friable, sticky and plastic; common fine roots; many fine pores; 2 percent pebbles; violent effervescence; many fine and medium soft lime masses; moderately alkaline; gradual wavy boundary.

IIIC3—46 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak laminar structure; hard, firm, sticky and plastic; few fine roots; few fine pores; 2 percent pebbles; violent effervescence; common fine and medium soft lime masses; moderately alkaline.

The thickness of the solum ranges from 16 to 30 inches and commonly is the same as the depth to free carbonates. The mollic epipedon is 16 to 26 inches thick.

The A horizon has color value of 3 to 5 (2 or 3 moist). The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. Some pedons have a B3 horizon. The IIC1 horizon is dominantly gravelly loam, but the range includes loamy sand and gravel. The IIIC horizon is dominantly clay loam, but in some pedons it is loam.

Flaxton series

The Flaxton series consists of deep, well drained soils on uplands. These soils formed in material weathered from wind- or water-deposited loamy sediments and the underlying glacial till. Permeability is moderately rapid in the upper part and moderately slow in the lower part. Slope ranges from 1 to 15 percent.

Flaxton soils are similar to Krem soils and are commonly adjacent to Krem, Noonan, Parshall, and Williams soils. Krem soils formed in sandy sediments and the underlying glacial till. Noonan soils have a natric horizon. Parshall soils have a coarse-loamy control section and do not have glacial till within a depth of 40 inches. Williams soils have a mollic epipedon that is less than 16 inches thick. They formed in glacial till.

Typical pedon of Flaxton fine sandy loam, 1 to 6 percent slopes, 45 feet west and 65 feet north of the southeast corner of the SW1/4 sec. 34, T. 144 N., R. 86 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse and medium subangular blocky structure parting to weak medium and fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

A12—8 to 11 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak very coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B1—11 to 28 inches; grayish brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, friable, slightly sticky and nonplastic; common fine roots; common fine pores; neutral; abrupt wavy boundary.

IIB2t—28 to 35 inches; grayish brown and light brownish gray (2.5Y 5/2 and 2.5Y 6/2) clay loam, dark grayish brown and grayish brown (2.5Y 4/2 and 2.5Y 5/2) moist; tongues of grayish brown (2.5Y 5/2) fine sandy loam in the upper part; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; many thin clay films on faces of peds; 1 percent pebbles; neutral; gradual wavy boundary.

IIBca—35 to 38 inches; grayish brown and light brownish gray (2.5Y 5/2 and 2.5Y 6/2) clay loam, dark grayish brown and grayish brown (2.5Y 4/2 and 2.5Y 5/2) moist; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm, sticky and plastic; few fine roots; common fine pores; common thin clay films on faces of peds; strong effervescence; few medium soft lime masses; 1 percent pebbles; mildly alkaline; gradual wavy boundary.

IICca—38 to 60 inches; light olive gray and pale olive (5Y 6/2 and 6/3) clay loam, olive gray and olive (5Y 4/2 and 4/3) moist; many fine and medium prominent brown (7.5YR 4/4 moist) mottles; massive; hard, firm, sticky and plastic; few fine roots; few fine pores; violent effervescence; many medium and large soft lime masses; 2 percent pebbles; moderately alkaline.

The thickness of the solum ranges from 25 to 45 inches. The thickness of the fine sandy loam sediments ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 16 to 32 inches.

The A1 horizon has color value of 3 or 4 (2 or 3 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but in some pedons it is loam. The B1 horizon has hue of 2.5Y or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The IIBt horizon has hue of 10YR or 2.5Y and value of 4 or 5 (3 or 4 moist). The IICca horizon has hue of 5Y or 2.5Y. It is dominantly clay loam, but in some pedons it is loam.

Grail series

The Grail series consists of deep, well drained, slowly permeable soils on foot slopes, on valley fans, and in upland swales. These soils formed in material weathered from calcareous alluvium. Slope ranges from 1 to 9 percent.

Grail soils are similar to Savage soils and are commonly adjacent to Belfield, Lawther, Regent, and Savage soils. Belfield soils have a natric horizon. Lawther soils lack an argillic horizon. Regent and Savage soils have a mollic epipedon that is less than 16 inches thick. Also, Regent soils have soft shale at a depth of 20 to 40 inches.

Typical pedon of Grail silty clay loam, 1 to 3 percent slopes, 45 feet north and 365 feet east of the southwest corner of NW1/4 sec. 21, T. 141 N., R. 90 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; many fine roots; many fine pores; slightly acid; abrupt smooth boundary.

B1—8 to 12 inches; dark gray (10YR 4/1) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, firm, sticky and plastic; many fine roots; many fine pores; few thin clay films on faces of peds; neutral; gradual wavy boundary.

B21t—12 to 18 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to strong medium and fine angular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; many thin clay films on faces of peds; neutral; gradual wavy boundary.

B22t—18 to 26 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; many thin clay films on faces of peds; neutral; gradual wavy boundary.

B3—26 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few fine roots; many fine pores; few thin clay films on faces of peds; slight effervescence; mildly alkaline; gradual wavy boundary.

C1—34 to 42 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, firm, sticky and plastic; few fine roots; many fine pores; strong effervescence; few fine soft lime masses; moderately alkaline; gradual wavy boundary.

C2ca—42 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; violent effervescence; many fine soft lime masses; moderately alkaline.

The thickness of the solum ranges from 25 to 40 inches. The depth to free carbonates ranges from 20 to 35 inches. The thickness of the mollic epipedon ranges from 16 to 35 inches; it is commonly more than 20 inches.

The A horizon has color value of 3 or 4 (2 or 3 moist). It is dominantly silty clay loam, but in some pedons it is silt loam. Some pedons do not have a B1 horizon. The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. Some pedons do not have a B3 horizon. The C2 horizon is dominantly silty clay loam but ranges from loam to silty clay.

Grassna series

The Grassna series consists of deep, well drained, moderately permeable soils on fans, terraces, and foot slopes and in upland swales. These soils formed in material weathered from calcareous silty alluvium derived primarily from loess deposits. Slope ranges from 1 to 6 percent.

Grassna soils are similar to Mandan soils and are commonly adjacent to Mandan, Temvik, Williams, and Wilton soils. Mandan soils have a coarse-silty control section. Temvik soils have a mollic epipedon that is less than 16 inches thick. They formed in loess that is 20 to 40 inches deep over glacial till. Williams soils formed in glacial till, have an argillic horizon, and have a mollic epipedon that is less than 16 inches thick. Wilton soils formed in loess that is 20 to 40 inches deep over till.

Typical pedon of Grassna silt loam, 3 to 6 percent slopes, 80 feet north and 120 feet west of the southeast corner of SW1/4 sec. 4, T. 146 N., R. 87 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

A12—8 to 17 inches; very dark gray (10YR 3/1) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate coarse and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B21—17 to 24 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; common fine soft lime masses; strong effervescence; mildly alkaline; gradual wavy boundary.

B22—24 to 29 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; common fine soft lime masses; strong effervescence; mildly alkaline; gradual wavy boundary.

C1ca—29 to 40 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; many fine pores; few fine soft lime masses; violent effervecence; moderately alkaline; gradual wavy boundary.

C2—40 to 60 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; many fine pores; strong effervescence; few fine soft lime masses; few fine gypsum crystals; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The mollic epipedon typically is more than 20 inches thick but ranges from 16 to 35 inches. Some pedons have a dark buried horizon below a depth of 50 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2 (2 moist). The B2 horizon typically has hue of 10YR, but in some pedons the lower part has hue of 2.5Y. This horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is dominantly silt loam, but the range includes silty clay loam. The C horizon has color value of 6 or 7 (4 to 6 moist). It is dominantly silt loam, but the range includes silty clay loam and clay loam.

Harriet series

The Harriet series consists of deep, poorly drained, slowly permeable soils on low terraces and bottom land. These soils formed in material weathered from alkaline alluvium. They are sodic. Slope is 0 to 1 percent.

Harriet soils are similar to Rhoades soils and are commonly adjacent to the Harriet Variant and to Rhoades and Straw soils. Rhoades soils are well drained. The Harriet Variant lacks a mollic epipedon and a natric horizon. Straw soils lack a natric horizon, have a mollic epipedon, are well drained, and have a fine-loamy control section.

Typical pedon of Harriet clay 70 feet north and 1,250 feet west of the southeast corner of sec. 27, T. 145 N., R. 85 W.

A2—0 to 1 inch; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak coarse platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; many fine and few medium pores; neutral; abrupt wavy boundary.

B21t—1 inch to 6 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; strong medium columnar structure; extremely hard, very firm, very sticky and very plastic; many fine roots; many fine pores; common thin films; light gray (10YR 6/1) coatings on tops of columns; slight effervescence; mildly alkaline; clear wavy boundary.

B22tsa—6 to 20 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate coarse prismatic structure parting to fine and very fine angular blocky; very hard, very firm, very sticky and very plastic; few fine roots; few fine pores; common thin clay films; strong effervescence; few fine soft lime masses; common fine salt crystals; strongy alkaline; gradual wavy boundary.

C1sa—20 to 36 inches; dark olive gray (5Y 3/2) clay loam, olive gray (5Y 5/2) dry; moderate coarse subangular blocky structure; very hard, firm, very sticky and very plastic; few fine pores; common fine gypsum crystals; strong effervescence; strongly alkaline; gradual wavy boundary.

IIAb—36 to 38 inches; very dark gray (5Y 3/1) loam, dark gray (5Y 4/1) dry; weak coarse subangular blocky structure; very hard, friable, sticky and plastic; few fine pores; strong effervescence; few fine salt crystals; very strongly alkaline; abrupt wavy boundary.

IIC2—38 to 60 inches; olive brown (2.5Y 4/4) loam with thin strata of silty clay loam and very fine sandy loam, light yellowish brown (2.5Y 6/4) dry; many medium prominent light gray (5Y 6/1) and yellowish brown (10YR 5/4) mottles; weak coarse and medium subangular blocky structure; very hard, friable, sticky and plastic; few fine pores; strong effervescence; common fine soft lime masses; few fine salt crystals; very strongly alkaline.

The thickness of the solum ranges from 10 to 24 inches. Typically, salt crystals are visible at a depth of 4 to 10 inches and are throughout the solum and substratum in most pedons. Some pedons have an A1 horizon. This horizon is 1 inch to 2 inches thick.

The A2 horizon has color value of 3 or 4 (5 or 6 dry). It is dominantly loam or silt loam, but the range includes very fine sandy loam. The B21t horizon has hue of 10YR, 2.5Y, or 5Y; value of 2 or 3 (4 or 5 dry); and chroma of 2 or less. It is dominantly clay or clay loam. Some pedons have a B3 horizon. Some pedons have no IIAb horizon. The C horizon has hue of 2.5Y, value of 3 to 5 (4 to 7 dry), and chroma of 1 to 4. It has few to many mottles. Coarser or finer textured material is below a depth of 30 inches in places.

Harriet Variant

The Harriet Variant consists of deep, poorly drained, slowly permeable soils on low terraces and bottom land. These soils formed in material weathered from loamy and clayey alluvium. They are saline and sodic. Slope is 0 to 1 percent.

The Harriet Variant is commonly adjacent to other Harriet soils and to Rhoades and Straw soils. The other Harriet soils have a natric horizon and a mollic epipedon. Rhoades soils are well drained and have a natric horizon and a mollic epipedon. Straw soils are well drained, have a mollic epipedon, do not have a high percentage of exchangeable sodium, and do not contain salt crystals.

Typical pedon of Harriet Variant silt loam 495 feet east and 530 feet south and the northwest corner of sec. 36, T. 141 N., R. 89 W.

A1sa—0 to 6 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak coarse prismatic structure parting to moderate medium and fine subangular blocky and angular blocky; hard, firm, slightly sticky and slightly plastic; many fine roots; many fine pores; strong effervescence; very many soluble salt crystals; strongly alkaline; clear wavy boundary.

B21sa—6 to 14 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; few fine faint gray (5Y 6/1) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; common fine roots; common fine pores; strong effervescence; very many soluble salt crystals; very strongly alkaline; clear wavy boundary.

B22gsa—14 to 19 inches; olive gray (5Y 4/2) silty clay loam, light olive gray (5Y 6/2) dry; few fine prominent dark yellowish brown (10YR 3/6) and light olive brown (2.5Y 5/4) and few faint gray (5Y 5/1) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few fine roots; few fine pores; strong effervescence; few fine soft lime masses; very many soluble salt crystals; very strongly alkaline; gradual wavy boundary.

C1g—19 to 50 inches; olive gray (5Y 4/2) silty clay loam with thin strata of silty clay in the lower part, olive gray (5Y 5/2) dry; few fine and medium faint gray (5Y 5/1) and common fine prominent olive brown

(2.5Y 4/4) mottles; weak fine subangular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; few fine pores; strong effervescence; few fine soluble salt crystals; few snail shells; strongly alkaline; clear wavy boundary.

C2g—50 to 60 inches; olive (5Y 4/3) clay loam, pale olive (5Y 6/3) dry; common medium dark gray and gray (5Y 4/1 and 5/1) and common fine and medium prominent olive brown (2.5Y 4/4) mottles; massive; extremely hard, firm, sticky and plastic; few fine pores; strong effervescence; few snail shells; strongly alkaline.

The thickness of the solum ranges from 12 to 30 inches. The upper 20 inches commonly is saline and sodic.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 (5 or 6 dry), and chroma of 2 or less. In some pedons it is dark colored and is less than 3 inches thick. It is dominantly silt loam, but in some pedons it is silty clay loam. It has no to many mottles. The B2g horizon has hue of 2.5Y or 5Y, value of 4 to 6 (5 to 7 dry), and chroma of 2 or less. It has few to many mottles. It is dominantly silt loam or silty clay loam, but the range includes silty clay. The Cg horizon has few to many mottles. It is dominantly silty clay loam or clay loam, but the range includes silt loam.

Havrelon series

The Havrelon series consists of deep, well drained, moderately permeable soils on bottom land. These soils formed in loamy alluvium. Slope is 0 to 1 percent.

The Havrelon soils in this survey area contain less clay and more silt than is defined as the range for the series. This difference, however, does not alter the use or behavior of the soils.

Havrelon soils are commonly adjacent to Banks and Lohler soils. Banks soils have a sandy control section. Lohler soils are moderately well drained and have a fine-textured control section.

Typical pedon of Havrelon loam 400 feet west and 230 feet south of the center of sec. 6, T. 144 N., R. 84 W.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium subangular blocky structure parting to moderate medium granular; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 17 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky and weak fine platy structure; hard, friable, sticky and plastic; common fine roots; many fine pores; strong effervescence; moderately alkaline; abrupt wavy boundary.

C2—17 to 23 inches; light brownish gray (2.5Y 6/2) silt loam with very fine strata of very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate fine and very fine platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many fine pores; strong effervescence; moderately alkaline; abrupt wavy boundary.

C3—23 to 45 inches; light brownish gray (2.5Y 6/2) very fine sand with several thin strata of very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; many fine pores; strong effervescence; moderately alkaline; abrupt wavy boundary.

C4—45 to 60 inches; light brownish gray (2.5Y 6/2) silt loam with very fine strata of very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; many medium distinct red (2.5Y 4/6 moist) mottles; massive; hard, very friable, slightly sticky and slightly plastic; few fine roots; common fine pores; strong effervescence; moderately alkaline.

The 10- to 40-inch control section is dominantly stratified silt loam and very fine sand, but it also can have thin strata of coarser or finer textured material. It is less than 18 percent clay and less than 15 percent fine sand and coarser sand. Some pedons contain a thin buried A horizon.

The A1 horizon has hue of 10YR or 2.5Y and value of 5 or 6 (4 or 5 moist). In some pedons the A horizon is less than 3 inches thick and is dark colored. It is dominantly loam or silty clay loam, but the range includes silt loam and fine sandy loam.

Heil series

The Heil series consists of deep, poorly drained, very slowly permeable soils in shallow basins on uplands and terraces. These soils are sodic. They formed in material weathered from alkaline clayey alluvium. Slope is 0 to 1 percent.

Heil soils are similar to Tonka soils and are commonly adjacent to Dimmick, Straw, Tonka, and Williams soils. Dimmick soils are very poorly drained and lack a natric horizon. Straw and Williams soils are well drained, lack a natric horizon, and have a fine-loamy control section. Tonka soils lack a natric horizon.

Typical pedon of Heil silty clay loam 345 feet north and 430 feet east of the southwest corner of sec. 16, T. 145 N., R. 86 W.

A1—0 to 2 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slightly acid; clear wavy boundary.

A2—2 to 4 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 6/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse and medium platy structure; hard, friable, sticky and plastic; many fine roots; many fine pores; slightly acid; abrupt wavy boundary.

B21t—4 to 9 inches; very dark gray (10YR 3/1) clay, gray (10YR 5/1) moist; strong fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine and few medium roots; common fine and few medium pores; gray (10YR 6/1 dry) on top of columns; neutral; gradual smooth boundary.

B22t—9 to 28 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; strong very coarse prismatic structure parting to strong coarse and medium angular blocky; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; faces of peds have glossy appearance when moist; neutral; gradual wavy boundary.

B3—28 to 38 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; strong coarse angular blocky structure parting to strong fine angular blocky; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores; slight effervescence; few fine soft lime masses; few fine salt crystals; moderately alkaline; clear wavy boundary.

C1g—38 to 44 inches; very dark gray (5Y 3/1) clay, gray (5Y 5/1) dry; common fine faint dark yellowish brown and yellowish brown (10YR 3/4 and 5/4) and many medium faint gray (5Y 5/1) mottles; weak coarse subangular blocky structure parting to moderate fine subangular blocky; very hard, very firm, very sticky and very plastic; very few roots; few fine pores; strong effervescence; common medium soft lime masses; tongues of very dark gray (10YR 3/1); strongly alkaline; clear wavy boundary.

C2g—44 to 54 inches; olive (5Y 4/3) silty clay, pale olive (5Y 6/3) dry; common fine distinct dark yellowish brown and yellowish brown (10YR 3/4 and 5/4) and many medium distinct gray (5Y 5/1) mottles; weak coarse subangular blocky structure; very hard, firm, very sticky and very plastic; very few fine pores; strong effervescence; many medium and fine soft lime masses; strongly alkaline; gradual wavy boundary.

C3g—54 to 60 inches; olive (5Y 5/4) silty clay loam, pale olive (5Y 6/4) dry; many large distinct yellowish brown (10YR 5/4) and many medium distinct gray (5Y 5/1 and 6/1) mottles; massive; very hard, firm, sticky and plastic; very few fine pores; strong effervescence; many fine and medium soft lime masses; strongly alkaline.

Depth to free carbonates ranges from 15 to 40 inches. The thickness of the solum ranges from 20 to 40 inches.

Some pedons lack an A1 horizon. The A2 horizon has color value of 3 to 5 (5 or 6 dry). It is dominantly silty clay loam or silt loam, but the range includes silty clay. The B2t horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 or 4 (4 or 5 dry); and chroma of 2 or less. It is clay or silty clay. Some pedons do not have a B3 horizon. The Cg horizon has few to many mottles. Some pedons have clay loam glacial till below a depth of 40 inches.

Krem series

The Krem series consists of deep, well drained soils on sand-mantled glacial till uplands. These soils formed in material weathered from wind- or water-deposited sandy sediments and the underlying glacial till. Permeability is rapid in the upper part and moderately slow in the lower part. Slope ranges from 1 to 15 percent.

Krem soils are similar to Flaxton soils and are commonly adjacent to Flaxton, Lihen, Seroco, and Telfer soils. Flaxton soils formed in loamy sediments and the underlying glacial till. Lihen, Seroco, and Telfer soils do not have glacial till within a depth of 40 inches. Also, Seroco soils lack a mollic epipedon.

Typical pedon of Krem loamy fine sand, 1 to 6 percent slopes, 790 feet west and 135 feet south of the northeast corner of NW1/4 sec. 17, T. 144 N., R. 85 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; common very fine medium and coarse roots; 1 percent pebbles; neutral; clear smooth boundary.

A12—7 to 15 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and few fine roots; 1 percent pebbles; neutral; clear wavy boundary.

A13—15 to 25 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and few medium roots; many very fine tubular pores; 1 percent pebbles; krotovina 3 inches in diameter; neutral; abrupt wavy boundary.

B1—25 to 30 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, loose, nonsticky and nonplastic; few very fine roots; common very fine roots; common very fine and medium tubular pores; about 5 percent coarse fragments; mildly alkaline; abrupt irregular boundary.

IIB21t—30 to 38 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct strong brown (7.5YR 5/6) mottles; strong coarse prismatic structure parting to strong angular blocky; very hard, firm, sticky and plastic; few very fine and fine roots; many very fine tubular pores; many moderately thick clay films on faces of peds and surfaces of pores; sandy coatings as much as 1/4 inch thick between prisms; about 3 percent coarse fragments, some lime coated; mildly alkaline; clear irregular boundary.

IIB22tca—38 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct strong brown (7.5YR 5/6) mottles; strong very coarse prismatic structure parting to moderate medium and coarse angular blocky; very hard, firm, sticky and plastic; few very fine and fine roots along faces of prisms; many very fine tubular pores; many moderately thick dark grayish brown (2.5Y 4/2 moist) clay films on faces of peds and surfaces of pores; sandy coatings as much as 1/4 inch thick between prisms; about 3 percent coarse fragments and one large weathered sandstone fragment; many irregularly shaped soft masses of lime; moderately alkaline; violent effervescence.

The thickness of the sandy sediments and the depth to underlying glacial till range from 16 to 40 inches. The soils are, by volume, as much as 10 percent pebbles and stones, which are mainly in the glacial till. The mollic epipedon commonly is more than 20 inches thick.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loamy fine sand, but in some pedons it is loamy sand and fine sand. Some pedons have no B1 horizon. The IIB2t horizon has hue of 10YR or 2.5Y hue, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is dominantly clay loam, but the range includes sandy clay loam and loam. Some pedons have a IIB3 or IIC horizon.

Lawther series

The Lawther series consists of deep, well drained, slowly permeable soils on valley fans, on terraces, and in upland swales. These soils formed in material weathered from clayey alluvium. Slope ranges from 1 to 3 percent.

Lawther soils are similar to Dimmick soils and are commonly adjacent to Dimmick, Grail, and Savage soils. Dimmick soils are very poorly drained. Grail and Savage soils have an argillic horizon. Also, Savage soils have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Lawther silty clay, 1 to 3 percent slopes, 395 feet north and 460 feet west of the southeast corner of SW1/4 sec. 28, T. 144 N., R. 89 W.

Ap—0 to 6 inches; gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak very coarse prismatic structure parting to moderate fine angular blocky; extremely hard, firm, very sticky and very plastic; common fine roots; many fine pores; very slight effervescence; mildly alkaline; abrupt smooth boundary.

B2—6 to 22 inches; dark gray (5Y 4/1) clay, black (5Y 2/1) moist; weak very coarse prismatic structure parting to moderate fine angular blocky; extremely hard, firm, very sticky and very plastic; common fine roots; many fine pores; shiny pressure faces; thin tongues of A horizon material; very slight effervescence; moderately alkaline; gradual wavy boundary.

B3cs—22 to 36 inches; dark gray (5Y 4/1) clay, black (5Y 2/1) moist; weak coarse subangular blocky structure parting to moderate medium and fine angular blocky; extremely hard, firm, very sticky and very plastic; common fine roots; many fine pores; slight effervescence; few fine soft lime masses; common fine and medium gypsum crystals; moderately alkaline; gradual wavy boundary.

C1—36 to 50 inches; olive gray (5Y 5/2) clay, dark olive gray (5Y 3/2) moist; common fine distinct olive brown (2.5Y 4/4 moist) mottles below a depth of 42 inches; moderate fine angular blocky structure; extremely hard, firm, very sticky and very plastic; very few fine roots; many fine pores; slight effervescence; few fine soft lime masses; few fine gypsum crystals; mildly alkaline; gradual wavy boundary.

C2—50 to 60 inches; olive (5Y 5/3) clay, olive gray (5Y 4/2) moist; common very fine distinct olive brown (2.5Y 4/4 moist) mottles; moderate fine angular blocky structure; extremely hard, firm, very sticky and very plastic; very few roots; many fine pores; slight effervescence; few fine soft lime masses; few fine gypsum crystals; mildly alkaline.

The thickness of the solum ranges from 25 to more than 40 inches. Free carbonates are typically throughout the soil, but in some pedons they are not evident within a depth of 20 inches. The mollic epipedon commonly is more than 20 inches thick. When the soil is dry, cracks as much as 2 inches wide are evident.

The A1 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silty clay, but in some pedons it is silty clay loam. The B2 horizon has hue of 2.5Y or 5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is clay or silty clay. The C horizon has hue of 5Y or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is clay or silty clay.

Lefor series

The Lefor series consists of moderately deep, well drained, moderately permeable soils on residual uplands. These soils formed in material weathered from soft sandstone. Slope ranges from 1 to 12 percent.

Lefor soils are similar to Vebar soils and are commonly adjacent to Amor, Arnegard, Cohagen, and Vebar soils. Amor soils lack an argillic horizon. Arnegard soils lack an argillic horizon, have a mollic epipedon that is more than 16 inches thick, and are not underlain by soft bedrock. Cohagen soils lack a mollic epipedon and an argillic horizon and have soft sandstone at a depth of 10 to 20 inches. Vebar soils lack an argillic horizon and have a coarse-loamy control section.

Typical pedon of Lefor fine sandy loam, 6 to 12 percent slopes, 825 feet east and 105 feet south of the northwest corner of sec. 28, T. 145 N., R. 89 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate medium and fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

B1—8 to 13 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine pores; neutral; clear wavy boundary.

B21t—13 to 20 inches; light yellowish brown (2.5Y 6/4) sandy clay loam, olive brown (2.5Y 4/4) moist; moderate very coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, sticky and slightly plastic; common fine roots; many fine pores; many thin clay films bridging sand grains and on faces of prisms; neutral; gradual wavy boundary.

B22t—20 to 24 inches; light yellowish brown (2.5Y 6/4) sandy clay loam, light olive brown (2.5Y 5/4) moist; moderate very coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, sticky and slightly plastic; few fine roots; many fine pores; common thin clay films bridging sand grains and on faces of prisms; neutral; gradual wavy boundary.

C1—24 to 34 inches; pale yellow (2.5Y 7/4) sandy clay loam, light yellowish brown (2.5Y 6/4) moist; weak very coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; neutral; gradual wavy boundary.

Cr—34 to 60 inches; pale yellow (2.5Y 7/4) soft fine grained sandstone, light yellowish brown (2.5Y 6/4) moist; massive; few fine roots in the upper part; neutral.

Depth to soft sandstone ranges from 20 to 40 inches. The thickness of the solum ranges from 20 to 35 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes loam and sandy loam. Some pedons do not have a B1 horizon. The B2t horizon has hue of 10YR or 2.5Y, value of 6 or 7 (4 or 5 moist), and chroma of 2 to 4. It is dominantly sandy clay loam, but the range includes loam. Some pedons have a B3ca or Cca horizon. The Cr horizon is massive or platy sandstone that crushes to fine sandy loam or sandy clay loam.

Lihen series

The Lihen series consists of deep, somewhat excessively drained, rapidly permeable soils on terraces and uplands. These soils formed in material weathered from wind- or water-deposited sandy sediments. Slope ranges from 1 to 6 percent.

Lihen soils are similar to Telfer soils and are commonly adjacent to Krem, Parshall, Seroco, and Telfer soils. Krem soils formed in sandy sediments and the underlying glacial till. Parshall soils have a coarse-loamy control section. Seroco soils lack a mollic epipedon. Telfer soils have a thinner mollic epipedon than Lihen soils and generally do not contain free carbonates within a depth of 60 inches.

Typical pedon of Lihen loamy fine sand, 1 to 6 percent slopes, 100 feet west and 925 feet north of the southeast corner of sec. 16, T. 144 N., R. 86 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak moderate and coarse granular structure; soft, very friable, nonsticky and nonplastic; many very fine coarse and very coarse roots; neutral; clear wavy boundary.

A12—7 to 17 inches; dark grayish brown (10YR 4/2) loamy fine sand; very dark brown (10YR 2/2) moist; weak moderate subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and medium roots; few very fine tubular pores; neutral; clear wavy boundary.

AC—17 to 24 inches; dark brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; few very fine and few medium tubular pores; mildly alkaline; clear wavy boundary.

C1—24 to 29 inches; dark brown (10YR 4/3) fine sand, dark brown (10YR 3/2) moist; massive; soft, loose, nonsticky and nonplastic; common very fine and fine roots; few very fine tubular pores; 10 percent pebbles less than 5 millimeters in size; few fine irregularly shaped soft lime masses; slight effervescence; mildly alkaline; clear wavy boundary.

C2—29 to 39 inches; dark brown (10YR 4/3) fine sand, dark brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; few fine irregularly shaped soft lime masses; slight effervescence in the lower part; 5 percent pebbles less than 5 millimeters in size; mildly alkaline; clear wavy boundary.

C3ca—39 to 48 inches; dark brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine roots; many very fine and common fine tubular pores; strong effervescence; moderately alkaline; clear wavy boundary.

C4ca—48 to 55 inches; dark brown (10YR 4/3) very fine sandy loam, dark brown (10YR 3/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine roots; many very fine pores; strong effervescence; mildly alkaline; clear wavy boundary.

C5—55 to 60 inches; pale brown (10YR 6/3) fine sand, dark brown (10YR 3/3) moist; single grained; soft, loose, nonsticky and nonplastic; few very fine roots; few medium tubular pores; moderately alkaline; slight effervescence.

Depth to free carbonates ranges from 20 to 40 inches. The mollic epipedon commonly is more than 20 inches thick.

The A horizon has color value of 4 or 5 (2 or 3 moist). It is loamy fine sand or fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (3 to 5 moist), and chroma of 2 to 4. It is loamy fine sand, loamy sand, or fine sand. Depth to fine sandy loam or finer textured material ranges from 40 to 60 inches.

Lohler Series

The Lohler series consists of deep, moderately well drained, moderately slowly or slowly permeable soils on bottom land. These soils formed in material weathered from recent clayey alluvium. Slope is 0 to 1 percent.

Lohler soils are similar to Magnus soils and are commonly adjacent to Banks, Havrelon, and Magnus soils. Banks soils have a sandy control section. Havrelon soils have a coarse-silty control section. Magnus soils have a mollic epipedon and lack fine stratification.

Typical pedon of Lohler silty clay 30 feet east and 60 feet north of the southwest corner of sec. 7, T. 144 N., R. 84 W.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure parting to moderate fine granular; hard, firm, sticky and very plastic; common fine roots; common fine pores; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 22 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate fine and medium platy and moderate very fine angular blocky structure; very hard, firm, sticky and very plastic; common fine roots; common fine pores; slight effervescence; few fine soft lime masses; few very thin very dark grayish brown (2.5Y 3/2 moist) layers; mildly alkaline; gradual wavy boundary.

C2—22 to 60 inches; grayish brown (2.5Y 5/2) silty clay with thin strata of silty clay loam and loam in the lower part, dark grayish brown (2.5Y 4/2) moist; few medium distinct dark yellowish brown (10YR 4/4 moist) and few medium distinct gray (N 5/0 moist) mottles; weak coarse and medium platy and moderate fine and very fine angular blocky structure; very hard, firm, sticky and very plastic; common fine roots in the upper part; common fine pores; slight effervescence; common fine soft lime masses; few very thin very dark grayish brown (2.5Y 3/2 moist) layers; moderately alkaline.

The soil typically contains free carbonates throughout. Some pedons have a buried A horizon below a depth of 30 inches.

The A horizon has color value of 5 or 6 (4 or 5 moist). In some pedons it is dark colored and is less than 3 inches thick. The C horizon has hue of 2.5Y or 5Y and value of 5 to 7 (4 to 6 moist). Some pedons have thin strata of sandy material below a depth of 40 inches. The C horizon has few to common mottles below a depth of 20 inches.

Magnus series

The Magnus series consists of deep, well drained, moderately slowly or slowly permeable soils on bottom land and terraces. These soils formed in material weathered from clayey alluvium. Slope is 0 to 1 percent.

Magnus soils are similar to Straw soils and are commonly adjacent to Straw and Velva soils. Straw soils have a fine-loamy control section. Velva soils have a coarse-loamy control section and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Magnus silty clay loam 690 feet south and 1,250 feet west of the center of sec. 8, T. 144 N., R. 86 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; many fine roots; neutral; abrupt smooth boundary.

A12—7 to 16 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to moderate fine granular; hard, firm, sticky and plastic; many fine roots; common fine pores; thin discontinuous very dark grayish brown (10YR 3/2 moist) layers in the lower part; neutral; clear wavy boundary.

B2—16 to 24 inches; dark grayish brown (10YR 4/2) silty clay with thin strata of silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate fine angular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; slight effervescence; 2-inch, very dark brown (10YR 2/2) layer in the upper part; moderately alkaline; gradual wavy boundary.

B3—24 to 29 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to moderate medium and fine angular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; strong effervescence; common fine soft lime masses; moderately alkaline; clear wavy boundary.

C1—29 to 34 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; many fine pores; strong effervescence; common fine soft lime masses; moderately alkaline; gradual wavy boundary.

C2—34 to 46 inches; grayish brown (2.5Y 5/2) silty clay loam with thin strata of silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; very few roots; many fine pores; strong effervescence; common fine soft lime masses; moderately alkaline; clear wavy boundary.

C3—46 to 60 inches; dark grayish brown and grayish brown (10YR 4/2 and 2.5Y 5/2) stratified silty clay and silty clay loam, very dark grayish brown and dark grayish brown (10YR 3/2 and 2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; very few roots; many fine pores; strong effervescence; common fine soft lime masses; moderately alkaline.

The mollic epipedon typically is more than 20 inches thick. The solum is 25 to 35 inches thick. Depth to free carbonates ranges from 10 to 30 inches, but some pedons contain free carbonates throughout. Most pedons contain one or more dark buried layers.

The A horizon has hue of 2.5Y or 10YR and value of 3 to 5 (2 or 3 moist). It is dominantly silty clay loam. The B horizon has hue of 10YR or 2.5Y and value of 4 or 5 (2 or 3 moist). The C horizon is dominantly silty clay loam, but it can have thin strata of coarser or finer textured material.

Makoti series

The Makoti series consists of deep, moderately well drained, moderately slowly permeable soils on lake plains on glacial till uplands. These soils formed in material weathered from calcareous silty lacustrine deposits. Slope is 0 to 1 percent.

Makoti soils are similar to Grassna soils and are commonly adjacent to Bowbells, Tonka, and Williams soils. Grassna soils are well drained. Bowbells soils have an argillic horizon and formed in glacial till. Tonka soils are poorly drained and have an argillic horizon. Williams soils formed in glacial till, have an argillic horizon, and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Makoti silt loam 75 feet north and 1,300 feet west of the southeast corner of sec. 16, T. 146 N., R. 85 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; slightly acid; abrupt wavy boundary.

A12—8 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; neutral; clear wavy boundary.

B2—11 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; common medium distinct yellowish brown (10YR 5/4 moist) mottles; moderate coarse and medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky and plastic; few fine roots; many fine pores; tongues of the A1 horizon in the upper part; few thin clay films on faces of peds; neutral; clear wavy boundary.

C1ca—22 to 26 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; few medium distinct gray (N 5/0 moist) and common fine distinct brown (7.5YR 4/4 moist) mottles; weak coarse and medium subangular blocky structure parting to weak medium subangular blocky; hard, friable, slightly sticky and plastic; few fine roots; many fine pores; violent effervescence; few medium soft lime masses; moderately alkaline; gradual wavy boundary.

C2ca—26 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/4) moist; common medium distinct gray (N 5/0 moist) and many fine distinct brown (7.5YR 4/4 moist) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine pores; violent effervescence; moderately alkaline; gradual wavy boundary.

IIC3—46 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; common medium distinct gray (N 5/0 moist) and many fine distinct brown (7.5Y 4/4 moist) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine pores; 2 percent pebbles; strong effervescence; few large soft lime masses; moderately alkaline.

The thickness of the solum ranges from 20 to 30 inches. The thickness of the mollic epipedon ranges from 16 to 24 inches; it commonly is more than 20 inches.

The A horizon has color value of 3 or 4 (2 or 3 moist). The B2 horizon has hue of 2.5Y or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. Some pedons do not have clay loam glacial till between depths of 40 and 60 inches.

Mandan series

The Mandan series consists of deep, well drained, moderately permeable soils on loess-covered uplands. These soils formed in material weathered from calcareous silty loess. Slope ranges from 1 to 6 percent.

Mandan soils are similar to Grassna soils and are commonly adjacent to Grassna, Temvik, and Wilton soils. Grassna soils formed in alluvium derived mainly from loess. They have a fine-silty control section. Temvik soils have a mollic epipedon that is less than 16 inches thick. They formed in loess over glacial till. Wilton soils also formed in loess over glacial till.

Typical pedon of Mandan silt loam, 1 to 3 percent slopes, 50 feet south and 660 feet west of the northeast corner of NW1/4 sec. 22, T. 147 N., R. 85 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

A12—8 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine pores; neutral; gradual wavy boundary.

B21—13 to 19 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine and few medium pores; neutral; gradual wavy boundary.

B22—19 to 30 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic and weak coarse and medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine and few medium pores; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—30 to 37 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; hard, very friable, slightly sticky and slightly plastic; few fine roots; many fine and few medium pores; strong effervescence; common fine soft lime masses; moderately alkaline; gradual wavy boundary.

C2—37 to 54 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; few fine pores; strong effervescence; common fine soft lime masses; moderately alkaline; abrupt wavy boundary.

A1b—54 to 58 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine pores; strong effervescence; common fine soft lime masses; moderately alkaline; abrupt wavy boundary.

C3—58 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine pores; strong effervescence; common fine soft masses; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 35 inches. The thickness of the solum ranges from 20 to 40 inches. Depth to free carbonates is dominantly 10 to 25 inches, but some pedons have free carbonates throughout.

The A horizon has color value of 4 or 5 (2 or 3 moist). The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. In some pedons the C horizon is sand and gravel or glacial till below a depth of 40 inches. Some pedons have no A1b horizon.

Moreau series

The Moreau series consists of moderately deep, well drained, slowly permeable soils on residual uplands. These soils formed in material weathered from soft, alkaline shale. Slope ranges from 3 to 15 percent.

Moreau soils are similar to Regent soils and are commonly adjacent to Regent, Rhoades, and Wayden soils. Regent soils have an argillic horizon. Rhoades soils have a natric horizon and strong columnar structure at a depth of 2 to 5 inches. Wayden soils lack a B horizon and have soft shale at a depth of 10 to 20 inches.

Typical pedon of Moreau silty clay, 3 to 6 percent slopes, 325 feet east and 650 feet north of the center of sec. 27, T. 142 N., R. 88 W.

Ap—0 to 7 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak medium subangular blocky structure parting to moderate fine and very fine granular; hard, firm, very sticky and very plastic; common fine roots; common fine pores; slight effervescence; moderately alkaline; abrupt smooth boundary.

B21—7 to 13 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to moderate fine and very fine subangular blocky and angular blocky; hard, firm, very sticky and very plastic; common fine roots; common fine pores; few thin clay films; slight effervescence; moderately alkaline; gradual wavy boundary.

B22—13 to 21 inches; light brownish gray (2.5Y 6/2) and light yellowish brown (2.5Y 6/4) silty clay, dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) moist; weak coarse prismatic structure parting to moderate fine subangular blocky and angular blocky; hard, firm, very sticky and very plastic; common fine roots; common fine pores; few thin clay films; strong effervescence; few fine soft lime masses; common medium yellowish brown (10YR 5/4) iron stains in the upper part; few fine gypsum crystals; moderately alkaline; gradual wavy boundary.

C1—21 to 28 inches; light yellowish brown (2.5Y 6/4) and light olive gray (5Y 6/2) silty clay, olive brown (2.5Y 4/4) and olive gray (5Y 4/2) moist; weak coarse subangular blocky and moderate fine platy structure (platiness inherited from soft shale); hard, firm, very sticky and very plastic; common fine roots; common fine pores; few fine gypsum crystals; strong effervescence; common medium soft lime masses; common medium dark yellowish brown (10YR 4/4) iron stains; moderately alkaline; clear smooth boundary.

Cr—28 to 60 inches; light olive gray (5Y 6/2) soft shale, olive gray (5Y 5/2) moist; platy rock structure; very hard, very sticky and very plastic; few fine roots in the upper part; strong effervescence; many medium soft lime masses in the upper part; common fine gypsum crystals; common medium dark yellowish brown (10YR 4/4) iron stains; strongly alkaline.

The solum is 20 to 28 inches thick. Depth to soft, alkaline shale typically is 25 to 30 inches but ranges from 20 to 40 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has hue of 2.5Y or 5Y and value of 4 or 5 (2 or 3 moist). The B2 horizon has color value of 4 to 6 (3 or 4 moist) and chroma of 2 to 4. It is dominantly silty clay, but the range includes clay and silty clay loam that are more than 35 percent clay. The C1 horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay or clay. The Cr horizon is platy or massive, alkaline shale that crushes to silty clay or clay.

Noonan series

The Noonan series consists of deep, well drained, slowly permeable soils on glacial till uplands. These soils are sodic. They formed in material weathered from alkaline glacial till. Slope ranges from 1 to 6 percent.

Noonan soils are similar to Williams soils and are commonly adjacent to Bowbells, Flaxton, and Williams soils. Bowbells, Flaxton, and Williams soils lack a natric horizon. Also, Flaxton soils formed in fine sandy loam deposits and the underlying glacial till.

Typical pedon of Noonan loam, in an area of Noonan-Williams loams, 1 to 6 percent slopes, 1,000 feet west and 1,050 feet north of the southwest corner of sec. 16, T. 145 N., R. 86 W.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak very coarse prismatic structure parting to weak medium subangular blocky and weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 2 percent pebbles; slightly acid; gradual wavy boundary.

B21t—7 to 12 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; strong coarse and medium columnar structure parting to strong medium angular blocky; extremely hard, very firm, sticky and plastic; many fine roots, mostly along faces of peds; common fine pores; many thin clay films; light gray (10YR 7/1) on tops of columns; 2 percent pebbles; mildly alkaline; gradual wavy boundary.

B22t—12 to 16 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and plastic; common fine roots; common fine pores; common thin clay films on faces of prisms; few fine salt crystals; 2 percent pebbles; moderately alkaline; gradual wavy boundary.

B3—16 to 30 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to coarse and medium subangular blocky; hard, firm, sticky and plastic; few fine roots; few fine pores; coatings of very dark grayish brown (10YR 3/2 moist) on faces of prisms; few fine salt crystals; 2 percent pebbles; strongly alkaline; clear wavy boundary.

C1ca—30 to 56 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; very weak coarse prismatic structure parting to weak coarse and medium subangular blocky; very hard, firm, sticky and plastic; few fine roots; few fine pores; strong effervescence; many medium soft lime masses; few fine salt crystals; 2 percent pebbles; common fine prominent dark red (2.5Y 3/6 moist) iron stains; strongly alkaline; clear wavy boundary.

C1—56 to 60 inches; light brownish gray and light gray (2.5Y 6/2 and 7/2) clay loam, grayish brown and light brownish gray (2.5Y 5/2 and 6/2) moist; massive; hard, firm, sticky and plastic; few fine pores; strong effervescence; common fine soft lime masses; few fine salt crystals; 2 percent pebbles; few fine prominent red (2.5YR 4/8 moist) iron stains; strongly alkaline.

The thickness of the solum ranges from 18 to 32 inches. Depth to free carbonates ranges from 16 to 35 inches.

The A1 horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is loam or fine sandy loam, but the range includes silt loam and clay loam. Some pedons have an A2 horizon. The B2t horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The B3 horizon is dominantly clay loam, but the range includes loam. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is dominantly clay loam, but the range includes loam. Some pedons have soft shale below a depth of 40 inches.

Parnell series

The Parnell series consists of deep, very poorly drained, slowly permeable soils in depressions in glaciated uplands. These soils formed in material weathered from water-sorted clayey sediments. Slope is 0 to 1 percent.

Parnell soils are similar to Tonka soils and are commonly adjacent to Arnegard, Bowbells, Tonka, and Williams soils. Arnegard and Bowbells soils are well drained and have a fine-loamy control section. Also, Arnegard soils lack an argillic horizon. Tonka soils are poorly drained and have an A2 horizon. Williams soils are well drained, have a fine-loamy control section, and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Parnell silt loam 90 feet north and 890 feet east of the southwest corner of SE1/4 sec. 27, T. 146 N., R. 85 W.

A11—0 to 6 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine pores; neutral; gradual smooth boundary.

A12—6 to 16 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; common medium prominent dark yellowish brown (10YR 3/4) mottles; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine pores; neutral; clear wavy boundary.

B21tg—16 to 20 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; many medium prominent dark yellowish brown (10YR 3/4) mottles; weak very coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common fine and medium roots; common fine and medium pores; common thin clay films; neutral; gradual wavy boundary.

B22tg—20 to 38 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few medium distinct dark yellowish brown (10YR 3/4) mottles in the upper part; weak very coarse prismatic structure parting to moderate fine and very fine subangular blocky; very hard, firm, very sticky and very plastic; few fine roots; common fine and medium pores; many thin clay films; neutral; gradual wavy boundary.

B3g—38 to 43 inches; very dark gray (5Y 3/1) silty clay, gray (5Y 5/1) dry; few medium distinct dark yellowish brown (10YR 3/4) mottles; moderate fine and very fine subangular blocky structure; very hard, firm, very sticky and very plastic; few fine roots; few fine pores; slight effervescence; mildly alkaline; gradual wavy boundary.

C1cag—43 to 53 inches; olive gray (5Y 4/2) silty clay loam, light olive gray (5Y 6/2) dry; common medium prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; very hard, firm, very sticky and very plastic; few fine pores; strong effervescence; moderately alkaline; clear wavy boundary.

C2cag—53 to 60 inches; olive gray (5Y 5/2) silty clay loam, light gray (5Y 7/2) dry; many coarse prominent yellowish brown (10YR 5/6) and common medium faint dark gray (5Y 4/1) mottles; massive and varved; very hard, firm, very sticky and plastic; few fine pores; common medium soft lime masses; strong effervescence; moderately alkaline.

The thickness of the solum typically is 35 to 50 inches but ranges from 35 to more than 60 inches. Depth to free carbonates ranges from 35 to 50 inches.

Some pedons have an O horizon. This horizon is less than 3 inches thick. The A horizon is dominantly silt loam, but the range includes silty clay loam. Some pedons have an A2 horizon. This horizon is less than 4 inches thick. The B2tg horizon has hue of 10YR or 2.5Y and value of 2 to 4. Some pedons lack a B3g horizon. The C horizon is dominantly silty clay loam alluvium, but the range includes loam and clay loam glacial till.

Parshall series

The Parshall series consists of deep, well drained, moderately rapidly permeable soils on terraces and outwash plains and in upland swales. These soils formed in material weathered from wind- or water-deposited loamy sediments. Slope ranges from 1 to 9 percent.

Parshall soils are similar to Vebar soils and are commonly adjacent to Bowdle, Flaxton, Lihen, and Vebar soils. Bowdle soils have a fine-loamy control section and have sand and gravel at a depth of 20 to 40 inches. Flaxton soils have an argillic horizon and formed in fine sandy loam deposits and the underlying glacial till. Lihen soils formed in sandy sediments. Vebar soils have soft sandstone at a depth of 20 to 40 inches and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Parshall loam, 1 to 6 percent slopes, 400 feet east and 160 feet south of the northwest corner of sec. 29, T. 144 N., R. 86 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine subangular blocky and weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

A12—8 to 17 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; clear smooth boundary.

B2—17 to 30 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine pores; neutral; gradual wavy boundary.

C1—30 to 36 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; few fine roots; few fine pores; neutral; gradual wavy boudary.

C2ca—36 to 51 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few fine roots; few fine pores; strong effervescence; 2 percent pebbles; moderately alkaline; clear wavy boundary.

A1b—51 to 56 inches; grayish brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few fine pores; strong effervescence; 5 percent pebbles; moderately alkaline.

C3—56 to 60 inches; light brownish gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; very weak coarse subangular blocky structure parting to single grained; loose, nonsticky and nonplastic; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 25 to 40 inches. The thickness of the mollic epipedon typically is more than 20 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist). It is dominantly loam or fine sandy loam, but the range includes sandy loam. The B2 horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. Some pedons have a B3 horizon. The C horizon is fine sandy loam or loamy fine sand. Some pedons have sand and gravel below a depth of 40 inches. Some pedons have no A1b horizon.

Regent series

The Regent series consists of moderately deep, well drained, slowly permeable soils on residual uplands. These soils formed in material weathered from residuum of soft, alkaline shale. Slope ranges from 1 to 9 percent.

Regent soils are similar to Savage soils and are commonly adjacent to Moreau, Rhoades, Savage, and Wayden soils. Moreau soils lack an argillic horizon. Rhoades and Savage soils do not have soft shale at a depth of 20 to 40 inches. Also, Rhoades soils have a natric horizon and have strong columnar structure at a depth of 2 to 5 inches. Wayden soils lack a mollic epipedon and have soft shale at a depth of 10 to 20 inches.

Typical pedon of Regent silty clay loam, in an area of Regent-Rhoades complex, 1 to 6 percent slopes, 330 feet west and 1,780 feet south of the northeast corner of sec. 29, T. 141 N., R. 90 W.

Ap—0 to 6 inches; dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, firm, sticky and plastic; common fine roots; common fine pores; neutral; abrupt smooth boundary.

B21t—6 to 13 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to strong fine angular blocky; very hard, very firm, very sticky and very plastic; common fine roots; many fine pores; continuous thin clay films; mildly alkaline; gradual wavy boundary.

B22t—13 to 24 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to strong fine angular blocky; very hard, very firm, very sticky and very plastic; common fine roots; many fine pores; slight effervescence in the upper part and strong effervescence in the lower part; very dark grayish brown (2.5Y 3/2 moist) coatings on faces of prisms; moderately alkaline; clear wavy boundary.

B3ca—24 to 38 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine pores; few thin clay films; strong effervescence; common fine soft lime masses; few fine gypsum crystals; common very fine strong brown (7.5YR 5/6) iron stains; moderately alkaline; clear smooth boundary.

Cr—38 to 60 inches; pale olive (5Y 6/3) soft shale, olive (5Y 5/3) moist; platy rock structure; very hard, firm, sticky and plastic; few fine roots in the upper part; strong effervescence; few medium soft lime masses in the upper part; few fine gypsum crystals; strongly alkaline.

Depth to soft shale typically is 30 to 40 inches. The mollic epipedon is 7 to 16 inches thick. Depth to free carbonates is 10 to 20 inches. The thickness of the solum ranges from 20 to 40 inches.

The A1 horizon has hue of 2.5Y or 10YR and value of 4 or 5 (2 or 3 moist). The B2t horizon has hue of 2.5Y or 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is dominantly silty clay, but the range includes silty clay loam. Some pedons do not have a B3ca horizon. The Cr horizon is platy or massive clayey or silty shale.

Rhoades series

The Rhoades series consists of deep, well drained, very slowly permeable soils on uplands, on terraces, and in swales. These soils are sodic. They formed in material weathered from alkaline residuum or alluvium. Slope ranges from 1 to 9 percent.

Rhoades soils are similar to Daglum soils and are commonly adjacent to Belfield, Daglum, Regent, and Sen soils. Belfield soils do not have visible salt crystals within a depth of 16 inches, generally lack strong columnar structure, and have a thicker A horizon than Rhoades soils. Daglum soils do not have visible salt crystals within a depth of 16 inches. Also, the thickness of the A1 horizon combined with that of the A2 horizon is greater in Daglum soils than in Rhoades soils. Regent and Sen soils lack a natric horizon. Also, Sen soils have a fine-silty control section.

Typical pedon of Rhoades silty clay, in an area of Rhoades-Daglum complex, 1 to 9 percent slopes, 890 feet west and 660 feet north of the southeast corner of sec. 16, T. 144 N., R. 89 W.

A2—0 to 2 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate and strong coarse to fine platy structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

B2t—2 to 13 inches; very dark grayish brown (10YR 3/2) silty clay, very dark brown (10YR 2/2) moist; strong medium and coarse columnar structure parting to strong medium and fine angular blocky; extremely hard, very firm, very sticky and very plastic; many fine roots along faces of peds; common fine pores; many thin clay films on faces of peds; slight effervescence in the lower part; few fine salt crystals; tops of columns coated with grayish brown (10YR 5/2); moderately alkaline; clear wavy boundary.

B3cs—13 to 21 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium and fine angular blocky; extremely hard, very firm, very sticky and very plastic; common fine roots along faces of peds; common fine pores; common fine soft lime masses; common fine salt crystals; strongly alkaline; gradual wavy boundary.

C1cs—21 to 41 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few fine roots; few fine pores; strong effervescence; few fine and medium soft lime masses; common fine and coarse gypsum crystals; very strongly alkaline; clear wavy boundary.

C2—41 to 53 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak fine and medium subangular blocky structure; hard, firm, sticky and plastic; few fine pores; strong effervescence; common medium soft lime masses; few fine and medium salt crystals; very strongly alkaline; gradual wavy boundary.

C3—53 to 60 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; strong effervescence; common medium soft lime masses; few fine and medium salt crystals; strongly alkaline.

The solum is 12 to 24 inches thick. Depth to free carbonates is 10 to 20 inches. Visible salt and gypsum crystals are within a depth of 16 inches.

Some pedons have a thin A1 horizon. The thickness of the A1 horizon combined with that of the A2 horizon is less than 5 inches. The A2 horizon has color value of 5 or 6 (3 or 4 moist). It is dominantly silt loam, but the range includes loam and very fine sandy loam. The B2t horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 or 3 moist). It is dominantly silty clay, but the range includes silty clay loam and clay. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. Some pedons have soft alkaline shale below a depth of 40 inches.

Ringling series

The Ringling series consists of excessively drained, very rapidly permeable soils that are shallow over porcelanite. These soils are on uplands. They formed in material weathered from porcelanite. Slope ranges from 6 to 35 percent.

Ringling soils are similar to Searing soils and are commonly adjacent to Cabba and Searing soils. Cabba soils have a loamy control section. Searing soils are moderately deep over porcelanite and have a fine-loamy control section.

Typical pedon of Ringling channery loam, in an area of Ringling-Cabba complex, 9 to 35 percent slopes, 300 feet south and 230 feet west of the northeast corner of sec. 30, T. 144 N., R. 84 W.

A1—0 to 7 inches; dark reddish gray (5YR 4/2) channery loam, dark reddish brown (5YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 30 percent hard porcelanite fragments; neutral; gradual wavy boundary.

C1—7 to 15 inches; reddish brown (2.5YR 4/4) very channery loam, dark reddish brown (2.5YR 3/4) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 60 percent hard porcelanite fragments; slight effervescence; lime coatings on undersides of fragments; mildly alkaline; gradual wavy boundary.

C2—15 to 60 inches; red (10YR 5/6 and 2.5YR 5/6) and reddish yellow (5YR 6/6) hard fractured porcelanite beds, red (10YR 4/6 and 2.5YR 4/6) and yellowish red (5YR 4/6) moist; platy rock structure; few roots in the upper part; fines from C1 horizon partly fill voids in the upper part; lime coatings on undersides of some fragments; slight effervescence; mildly alkaline.

Depth to fractured porcelanite beds ranges from 5 to 20 inches. The percent of porcelanite fragments ranges from 30 in the A1 horizon to 80 in the lower part of the C1 horizon.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly channery loam, but the range includes loam. The C horizon is hard or soft, fractured porcelanite beds.

Savage series

The Savage series consists of deep, well drained, slowly permeable soils on terraces, fans, and uplands. These soils formed in material weathered from clayey alluvium or residuum of clayey shale. Slope ranges from 1 to 3 percent.

Savage soils are similar to Regent soils and are commonly adjacent to Grail, Regent, and Rhoades soils. Grail soils have a mollic epipedon that is more than 16 inches thick. Regent soils have soft bedrock at a depth of 20 to 40 inches. Rhoades soils have a natric horizon at a depth of 2 to 5 inches.

Typical pedon of Savage silty clay loam, 1 to 3 percent slopes, 1,320 feet north and 890 feet east of the center of sec. 34, T. 144 N., R. 88 W.

Ap—0 to 5 inches; dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium and fine subangular blocky structure parting to moderate medium and fine granular; hard, friable, sticky and plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

A12—5 to 8 inches; dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, sticky and plastic; common fine roots; many fine pores; neutral; clear wavy boundary.

B21t—8 to 17 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse and medium prismatic structure parting to strong medium and fine angular blocky; very hard, firm, very sticky and very plastic; common fine roots; many fine pores; continuous thin clay films; very dark grayish brown (2.5Y 3/2 moist) coatings on faces of peds; mildly alkaline; clear wavy boundary.

B3ca—17 to 24 inches; light olive brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) moist; moderate coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm, sticky and plastic; common fine roots; many fine and few medium pores; strong effervescence; few fine soft lime masses; moderately alkaline; gradual wavy boundary.

C1ca—24 to 45 inches; light yellowish brown (2.5Y 6/4) stratified silty clay and silty clay loam with thin strata of silt loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, firm, sticky and plastic; few fine roots; many fine pores; violent effervescence; common fine soft lime masses; moderately alkaline; gradual wavy boundary.

C2—45 to 60 inches; light yellowish brown (2.5Y 6/4) stratified silty clay and silty clay loam with thin strata of silt loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm, sticky and plastic; few fine pores; strong effervescence; few fine soft lime masses; strongly alkaline.

Depth to free carbonates is 12 to 24 inches. The solum is 18 to 30 inches thick. The mollic epipedon is 7 to 16 inches thick.

The A1 horizon has hue of 2.5Y or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly silty clay loam, but the range includes silt loam. The B2t horizon has color value of 4 or 5 (3 or 4 moist). It is dominantly silty clay, but the range includes silty clay loam and the content of clay is 35 to 45 percent. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. Some pedons have soft shale below a depth of 40 inches.

Searing series

The Searing series consists of well drained, moderately permeable soils that are moderately deep over porcelanite. These soils are on uplands. They formed in material weathered from porcelanite beds. Slope ranges from 1 to 9 percent.

Searing soils are similar to Ringling soils and are commonly adjacent to Ringling, Sen, and Williams soils. Ringling soils have porcelanite at a depth of 5 to 20 inches. Sen soils have no porcelanite beds and have a fine-silty control section. Williams soils have an argillic horizon and formed in glacial till.

Typical pedon of Searing loam, 1 to 6 percent slopes, 300 feet north and 210 feet west of the southeast corner of sec. 16, T. 144 N., R. 87 W.

Ap—0 to 6 inches; dark brown (7.5YR 4/2) loam, very dark brown (7.5YR 2/2) moist; weak coarse and medium subangular blocky structure parting to weak medium and fine granular; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; neutral; abrupt smooth boundary.

B21—6 to 12 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; moderate coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; very dark brown (7.5YR 2/2 moist) coatings on faces of prisms; 2 percent porcelanite fragments and glacial pebbles; neutral; clear wavy boundary.

B22—12 to 18 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; 2 percent porcelanite fragments and glacial pebbles; neutral; clear wavy boundary.

C1—18 to 25 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak coarse and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; slight effervescence; 5 percent porcelanite fragments and glacial pebbles; mildly alkaline; clear wavy boundary.

C2—25 to 28 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 5/6) moist; weak coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; strong effervescence; 5 percent porcelanite fragments and glacial pebbles; moderately alkaline; clear wavy boundary.

C3—28 to 60 inches; reddish yellow (5YR 6/8) soft porcelanite beds and some loamy material filling upper voids, yellowish red (5YR 5/8) moist; strong effervescence; 2 percent glacial pebbles; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 10 to 24 inches. Depth to porcelanite beds ranges from 20 to 40 inches.

The A1 horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 or 5 (2 or 3 moist); and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam and clay loam. The B2 horizon has hue of 5YR, 7.5YR, or 10YR; value of 4 to 6 (3 or 4 moist); and chroma of 2 to 4. It is dominantly loam, but the range includes clay loam. The C horizon has hue of 5YR or 7.5YR. The C3 horizon is soft or hard, fractured porcelanite beds.

Sen series

The Sen series consists of moderately deep, well drained, moderately permeable soils on residual uplands. These soils formed in material weathered from silty residuum of soft bedrock. Slope ranges from 3 to 9 percent.

Sen soils are similar to Amor soils and are commonly adjacent to Amor, Rhoades, and Werner soils. Amor soils have a fine-loamy control section. Rhoades soils have a natric horizon, have a fine-textured control section, and have strong columnar structure at a depth of 2 to 5 inches. Werner soils have soft bedrock at a depth of 10 to 20 inches and lack a B2 horizon.

Typical pedon of Sen silt loam, 3 to 6 percent slopes, 50 feet west and 760 feet north of the southeast corner of NE1/4 sec. 22, T. 144 N., R. 87 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium and fine subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B21—5 to 10 inches; brown (10YR 4/3) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; clear wavy boundary.

B22—10 to 14 inches; light olive brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; very dark grayish brown (10YR 3/2 moist) coatings on faces of prisms; slight effervescence; mildly alkaline; gradual wavy boundary.

C1ca—14 to 22 inches; light yellowish brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) moist; very weak coarse prismatic structure parting to weak medium and fine subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; strong effervescence; few fine soft lime masses; moderately alkaline; clear wavy boundary.

C2ca—22 to 31 inches; light yellowish brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) moist; weak coarse and medium subangular blocky structure; very hard, friable, sticky and plastic; many fine roots; many fine pores; strong effervescence; many medium soft lime masses; moderately alkaline; clear wavy boundary.

Cr1—31 to 43 inches; light yellowish brown (2.5Y 6/4) soft sedimentary beds, olive brown (2.5Y 4/4) moist; platy rock structure; hard and brittle, friable, slightly sticky and slightly plastic; common fine roots along rock fractures; strong effervescence; moderately alkaline; clear wavy boundary.

Cr2—43 to 60 inches; pale olive (5Y 6/4) soft sedimentary beds, olive (5Y 4/4) moist; platy rock structure; hard and brittle, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Depth to free carbonates is 10 to 20 inches. The solum is 13 to 25 inches thick. The mollic epipedon is 7 to 16 inches thick.

The A1 horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly silt loam, but the range includes loam and silty clay loam. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is dominantly silt loam, but the range includes silty clay loam. Some pedons have a B3 horizon. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silt loam or silty clay loam. The Cr horizon is soft sedimentary bedrock that crushes to silt loam or loam.

Seroco series

The Seroco series consists of deep, excessively drained, rapidly permeable soils on terraces and uplands. These soils formed in material weathered from eolian sandy sediments. Slope ranges from 1 to 25 percent.

Seroco soils are similar to Telfer soils and are commonly adjacent to Dune land and to Krem, Lihen, and Telfer soils. Dune land is actively shifting sand dunes. Krem soils have an argillic horizon, have a mollic epipedon, and formed in sandy sediments and the underlying glacial till. Lihen and Telfer soils have a mollic epipedon.

Typical pedon of Seroco loamy fine sand, in an area of Seroco-Telfer loamy fine sands, 1 to 15 percent slopes, 1,050 feet south and 60 feet east of the northwest corner of sec. 13, T. 144 N., R. 86 W.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 3/2) moist; weak medium subangular blocky structure parting to single grained; loose; many fine roots; slightly acid; gradual wavy boundary.

C1—3 to 20 inches; brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; single grained; common fine roots; neutral; gradual wavy boundary.

C2—20 to 60 inches; brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; single grained; few roots; neutral.

The 10- to 40-inch control section is dominantly fine sand, but the range includes loamy fine sand and loamy sand. Depth to free carbonates typically is more than 60 inches but ranges from 30 to 60 inches. Some pedons have a thin, dark buried layer.

The A horizon has color value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is dominantly loamy fine sand, but the range includes fine sand. Some pedons have an AC horizon. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. Some pedons have finer or coarser material below a depth of 40 inches.

Shambo series

The Shambo series consists of deep, well drained, moderately permeable soils on terraces and fans. These soils formed in material weathered from calcareous loamy alluvium. Slope ranges from 1 to 6 percent.

Shambo soils are similar to Arnegard soils and are commonly adjacent to Arnegard, Belfield, Parshall, Savage, and Straw soils. Arnegard soils have a mollic epipedon that is more than 16 inches thick. Belfield soils have a fine-textured natric horizon. Parshall soils have a mollic epipedon that is more than 16 inches thick and have a coarse-loamy control section. Savage soils have a fine-textured argillic horizon. Straw soils have a mollic epipedon that is more than 16 inches thick. They typically are on bottom land and the lower terraces.

Typical pedon of Shambo loam, 1 to 3 percent slopes, 1,040 feet north and 955 feet west of the southeast corner of sec. 28, T. 144 N., R. 88 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak coarse and medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

B2—8 to 19 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; very dark grayish brown (10YR 3/2) coatings on faces of peds in the upper part; neutral; gradual wavy boundary.

B3ca—19 to 24 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to moderate coarse and medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; strong effervescence; few fine soft lime masses; moderately alkaline; clear wavy boundary.

C1ca—24 to 41 inches; light brownish gray (2.5Y 6/2) stratified loam, silt loam, and silty clay loam, grayish brown (2.5Y 5/2) moist; weak coarse and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; strong effervescence; common fine soft lime masses; moderately alkaline; gradual wavy boundary.

C2—41 to 60 inches; light brownish gray (2.5Y 6/2) stratified loam, silt loam, and silty clay loam; grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; many fine pores; strong effervescence; few fine soft lime masses; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 16 to 28 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has color value of 4 or 5 (2 or 3 moist). It is dominantly loam, but the range includes silt loam. The B2 horizon has hue of 2.5Y or 10YR, value of 5 or 6 (3 or 4 moist), and chroma of 2 to 4. It is dominantly loam, but in some pedons it is silt loam. Some pedons lack a B3ca horizon. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. Some pedons have coarser or finer textured material below a depth of 40 inches.

Straw series

The Straw series consists of deep, well drained, moderately permeable soils on bottom land and terraces. These soils formed in material weathered from loamy alluvium. Slope ranges from 0 to 6 percent.

Straw soils are similar to Magnus soils and are commonly adjacent to Magnus, Shambo, and Velva soils. Magnus soils have a fine-textured control section. Shambo soils have a mollic epipedon that is less than 16 inches thick and regularly decrease in content of organic matter with increasing depth. They typically are on the higher terraces. Velva soils have a coarse-loamy control section and have a mollic epipedon that is less than 16 inches thick.

Typical pedon of Straw loam, 0 to 3 percent slopes, 990 feet west and 410 feet south of the northeast corner of sec. 18, T. 142 N., R. 90 W.

A11—0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; 1-inch layer is very dark grayish brown (10YR 3/2); weak medium prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and common medium roots; many fine and common medium pores; neutral; clear smooth boundary.

A12—7 to 20 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; 1-inch layer of dark grayish brown (10YR 4/2) loam in the lower part; weak medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, sticky and plastic; many fine and common medium roots; many fine and common medium pores; slight effervescence at a depth of 16 inches; few fine soft lime masses in the lower part; moderately alkaline; clear smooth boundary.

C1—20 to 46 inches; grayish brown (2.5Y 5/2) loam with thin strata of silt loam and fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine and few medium pores; strong effervescence; few fine soft lime masses; moderately alkaline; clear smooth boundary.

C2—46 to 60 inches; grayish brown (2.5Y 5/2) fine sandy loam with thin strata of loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; strong effervescence; few fine soft lime masses; moderately alkaline.

Depth to free carbonates ranges from 7 to 20 inches. The thickness of the solum ranges from 20 to 35 inches. The thickness of the mollic epipedon ranges from 16 to 30 inches. Most pedons have one or more dark buried layers.

The A1 horizon has color value of 3 to 5 (2 or 3 moist). It is loam, silt loam, or silty clay loam. Some pedons have a B horizon. The C horizon has hue of 2.5Y or 10YR and value of 5 or 6 (4 or 5 moist). Coarser or finer textured material is below a depth of 40 inches in some pedons.

Telfer series

The Telfer series consists of deep, excessively drained, rapidly permeable soils on terraces and uplands. These soils formed in material weathered from wind- or water-deposited sandy sediments. Slope ranges from 1 to 15 percent.

Telfer soils are similar to Seroco soils and are commonly adjacent to Krem, Lihen, and Seroco soils. Krem soils have an argillic horizon and formed in sandy sediments and the underlying glacial till. Lihen soils have free carbonates within a depth of 40 inches. Seroco soils have a mollic epipedon.

Typical pedon of Telfer loamy fine sand, in an area of Seroco-Telfer loamy fine sands, 1 to 15 percent slopes, 1,060 feet south and 140 feet east of the northwest corner of sec. 13, T. 144 N., R. 86 W.

A1—0 to 10 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) moist; very weak coarse prismatic structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; many very fine roots, matted in the upper 1 inch; many fine and few medium pores; neutral; gradual wavy boundary.

AC—10 to 15 inches; grayish brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; very weak coarse subangular blocky structure parting to single grained; loose, nonsticky and nonplastic; common very fine roots; common fine pores; neutral; gradual wavy boundary.

C—15 to 60 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grained; loose, nonsticky and nonplastic; few very fine to common fine roots in the upper part and few fine roots at a depth of 40 inches; neutral.

Depth to free carbonates is dominantly more than 60 inches but is 40 to 60 inches in some pedons. The mollic epipedon is 10 to 16 inches thick.

The A1 horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loamy fine sand, but the range includes loamy sand and fine sandy loam. The AC horizon has color value of 4 or 5 and chroma of 2 or 3. It is dominantly fine sand, but the range includes loamy sand and loamy fine sand. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (4 or 5 moist), and chroma of 2 to 4. Some pedons have glacial till below a depth of 40 inches.

Temvik series

The Temvik series consists of deep, well drained soils on loess-mantled glacial till uplands. These soils are moderately permeable in the upper part and moderately slowly permeable in the lower part. They formed in material weathered from silty loess overlying glacial till. Slope ranges from 3 to 9 percent.

Temvik soils are similar to Wilton soils and are commonly adjacent to Grassna, Mandan, Williams, and Wilton soils. Grassna soils have a mollic epipedon that is more than 16 inches thick, do not have glacial till within a depth of 40 inches, and formed in alluvium derived from loess deposits. Mandan soils have a mollic epipedon that is more than 16 inches thick, do not have glacial till within a depth of 40 inches, and have a coarse-silty control section. Williams soils have an argillic horizon and formed in glacial till. Wilton soils have a mollic epipedon that is more than 16 inches thick.

Typical pedon of Temvik silt loam, in an area of Temvik-Williams silt loams, 3 to 6 percent slopes, 60 feet south and 100 feet east of the northwest corner of NE1/4 sec. 35, T. 147 N., R. 85 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

A12—8 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B21—11 to 15 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; moderate coarse and medium prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; neutral; gradual wavy boundary.

B22—15 to 27 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; neutral; clear wavy boundary.

IIC1ca—27 to 32 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, friable, sticky and plastic; common fine roots; many fine pores; violent effervescence; common medium soft lime masses; 2 percent pebbles; moderately alkaline; gradual wavy boundary.

IIC2ca—32 to 45 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; hard, friable, sticky and plastic; few fine roots; many fine pores; violent effervescence; many medium soft lime masses; 2 percent pebbles; moderately alkaline; gradual wavy boundary.

IIC3—45 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; weak coarse and medium subangular blocky structure; hard, friable, sticky and plastic; few fine roots; common fine pores; strong effervescence; common medium and fine soft lime masses; 2 percent pebbles; moderately alkaline.

The thickness of the solum and the depth to free carbonates are 20 to 30 inches. The mollic epipedon is 7 to 16 inches thick. Depth to the underlying glacial till ranges from 26 to 40 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist). The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is dominantly silt loam, but the range includes silty clay loam. Some pedons have a B3 horizon, which can extend into the glacial till. The IIC horizon is clay loam or loam glacial till. It has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. Some pedons have soft bedrock below a depth of 40 inches.

Tonka series

The Tonka series consists of deep, poorly drained, slowly permeable soils in shallow basins and depressions in the glaciated uplands. These soils formed in material weathered from glacial till or water-sorted sediments. Slope is 0 to 1 percent.

Tonka soils are similar to Heil soils and are commonly adjacent to Bowbells, Heil, Parnell, and Williams soils. Heil soils have a natric horizon at a depth of 1 inch to 4 inches. The very poorly drained Parnell soils and the well drained Williams and Bowbells soils lack an A2 horizon.

Typical pedon of Tonka silt loam 400 feet west and 100 feet south of the northeast corner of sec. 9, T. 145 N., R. 85 W.

A11—0 to 4 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slightly acid; clear wavy boundary.

A12—4 to 9 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to weak medium platy and angular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slightly acid; abrupt wavy boundary.

A2—9 to 16 inches; dark gray (10YR 4/1) loam, light gray (10YR 6/1) dry; many medium prominent dark brown (7.5YR 3/2) mottles; weak and moderate medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine and common medium pores; slightly acid; abrupt wavy boundary.

B21t—16 to 20 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; many medium prominent dark yellowish brown (10YR 3/4) mottles; moderate coarse prismatic structure parting to moderate medium angular blocky; very hard, firm, very sticky and plastic; common fine roots; common fine pores; many thin clay films; common uncoated sand grains on faces of prisms; slightly acid; clear wavy boundary.

B22t—20 to 33 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; many large prominent dark brown (7.5YR 3/2) mottles; strong medium prismatic structure parting to moderate angular blocky; very hard, firm, very sticky and plastic; few fine roots; common fine pores; many thin clay films; 5 percent pebbles; common uncoated sand grains on faces of prisms; slightly acid; gradual wavy boundary.

B3—33 to 38 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; many large prominent dark brown (7.5YR 3/2) mottles; weak coarse prismatic structure parting to weak medium angular blocky; very hard, firm, very sticky and plastic; few fine roots; common fine pores; few thin clay films on faces of prisms; 5 percent pebbles; neutral; clear wavy boundary.

Cg—38 to 60 inches; olive (5Y 5/4) clay loam, pale olive (5Y 6/4) dry; common large prominent brown (7.5YR 4/4) and common fine prominent gray (N 5/0) mottles; massive; very hard, firm, very sticky and plastic; few fine roots in the upper part; few fine pores; slight effervescence; 2 percent pebbles; common fine soft lignite masses; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 50 inches. The A1 horizon is dominantly silt loam, but the range includes silty clay loam. The A2 horizon has hue of 2.5Y or 10YR, value of 3 to 5 (5 to 7 dry), and chroma of 2 or less. It is loam or silt loam. The B horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 or 2. It is clay loam or silty clay loam. The C horizon is dominantly clay loam glacial till, but the range includes loamy alluvium.

Vebar series

The Vebar series consists of moderately deep, well drained, moderately rapidly permeable soils on residual uplands. These soils formed in material weathered from residuum of soft sandstone. Slope ranges from 3 to 15 percent.

Vebar soils are similar to Cohagen soils and are commonly adjacent to Arnegard, Cohagen, and Lefor soils and Rock outcrop. Arnegard soils have a mollic epipedon that is more than 16 inches thick, have a fine-loamy control section, and do not have soft sandstone within a depth of 60 inches. Cohagen soils lack a mollic epipedon, lack a B horizon, and have soft sandstone at a depth of 10 to 20 inches. Lefor soils have a fine-loamy argillic horizon. Rock outcrop is hard sandstone.

Typical pedon of Vebar fine sandy loam, 6 to 9 percent slopes, 45 feet north and 925 feet west of the southeast corner of SW1/4 sec. 15, T. 144 N., R. 87 W.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; neutral; clear wavy boundary.

B21—5 to 10 inches; dark brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B22—10 to 18 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

B3—18 to 24 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; common fine roots; common fine pores; neutral; gradual wavy boundary.

C1—24 to 34 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few fine roots; few fine pores; strong effervescence; common large soft lime masses; mildly alkaline; gradual wavy boundary.

Cr1—34 to 40 inches; pale yellow (2.5Y 7/4) soft sandstone, light yellowish brown (2.5Y 6/4) moist; massive; slightly hard and brittle; few fine roots; strong effervescence; common large lime masses; diffuse wavy boundary.

Cr2—40 to 60 inches; pale yellow (2.5Y 7/4) soft sandstone, light yellowish brown (2.5Y 6/4) moist; massive; slightly hard and brittle; slight effervescence; few medium soft lime masses; moderately alkaline.

The thickness of the solum ranges from 20 to 35 inches. Depth to free carbonates is 20 to 30 inches. Depth to soft sandstone ranges from 20 to 40 inches. The mollic epipedon is 7 to 16 inches thick.

The A1 horizon has color value of 3 or 4 (2 or 3 moist) and chroma of 2 or 3. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. The Cr horizon is massive or platy, soft sandstone that crushes to fine sandy loam or loamy fine sand. Some pedons have thin ledges of hard sandstone.

Velva series

The Velva series consists of deep, well drained, moderately rapidly permeable soils on bottom land and terraces. These soils formed in material weathered from loamy alluvium. Slope ranges from 1 to 6 percent.

Velva soils are similar to Parshall soils and are commonly adjacent to Magnus, Parshall, Shambo, and Straw soils. Magnus soils have a mollic epipedon that is more than 16 inches thick and have a fine-textured control section. Parshall soils regularly decrease in content of organic matter with increasing depth and have a mollic epipedon that is more than 16 inches thick. They are on the higher terraces adjacent to Velva soils. Shambo soils regularly decrease in content of organic matter with increasing depth and have a fine-loamy control section. They are on the higher terraces adjacent to Velva soils. Straw soils have a mollic epipedon that is more than 16 inches thick and have a fine-loamy control section.

Typical pedon of Velva fine sandy loam, 1 to 6 percent slopes, 1,090 feet west and 90 feet north of the southeast corner of sec. 13, T. 144 N., R. 87 W.

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; many fine pores; neutral; abrupt smooth boundary.

C1—6 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak very coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many fine pores; mildly alkaline; abrupt smooth boundary.

A1b—12 to 13 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many fine pores; slight effervescence; mildly alkaline; clear smooth boundary.

C2—13 to 15 inches; grayish brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common roots; common fine pores; strong effervescence; mildly alkaline; clear smooth boundary.

C3—15 to 36 inches; grayish brown (2.5Y 5/2) fine sandy loam with strata of loam and loamy fine sand less than 1 inch thick, dark grayish brown (2.5Y 4/2) moist; weak very coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common roots; common fine pores; strong effervescence; mildly alkaline; clear smooth boundary.

C4—36 to 52 inches; grayish brown (2.5Y 5/2) loamy fine sand, very dark grayish brown (2.5Y 3/2) moist; single grained; few roots; strong effervescence; moderately alkaline; clear smooth boundary.

C5—52 to 60 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky, and slightly plastic; few roots; few pores; strong effervescence; moderately alkaline.

The mollic epipedon is 7 to 16 inches thick. Depth to free carbonates is dominantly 10 to 20 inches, but some pedons contain free carbonates throughout. Most pedons contain one or more buried A horizons.

The A horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 or 3 moist). It is dominantly fine sandy loam, but the range includes loam. Some pedons have a B2 horizon. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (3 to 5 moist), and chroma of 2 to 4. Some pedons have a Cca horizon.

Wabek series

The Wabek series consists of deep, excessively drained soils on outwash plains and terraces. These soils are moderately rapidly permeable in the upper part and very rapidly permeable in the lower part. They formed in material weathered from loamy sediments that are shallow or very shallow over sand and gravel. Slope ranges from 3 to 25 percent.

Wabek soils are commonly adjacent to Bowdle, Williams, and Zahl soils. Bowdle soils have a mollic epipedon that is more than 16 inches thick and have sand and gravel at a depth of 20 to 40 inches. Williams soils have an argillic horizon and formed in loamy glacial till. Zahl soils also formed in loamy glacial till.

Typical pedon of Wabek gravelly sandy loam, in an area of Wabek soils, 3 to 25 percent slopes, 40 feet east and 75 feet south of the northwest corner of SW1/4 sec. 34, T. 144 N., R. 87 W.

A1—0 to 7 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; many fine roots, matted in the upper 1 inch; many fine pores; slight effervescence in the lower part; mildly alkaline; gradual wavy boundary.

IIC1ca—7 to 13 inches; grayish brown (10YR 5/2) gravelly loamy coarse sand, dark grayish brown (10YR 4/2) moist; single grained; loose, nonsticky and nonplastic; many fine roots in the upper part; strong effervescence; lime coatings on undersides of pebbles; mildly alkaline; diffuse wavy boundary.

IIIC2—13 to 60 inches; light brownish gray (10YR 6/2) stratified sand and gravel, grayish brown (10YR 5/2) moist; single grained; loose, nonsticky and nonplastic; few roots to a depth of 20 inches; strong effervescence in the upper part and slight effervescence in the lower part; mildly alkaline.

Depth to sand and gravel is 7 to 14 inches. Depth to free carbonates is 4 to 9 inches. The A1 horizon has color value of 4 or 5 (2 or 3 moist). It is gravelly sandy loam, sandy loam, gravelly loamy sand, loamy sand, gravelly loam, or loam.

Wayden series

The Wayden series consists of shallow, excessively drained, slowly permeable soils on residual uplands. These soils formed in material weathered from soft alkaline shale. Slope ranges from 9 to 15 percent.

Wayden soils are similar to Cabba soils and are commonly adjacent to Cabba, Moreau, and Regent soils. Cabba soils have a loamy control section. Moreau and Regent soils have a mollic epipedon that is 7 to 16 inches thick and have soft shale at a depth of 20 to 40 inches. Also, Regent soils have an argillic horizon.

Typical pedon of Wayden silty clay, in an area of Wayden-Moreau silty clays, 9 to 15 percent slopes, 950 feet west and 700 feet south of the center of sec. 26, T. 146 N., R. 88 W.

A1—0 to 3 inches; grayish brown (2.5Y 5/2) and pale olive (5Y 6/3) silty clay, very dark grayish brown (2.5Y 3/2) and olive (5Y 5/3) moist; moderate fine and very fine angular blocky structure; hard, firm, sticky and plastic; many fine and common medium roots; many fine and common medium pores; slight effervescence; 1 percent coarse fragments; mildly alkaline; clear wavy boundary.

C1—3 to 7 inches; pale olive (5Y 6/3) silty clay, olive (5Y 5/3) moist; moderate medium subangular blocky structure parting to moderate fine and very fine angular blocky; very hard, firm, very sticky and very plastic; many fine and common medium roots; many fine and common medium pores; slight effervescence; moderately alkaline; gradual wavy boundary.

C2—7 to 12 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; weak coarse subangular blocky structure parting to moderate fine and very fine angular blocky; very hard, firm, very sticky and very plastic; many fine roots; many fine pores; strong effervescence; few fine gypsum crystals; few soft weathered shale fragments; moderately alkaline; gradual wavy boundary.

Cr—12 to 60 inches; light gray (5Y 6/1 and 5Y 7/2) soft shale, gray (5Y 5/1) and olive gray (5Y 5/2) moist; platy rock structure; very hard and brittle, firm, very sticky and very plastic; common fine roots to a depth of 28 inches along rock fractures; strong effervescence; common fine soft lime masses in the upper part; common fine gypsum crystals; common fine and medium yellowish brown (10YR 5/6) iron stains; strongly alkaline.

Depth to soft shale is 10 to 20 inches. The C and Cr horizons contain few to many gypsum crystals.

The A1 horizon has color value of 5 and 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly silty clay, but the range includes silty clay loam and clay. The C horizon has hue of 2.5Y or 5Y, value of 5 to 8 (4 to 6 moist), and chroma of 1 to 4. The Cr horizon is soft, massive or platy shale that crushes to silty clay or clay.

Werner series

The Werner series consists of shallow, well drained, moderately permeable soils on residual uplands. These soils formed in material weathered from soft, fine grained sandstone. Slope ranges from 6 to 15 percent.

Werner soils are similar to Cabba soils and are commonly adjacent to Amor, Cabba, and Sen soils. Amor soils have a B horizon and have soft sandstone at a depth of 20 to 40 inches. Cabba soils lack a mollic epipedon. Sen soils have a B horizon and have soft bedrock at a depth of 20 to 40 inches.

Typical pedon of Werner loam, in an area of Amor-Werner loams, 9 to 15 percent slopes, 665 feet south and 240 feet east of the northwest corner of sec. 24, T. 142 N., R. 88 W.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and few medium pores; mildly alkaline; abrupt wavy boundary.

AC—8 to 12 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; strong effervescence; common fine soft lime masses; moderately alkaline; gradual wavy boundary.

C1ca—12 to 17 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic and subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; violent effervescence; many fine and medium soft lime masses; moderately alkaline; clear wavy boundary.

Cr1—17 to 28 inches; light olive gray (5Y 6/2) soft sandstone, olive gray (5Y 5/2) moist; platy rock structure; hard and brittle, firm, slightly sticky and slightly plastic; few fine roots along rock fractures; strong effervescence; few fine soft lime masses; moderately alkaline; gradual wavy boundary.

Cr2—28 to 60 inches; light olive gray (5Y 6/2) soft sandstone, olive gray (5Y 5/2) moist; platy structure; hard and brittle, firm, slightly sticky and slightly plastic; few fine roots along rock fractures in the upper part; strong effervescence; few fine and medium dark reddish brown (5YR 3/3 moist) iron stains; moderately alkaline.

Depth to soft sandstone is 10 to 20 inches. The mollic epipedon is 7 to 16 inches thick. Depth to free carbonates is 5 to 15 inches.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam. The AC horizon has hue of 10YR or 2.5Y. It is dominantly loam, but the range includes silt loam. The C1ca horizon is dominantly loam, but the range includes silt loam. Some pedons lack a C1ca horizon. The Cr horizon is dominantly soft sandstone, but the range includes silty and clayey soft bedrock.

Williams series

The Williams series consists of deep, well drained soils on glaciated uplands. These soils formed in material weathered from calcareous loamy glacial till. Permeability is moderate in the upper part and moderately slow in the lower part. Slope ranges from 1 to 15 percent.

Williams soils are similar to Bowbells soils and are commonly adjacent to Bowbells, Flaxton, Noonan, Temvik, and Zahl soils. Bowbells and Flaxton soils have a mollic epipedon that is more than 16 inches thick. Also, Flaxton soils formed in fine sandy loam deposits and the underlying glacial till. Noonan soils have a natric horizon. Temvik and Zahl soils lack an argillic horizon. Also, Temvik soils formed in silty loess deposits over glacial till.

Typical pedon of Williams loam, 1 to 3 percent slopes, 105 feet north and 340 feet west of the southeast corner of SW1/4 sec. 23, T. 145 N., R. 86 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to moderate fine granular; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; 1 percent pebbles; neutral; abrupt smooth boundary.

B21t—7 to 11 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to strong medium and fine angular blocky; very hard, friable, sticky and plastic; many roots; many fine pores; few pebbles; many thin clay films on faces of peds; 2 percent pebbles; neutral; gradual wavy boundary.

B22t—11 to 18 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to strong medium subangular blocky; hard, friable, sticky and plastic; many roots; few large and common fine pores; many thin clay films on faces of peds; 2 percent pebbles; mildly alkaline; clear wavy boundary.

B3ca—18 to 26 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable, slightly sticky and plastic; few roots; common fine pores; strong effervescence; 2 percent pebbles; moderately alkaline; clear wavy boundary.

C1ca—26 to 30 inches; light gray (2.5Y 7/2) clay loam, light brownish gray (2.5Y 6/2) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, slightly sticky and plastic; few roots; few large and common fine pores; violent effervescence; many fine and medium soft lime masses; 2 percent pebbles; moderately alkaline; clear wavy boundary.

C2—30 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; weak medium and fine subangular blocky structure; hard, friable, sticky and plastic; few roots in the upper part; common to few pores; strong effervescence; 2 percent pebbles; common fine and medium soft lime masses; moderately alkaline.

The thickness of the solum ranges from 15 to 30 inches. Depth to free carbonates ranges from 10 to 24 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has color value of 4 or 5 (2 or 3 moist). It is dominantly loam, but the range includes fine sandy loam, silt loam, and clay loam. The B2t horizon has color value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly clay loam, but in some pedons it is loam. Some pedons do not have a B3ca horizon. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is dominantly clay loam, but in some pedons it is loam.

Wilton series

The Wilton series consists of deep, well drained soils on loess-mantled glacial till uplands. These soils formed in material weathered from loess over glacial till. Permeability is moderate in the upper part and moderately slow in the lower part. Slope ranges from 1 to 3 percent.

Wilton soils are similar to Temvik soils and are commonly adjacent to Grassna, Mandan, Temvik, and Williams soils. Grassna soils formed in alluvium derived from loess deposits and do not have glacial till at a depth of 26 to 40 inches. Mandan soils have a coarse-silty control section and do not have glacial till at a depth of 26 to 40 inches. Temvik and Williams soils have a mollic epipedon that is less than 16 inches thick. Also, Williams soils have an argillic horizon and formed in glacial till.

Typical pedon of Wilton silt loam, 1 to 3 percent slopes, 50 feet west and 270 feet north of the southeast corner of NE1/4 sec. 28, T. 147 N., R. 85 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse and medium subangular blocky structure parting to weak fine granular; hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

B2—9 to 26 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium prismatic and subangular blocky; hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; few thin clay films on faces of prisms; neutral; clear wavy boundary.

IIB3ca—26 to 31 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, friable, sticky and plastic; common fine roots; many fine pores; strong effervescence; common fine and medium soft lime masses; 1 percent pebbles; very dark grayish brown (10YR 3/2 moist) coatings on faces of prisms; mildly alkaline; gradual wavy boundary.

IIC1ca—31 to 42 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, sticky and plastic; few fine roots; many fine pores; violent effervescence; many medium and large soft lime masses; 2 percent pebbles; moderately alkaline; gradual wavy boundary.

IIC2ca—42 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; few fine roots in the upper part; common fine pores; strong effervescence; common fine and medium soft lime masses; 2 percent pebbles; moderately alkaline.

Depth to free carbonates is 20 to 30 inches. The thickness of the solum ranges from 20 to 36 inches. The thickness of the mollic epipedon ranges from 16 to 30 inches. Depth to the underlying glacial till ranges from 26 to 40 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist). The B2 horizon has hue of 10YR or 2.5Y and value of 4 or 5 (3 or 4 moist). Some pedons lack a IIB3ca horizon, and some have a silt loam B3 horizon. The IIC horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is dominantly clay loam glacial till, but the range includes loam glacial till.

Zahl series

The Zahl series consists of deep, well drained, moderately slowly permeable soils on glaciated uplands. These soils formed in material weathered from calcareous loamy glacial till. Slope ranges from 3 to 35 percent.

Zahl soils are similar to Werner soils and are commonly adjacent to Bowbells and Williams soils. Bowbells soils have a mollic epipedon that is more than 16 inches thick and have an argillic horizon. Werner soils have soft bedrock at a depth of 10 to 20 inches. Williams soils have an argillic horizon.

Typical pedon of Zahl loam, in an area of Zahl-Williams loams, 9 to 15 percent slopes, 120 feet west and 420 feet south of the northeast corner of NW1/4 sec. 5, T. 144 N., R. 86 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine and medium pores; slight effervescence; 2 percent pebbles; mildly alkaline; clear wavy boundary.

C1ca—5 to 23 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; very weak coarse prismatic structure parting to moderate medium and fine subangular blocky; very hard, friable, slightly sticky and plastic; common fine roots; many fine and common medium pores; violent effervescence; many medium soft lime masses; 2 percent pebbles; few fine dark red (10YR 3/6 moist) iron stains; moderately alkaline; gradual wavy boundary.

C2—23 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; weak medium and fine subangular blocky structure; hard, friable, sticky and plastic; common fine and common medium pores; strong effervescence; common fine soft lime masses; 2 percent pebbles; few fine dark red (10YR 3/6 moist) iron stains; moderately alkaline.

The thickness of the mollic epipedon ranges from 5 to 16 inches. The soils typically contain free carbonates throughout, but some pedons have no free carbonates within a depth of 8 inches.

The A horizon has color value of 3 or 4 (2 or 3 moist). It is dominantly loam, but the range includes gravelly loam and clay loam. Some pedons have an AC horizon. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4 moist. It is dominantly clay loam, but the range includes loam. Some pedons have soft bedrock below a depth of 40 inches.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*8*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 17, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cold, 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 expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haploborolls (*Hapl*, meaning simple horizons, plus *boroll*, the suborder of Mollisols that have a mean annual soil temperature of less than 47 degrees F).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceeding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed Typic Haploborolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Formation of the soils

This section relates the factors of soil formation to the formation of soils in the survey area.

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. Soil characteristics are determined by (1) the physical traits and chemical and mineralogical composition of the parent material; (2) the climate under which the soil formed and has existed since soil formation; (3) the plant and animal life on and in the soil; (4) the relief; and (5) the length of time that the processes of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are very influential factors of soil formation. They determine the nature of weathering and slowly change the parent material into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by the relief and the parent material. Finally, time is needed in order for the climatic and biological forces to weather the parent material and form a soil. 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 processes of soil formation are still unknown.

Parent material

The texture of the parent material is one of the most important physical properties of the parent material; it determines the texture of most soils. Other properties of the parent material can also be important. For example, soils containing excess sodium salts generally formed in parent material also containing excess sodium salts.

The parent material of soils in Mercer County has several different origins. The most extensive parent material is glacial till and other glacial material. All areas of the county but some high areas were glaciated. Most of the glacial till in the southwestern part, however, has been removed by erosion. Most of the glacial till throughout the county was deposited during the Wisconsin ice age, but some was probably deposited during an older ice age. Williams, Bowbells, and Zahl soils are examples of soils that formed in glacial till.

In some areas glacial till was sorted by wind or water. Soils that formed in material weathered from water-sorted glacial till are the poorly drained and very poorly drained Tonka and Parnell soils in small depressions and potholes, the Makoti soils on glacial lake plains, and the Bowdle and Wabek soils in outwash areas. Loess deposits, or wind-laid silty material, are thickest and most extensive along the shores of Lake Sakakawea and the banks of the Missouri River. Mandan, Temvik, and Wilton soils formed in loess or loess overlying glacial till. Grassna soils formed in alluvium derived from loess deposits.

Along the Knife River, especially south of the river, is a large area of wind- or water-deposited sandy and loamy material. This material was deposited by the glacial melt water flowing through the valley of the Knife River. The material was reworked by wind following deposition by melt water. Seroco, Lihen, Telfer, Krem, Flaxton, and Parshall soils formed in this material.

The parent material of the soils on flood plains and terraces is alluvium deposited by flood water of streams. These soils are stratified with diverse material, and the ones subject to flooding commonly have an old buried surface layer. Straw, Velva, and Magnus soils are common in these areas. On the bottom land along the Missouri River are soils that are light colored because they were frequently flooded before the Garrison Dam was closed. Havrelon, Banks, and Lohler soils are on this bottom land. The soils on terraces, for example, Savage, Grail, Shambo, and Belfield soils, generally are older and have more fully developed profiles than those on the flood plains. Belfield soils formed in material containing excess sodium.

Many soils formed in material weathered from soft residual bedrock. The Fort Union Formation of the Tertiary period is the oldest geological formation to crop out in the survey area. Only the upper members of the Fort Union Formation, that is, Sentinel Butte and Tongue River, are evident. The parent material of Amor, Regent, Rhoades, Cabba, Vebar, Cohagen, and Sen soils is of the Fort Union Formation. The Golden Valley Formation, also of the Tertiary period, is evident in scattered areas throughout the western part of the county. It is a younger formation than the Fort Union beds and is at a higher elevation. Lefor, Vebar, and Cohagen soils are the most dominant soils in areas of this formation. The Golden Valley Formation has a fair percentage of kaolinitic clays.

In a few areas the soils formed in material weathered from porcelanite (scoria). Porcelanite was formed by the burning lignite veins in the Fort Union and Golden Valley Formations. The heat melted and baked the surrounding material. Searing and Ringling soils formed in material weathered from porcelanite.

Climate

Climate is perhaps the most influential factor in soil formation. The physical and chemical processes of weathering in the parent material, as well as biological activity, are influenced by climate. The processes of soil formation are most active if the climate is warm and moist. Climate influences these processes to a large extent through the effect that it has on vegetation.

Mercer County has a continental, semiarid climate characterized by long, cold winters and short, warm summers. Most of the precipitation falls during the growing season. This type of climate favors the growth of mid and short grasses.

Moisture and temperature directly affect the weathering processes in the parent material. They also affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil profile. Freezing and thawing help to break down the parent material, thereby providing more surface area for chemical processes. The cold and semiarid climate prevents deep leaching and extensive chemical weathering. In this survey area it prevents large yields of vegetation, but it allows a slow rate of plant decay, thus enabling organic matter to accumulate in the soil.

Plant and animal life

Plants have significantly influenced the formation of soils in this county. Earthworms, small animals, and micro-organisms are also important but to a lesser extent.

The native vegetation consisted mostly of mid and short grasses. Plant roots act, both physically and chemically, as agents in weathering the parent material. The plants provide a medium whereby nutrients that have been leached into the lower part of soil are brought back to the surface. Animal life and micro-organisms break down the dead plant tissues into humus, thus releasing nutrients for plants.

Relief

Relief, or the lay of the land, influences soil formation chiefly by controlling the movement of water. The effects of relief are modified by the other four factors of soil formation, especially climate and vegetation.

The profile of soils formed in depressions differs from that of soils formed in steep areas. Soils having gentle slopes generally support a more luxuriant plant cover than soils having steeper slopes. The steeper soils in this survey area generally have sparse vegetation, have lime close to the surface, are low in content of organic matter, and have minimally developed profiles. Cabba and Cohagen soils are examples.

Time

The formation of a soil is a very slow process. Much time is required for the processes of soil formation to act on the parent material and to form distinct horizons within the soil profile.

More time has been available for the formation of Bowbells soils on glacial till plains than for the formation of Havrelon soils on bottom land along the Missouri River. Whereas the forces of soil formation have been continually acting on the parent material of Bowbells soils, Havrelon soils are frequently flooded and receive new material during each flood. As a result, Bowbells soils have well defined horizons and a high content of organic matter and Havrelon soils lack distinct horizons and have a low content of organic matter.

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Glossary

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.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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	More than 9

Badland. Steep or very steep, commonly nonstony barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Channery soil. A soil, that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

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.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

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.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

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.

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 (or contour farming). 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 40 or 80 inches (1 or 2 meters).

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. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

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 frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by running 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 a bare surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Excess sodium. Excess exchangeable sodium. The resulting poor physical properties restrict the growth of plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

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.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather 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. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered 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. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the assorted and unassorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

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 from 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 (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, which is the upper limit of saturation.

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.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming 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.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks 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 from which the solum is presumed to have 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.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

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.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at 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.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

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. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

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 single 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.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

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. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the 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 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in 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 a semisolid to a plastic state.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree 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.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

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.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

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.

Slow intake. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

Soil. A natural, three-dimensional body at the earth's surface that 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 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature 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 other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

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 that are separated from adjoining 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 grained* (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, to provide protection from soil blowing 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 solum 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.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface soil. 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 or management.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

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 it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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, silt loam, 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."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within 1 year; specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by melt water streams, in a glacial lake or other body of still water in front of a glacier.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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.

Illustrations

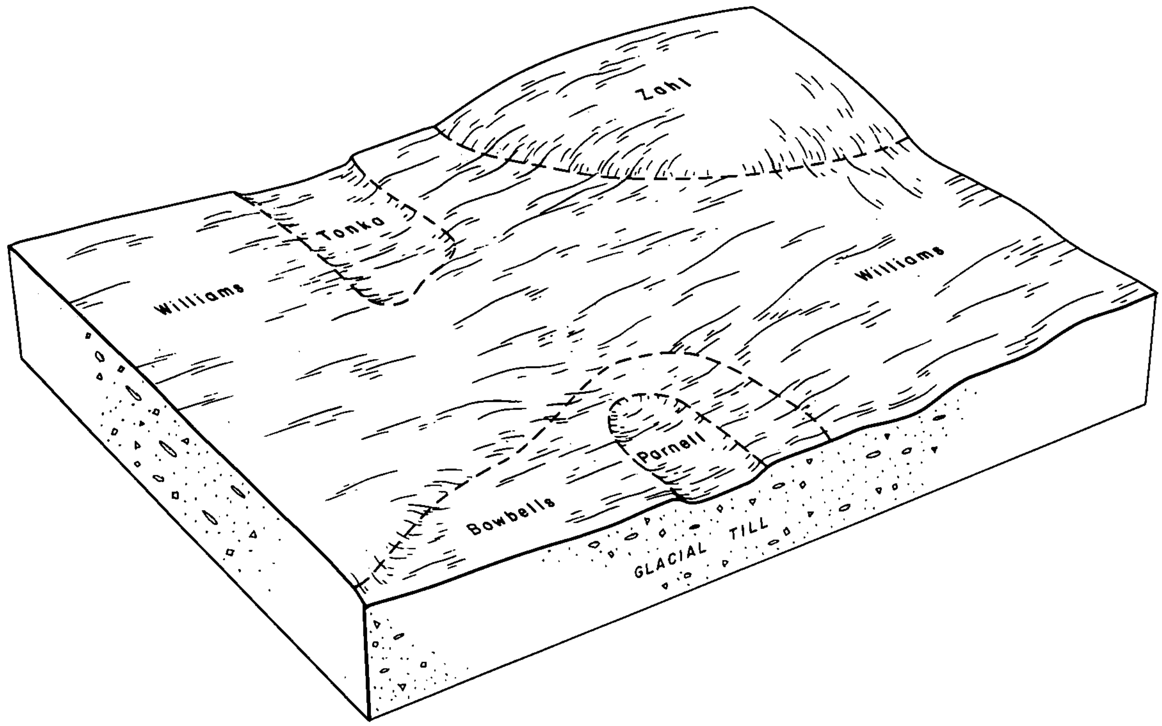

Figure 1.—Typical pattern of soils and underlying material in the Williams-Zahl map unit.

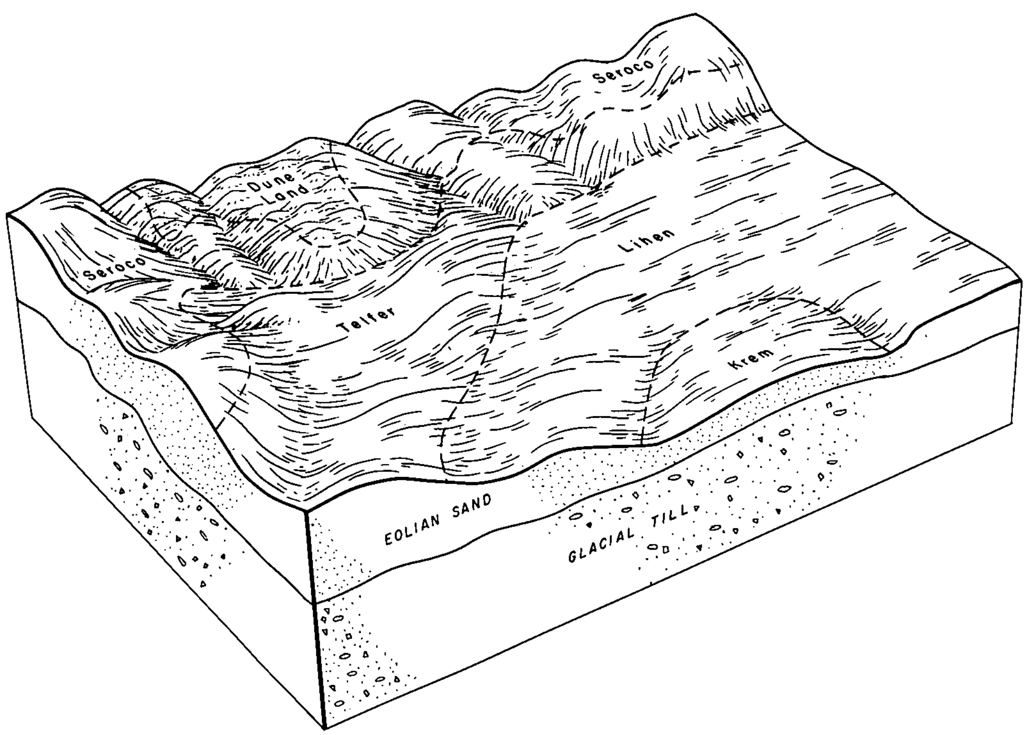

Figure 2.—Typical pattern of soils and underlying material in the Lihen-Seroco-Telfer map unit.

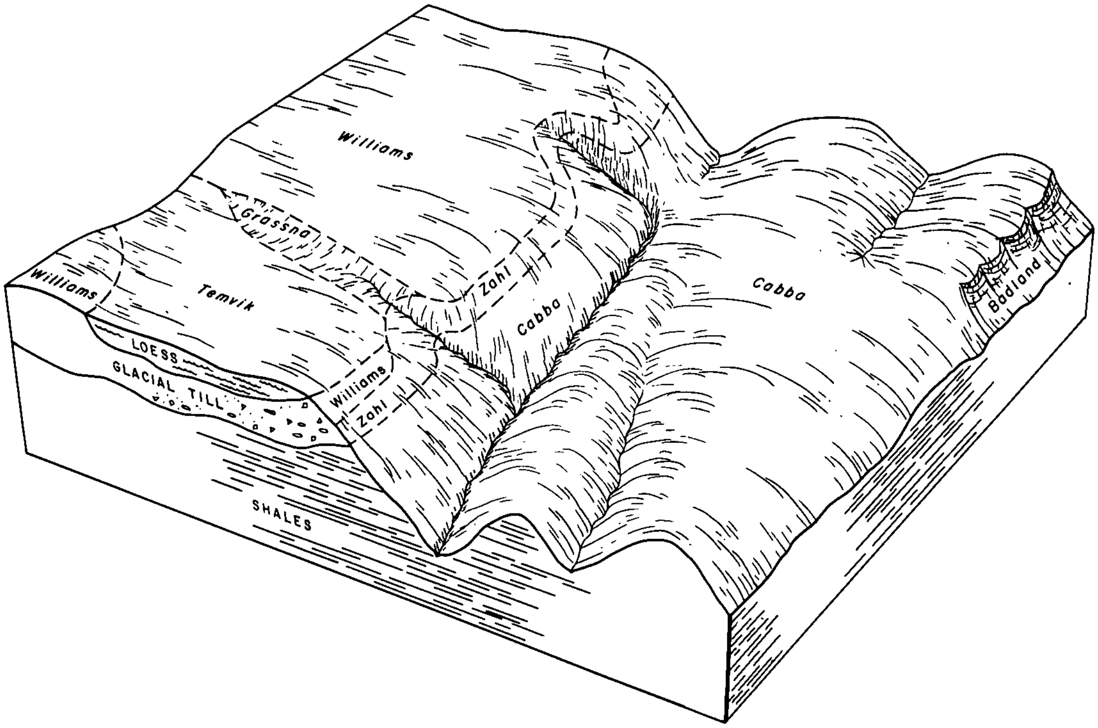

Figure 3.—Typical pattern of soils and underlying material in the Cabba-Williams-Temvik map unit.

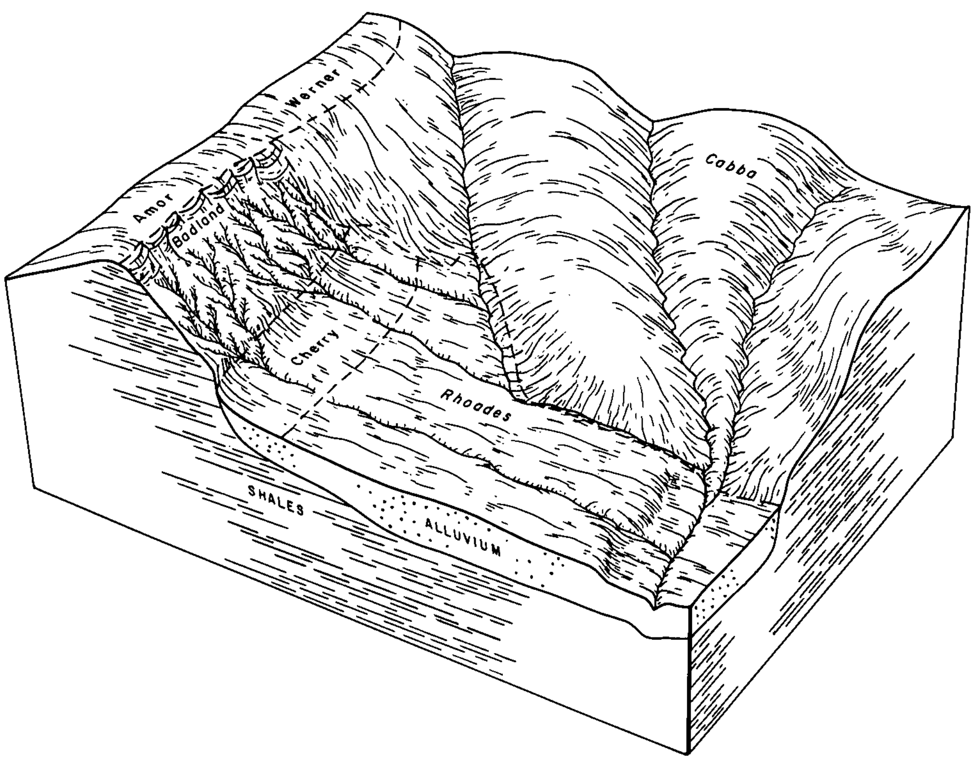

Figure 4.—Typical pattern of soils and underlying material in the Cabba-Rhoades map unit.

Figure 5.—Dune land in an area of Seroco-Dune land complex, 3 to 25 percent slopes. A dark buried surface layer is in the foreground.

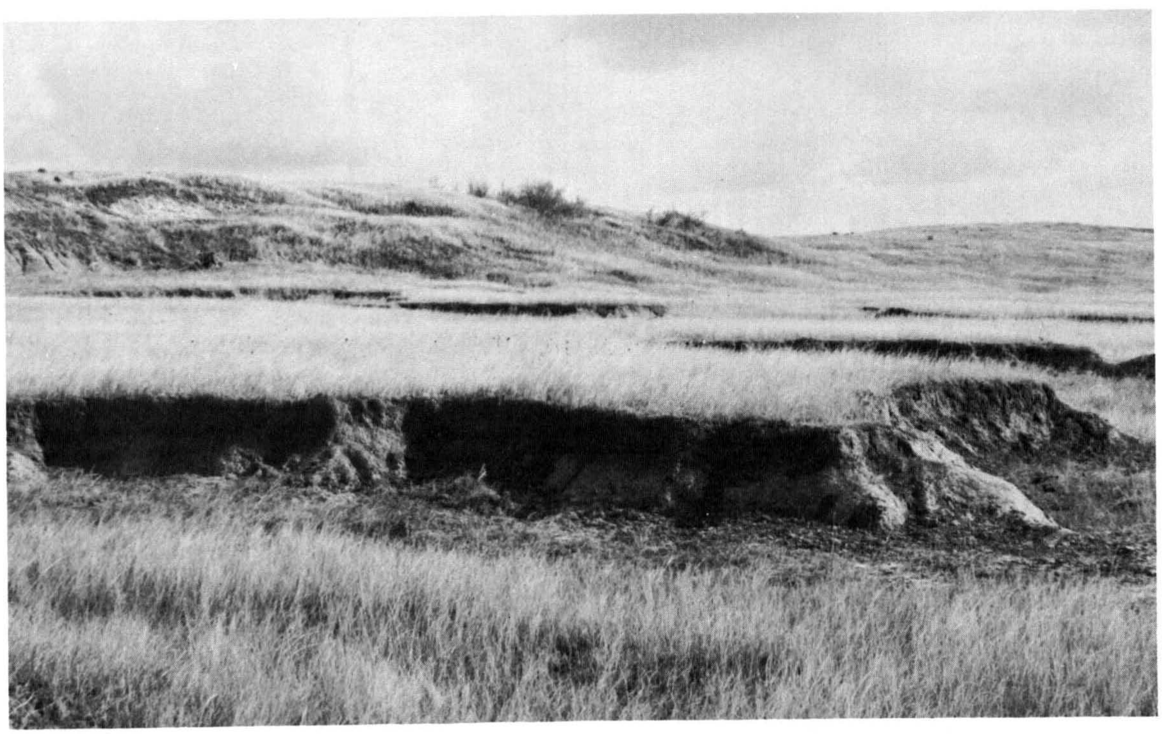

Figure 6.—Rangeland on Cherry silty clay loam, gullied, 3 to 9 percent slopes. The bare, eroded areas are gullied.

Figure 7.—Profile of Searing loam, 1 to 6 percent slopes. Fractured porcelanite beds are at a depth of about 28 inches.

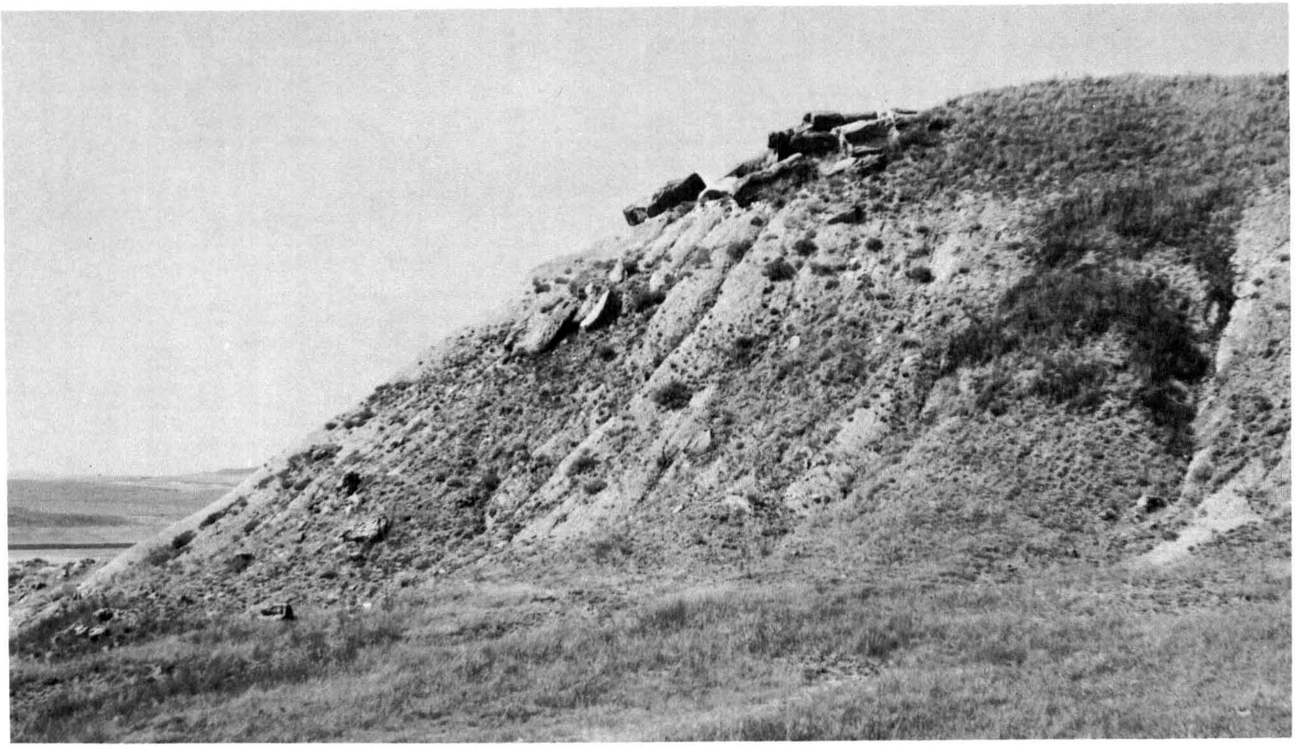

Figure 8.—An area of Cabba-Badland complex, 15 to 50 percent slopes. The Badland is sparsely vegetated. The vegetated area on top of the hill is Cabba soils.

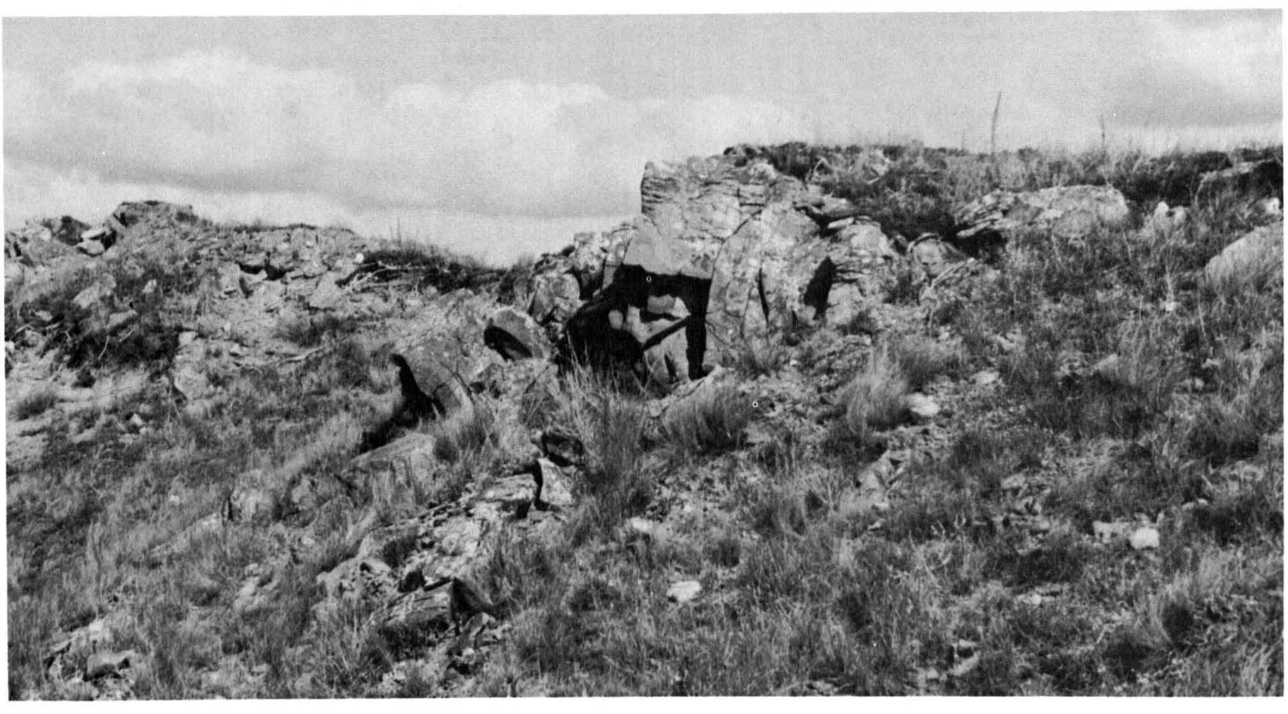

Figure 9.—Rock outcrop on a ridgetop in an area of Cohagen-Vebar-Rock outcrop complex, 9 to 50 percent slopes. The vegetated area is Cohagen soils.

Figure 10.—Rangeland on Rhoades-Daglum complex, 1 to 9 percent slopes. The Rhoades soil is sparsely vegetated. Areas with better vegetation are mostly Daglum soil.

Figure 11.—An area of Ustorthents. The topography is affected by stripmining for lignite coal.

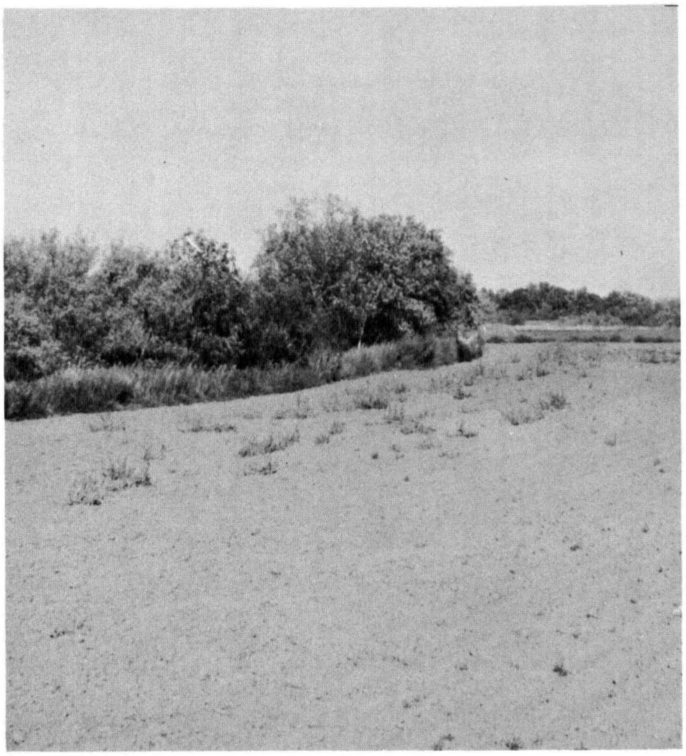

Figure 12.—A cultivated area of Straw loam, 0 to 3 percent slopes. The trees are along the Knife River.

Figure 13.—Fractured porcelanite beds about 15 inches from the surface of the Ringling soil in Ringling-Cabba complex, 9 to 35 percent slopes.

Figure 14.—Red-tailed hawk, a valuable predator of rodents. These hawks commonly inhabit the survey area in summer.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

Month	Temperature[1]						Precipitation[1]				
	Average daily maximum	Average daily minimum	Average	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[2]	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----	18.8	-3.7	7.6	48	-37	0	.36	.11	.55	1	4.5
February---	24.7	1.2	13.0	52	-31	0	.32	.07	.51	1	4.2
March------	37.3	14.6	26.0	73	-23	63	.41	.13	.62	1	4.2
April------	53.6	28.3	41.0	85	9	124	1.72	.52	2.67	4	3.5
May--------	67.6	39.7	53.7	94	21	425	2.72	1.28	3.90	6	.5
June-------	77.0	49.9	63.5	97	34	705	3.35	1.79	4.61	7	.0
July-------	84.2	54.3	69.2	101	41	905	2.79	1.07	4.16	5	.0
August-----	84.5	52.5	68.5	104	37	884	1.65	.51	2.55	3	.0
September--	71.0	40.6	55.8	98	21	474	1.27	.48	1.90	3	.2
October----	60.4	31.0	45.7	89	13	230	.65	.13	1.05	2	.5
November---	38.9	16.5	27.7	69	-12	34	.57	.12	.92	2	4.6
December---	25.8	4.2	15.0	56	-31	17	.32	.12	.48	1	4.8
Year-----	53.7	27.4	40.6	104	-39	3,861	16.13	12.80	19.29	36	27.0

[1] Recorded in the period 1955-74 at Beulah, N. Dak.

[2] 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 (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 16	May 31	June 4
2 years in 10 later than--	May 11	May 24	May 31
5 years in 10 later than--	May 1	May 12	May 23
First freezing temperature in fall:			
1 year in 10 earlier than--	September 17	September 7	September 2
2 years in 10 earlier than--	September 23	September 13	September 6
5 years in 10 earlier than--	October 5	September 23	September 16

[1]Recorded in the period 1955-74 at Beulah, N. Dak.

TABLE 3.--GROWING SEASON LENGTH

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	134	117	99
8 years in 10	142	122	104
5 years in 10	156	134	115
2 years in 10	170	145	126
1 year in 10	178	151	131

[1]Recorded in the period 1955-74 at Beulah, N. Dak.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Parnell silt loam	1,170	0.2
2	Tonka silt loam	900	0.1
3D	Seroco-Telfer loamy fine sands, 1 to 15 percent slopes	7,700	1.2
3E	Seroco-Dune land complex, 3 to 25 percent slopes	880	0.1
5	Dimmick silty clay	1,140	0.2
7	Straw silty clay loam	3,350	0.5
8	Grail silty clay loam, 1 to 3 percent slopes	3,650	0.5
8B	Grail silty clay loam, 3 to 6 percent slopes	2,680	0.4
8C	Grail silty clay loam, 6 to 9 percent slopes	420	0.1
9B	Regent silty clay loam, 3 to 6 percent slopes	960	0.1
9C	Regent silty clay loam, 6 to 9 percent slopes	720	0.1
10	Savage silty clay loam, 1 to 3 percent slopes	1,680	0.3
11C	Cherry silty clay loam, gullied, 3 to 9 percent slopes	2,190	0.3
14	Havrelon silty clay loam	2,660	0.4
15	Lawther silty clay, 1 to 3 percent slopes	1,970	0.3
17	Heil silty clay loam	690	0.1
20	Lohler silty clay	940	0.1
21B	Lihen loamy fine sand, 1 to 6 percent slopes	10,040	1.5
21D	Telfer loamy fine sand, 6 to 15 percent slopes	4,770	0.7
22B	Krem loamy fine sand, 1 to 6 percent slopes	4,050	0.6
22D	Krem loamy fine sand, 6 to 15 percent slopes	2,360	0.4
27	Mandan silt loam, 1 to 3 percent slopes	3,940	0.6
27B	Mandan silt loam, 3 to 6 percent slopes	1,660	0.2
28	Wilton silt loam, 1 to 3 percent slopes	6,630	1.0
28B	Temvik-Williams silt loams, 3 to 6 percent slopes	18,160	2.7
28C	Temvik-Williams silt loams, 6 to 9 percent slopes	2,380	0.4
35C	Amor-Werner loams, 6 to 9 percent slopes	10,470	1.6
35D	Amor-Werner loams, 9 to 15 percent slopes	5,040	0.8
36	Williams loam, 1 to 3 percent slopes	5,670	0.9
36B	Williams loam, 3 to 6 percent slopes	72,890	10.9
36C	Williams loam, 6 to 9 percent slopes	27,620	4.1
38C	Williams-Zahl loams, 6 to 9 percent slopes	17,150	2.6
38D	Zahl-Williams loams, 9 to 15 percent slopes	21,980	3.3
38E	Zahl loam, 15 to 35 percent slopes	6,540	1.0
40	Shambo loam, 1 to 3 percent slopes	3,150	0.5
40B	Shambo loam, 3 to 6 percent slopes	1,150	0.2
41B	Parshall loam, 1 to 6 percent slopes	2,260	0.3
43	Colvin silt loam	570	0.1
44	Arnegard loam, 1 to 3 percent slopes	8,280	1.2
44B	Arnegard loam, 3 to 6 percent slopes	7,670	1.2
44C	Arnegard loam, 6 to 9 percent slopes	440	0.1
47	Havrelon loam	2,490	0.4
51	Straw silt loam	7,560	1.1
53	Banks loam	300	(*)
54B	Lihen fine sandy loam, 1 to 6 percent slopes	2,930	0.4
55B	Vebar fine sandy loam, 3 to 6 percent slopes	1,230	0.2
55C	Vebar fine sandy loam, 6 to 9 percent slopes	2,740	0.4
56B	Lefor fine sandy loam, 1 to 6 percent slopes	2,520	0.4
56D	Lefor fine sandy loam, 6 to 12 percent slopes	1,960	0.3
57B	Flaxton fine sandy loam, 1 to 6 percent slopes	13,100	2.0
57C	Flaxton fine sandy loam, 6 to 9 percent slopes	900	0.1
58B	Flaxton-Williams complex, 3 to 6 percent slopes	10,900	1.6
58C	Flaxton-Williams complex, 6 to 9 percent slopes	5,900	0.9
58D	Flaxton-Williams complex, 9 to 15 percent slopes	1,990	0.3
59B	Parshall fine sandy loam, 1 to 6 percent slopes	6,410	1.0
62B	Velva fine sandy loam, 1 to 6 percent slopes	4,060	0.6
67	Straw soils, channeled	12,360	1.9
71B	Searing loam, 1 to 6 percent slopes	1,270	0.2
71C	Searing-Ringling loams, 6 to 9 percent slopes	790	0.1
73	Belfield silt loam, 1 to 3 percent slopes	8,260	1.2
74B	Regent-Rhoades complex, 1 to 6 percent slopes	6,370	1.0
74C	Regent-Rhoades complex, 6 to 9 percent slopes	2,860	0.4
75	Belfield-Daglum silt loams, 1 to 3 percent slopes	6,910	1.0
75B	Belfield-Daglum silt loams, 3 to 6 percent slopes	11,230	1.7
75C	Belfield-Daglum silt loams, 6 to 9 percent slopes	1,880	0.3
76B	Sen-Rhoades complex, 3 to 6 percent slopes	1,030	0.2
76C	Sen-Rhoades complex, 6 to 9 percent slopes	780	0.1
77	Bowdle loam, 1 to 3 percent slopes	2,020	0.3
77B	Bowdle loam, 3 to 6 percent slopes	2,440	0.4
77C	Bowdle-Wabek complex, 6 to 9 percent slopes	480	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
78B	Noonan-Flaxton fine sandy loams, 1 to 6 percent slopes	4,120	0.6
79B	Moreau silty clay, 3 to 6 percent slopes	2,510	0.4
79C	Moreau silty clay, 6 to 9 percent slopes	3,830	0.6
79D	Wayden-Moreau silty clays, 9 to 15 percent slopes	4,790	0.7
81D	Cabba loam, 9 to 15 percent slopes	20,900	3.1
81E	Cabba loam, 15 to 35 percent slopes	66,370	10.0
82E	Cabba-Badland complex, 15 to 50 percent slopes	14,100	2.1
83C	Vebar-Cohagen fine sandy loams, 3 to 9 percent slopes	3,950	0.6
83E	Cohagen-Vebar fine sandy loams, 9 to 35 percent slopes	28,000	4.2
84E	Cohagen-Vebar-Rock outcrop complex, 9 to 50 percent slopes	4,820	0.7
85	Harriet Variant silt loam	1,640	0.2
86E	Wabek soils, 3 to 25 percent slopes	2,090	0.3
87C	Rhoades-Daglum complex, 1 to 9 percent slopes	30,630	4.6
88	Harriet clay	2,740	0.4
89E	Ustorthents	4,710	0.7
90C	Williams loam, mine sink, 1 to 9 percent slopes	560	0.1
91	Straw loam, 0 to 3 percent slopes	10,990	1.6
91B	Straw loam, 3 to 6 percent slopes	1,480	0.2
92B	Noonan-Williams loams, 1 to 6 percent slopes	2,660	0.4
93	Falkirk loam, 1 to 3 percent slopes	1,190	0.2
94	Makoti silt loam	900	0.1
95	Flaxton-Williams loams, 1 to 3 percent slopes	1,890	0.3
96	Grassna silt loam, 1 to 3 percent slopes	1,970	0.3
96B	Grassna silt loam, 3 to 6 percent slopes	410	0.1
97B	Sen silt loam, 3 to 6 percent slopes	3,370	0.5
97C	Sen silt loam, 6 to 9 percent slopes	2,720	0.4
98E	Ringling-Cabba complex, 9 to 35 percent slopes	10,550	1.6
100B	Amor loam, 3 to 6 percent slopes	2,800	0.4
100C	Amor loam, 6 to 9 percent slopes	800	0.1
101C	Parshall fine sandy loam, 6 to 9 percent slopes	650	0.1
102	Bowbells loam, 1 to 3 percent slopes	14,650	2.2
104	Magnus silty clay loam	1,000	0.2
108	Belfield-Straw silt loams, 1 to 3 percent slopes	3,100	0.5
109B	Bowbells-Zahl loams, 3 to 6 percent slopes	2,880	0.4
110B	Belfield silt loam, 3 to 6 percent slopes	4,270	0.6
111	Pits, gravel	280	(*)
	Total	666,560	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[All yields were estimated for a high level of management in 1976. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Spring wheat	Oats	Barley	Grass-legume hay
	Bu	Bu	Bu	Ton
1----- Parnell	---	---	---	---
2*----- Tonka	26	52	44	2.0
3D----- Seroco-Telfer	---	---	---	---
3E----- Seroco-Dune land	---	---	---	---
5----- Dimmick	---	---	---	---
7----- Straw	30	60	51	2.2
8----- Grail	32	64	54	2.4
8B----- Grail	30	60	51	2.2
8C----- Grail	26	52	44	1.8
9B----- Regent	24	48	40	1.8
9C----- Regent	20	40	34	1.4
10----- Savage	27	54	46	1.9
11C----- Cherry	12	24	20	0.9
14----- Havrelon	27	54	46	1.9
15----- Lawther	28	56	47	2.0
17----- Heil	---	---	---	---
20----- Lohler	29	58	49	2.1
21B----- Lihen	13	26	22	1.0
21D----- Telfer	---	---	---	---
22B----- Krem	16	32	25	1.1
22D----- Krem	---	---	---	1.0

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Grass-legume hay
	Bu	Bu	Bu	Ton
27 Mandan	29	58	49	2.1
27B Mandan	26	52	44	1.9
28 Wilton	31	62	53	2.3
28B Temvik-Williams	27	54	46	2.0
28C Temvik-Williams	20	40	34	1.3
35C Amor-Werner	16	32	27	1.1
35D Amor-Werner	11	22	19	0.8
36 Williams	27	54	46	1.9
36B Williams	24	48	41	1.8
36C Williams	20	40	34	1.3
38C Williams-Zahl	17	35	29	1.1
38D Zahl-Williams	---	---	---	---
38E Zahl	---	---	---	---
40 Shambo	27	54	46	1.9
40B Shambo	24	48	41	1.8
41B Parshall	23	46	39	1.6
43* Colvin	23	46	39	2.0
44 Arnegard	32	64	54	2.4
44B Arnegard	30	60	51	2.2
44C Arnegard	26	52	44	1.9
47 Havrelon	27	54	46	1.9
51 Straw	32	64	54	2.4
53 Banks	11	22	19	0.8

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Grass-legume hay
	Bu	Bu	Bu	Ton
54B-----Lihen	15	30	26	1.1
55B-----Vebar	20	40	34	1.3
55C-----Vebar	18	36	31	1.2
56B-----Lefor	19	38	32	1.3
56D-----Lefor	15	30	26	1.0
57B-----Flaxton	23	46	39	1.6
57C-----Flaxton	18	37	31	1.2
58B-----Flaxton-Williams	24	48	42	1.8
58C-----Flaxton-Williams	19	38	32	1.3
58D-----Flaxton-Williams	---	---	---	---
59B-----Parshall	23	46	39	1.6
62B-----Velva	22	44	37	1.5
67-----Straw	---	---	---	---
71B-----Searing	18	36	30	1.2
71C-----Searing-Ringling	10	20	17	0.7
73-----Belfield	23	46	39	1.6
74B-----Regent-Rhoades	18	36	30	1.2
74C-----Regent-Rhoades	14	28	24	1.0
75-----Belfield-Daglum	18	37	31	1.2
75B-----Belfield-Daglum	14	28	24	1.0
75C-----Belfield-Daglum	11	22	18	0.8
76B-----Sen-Rhoades	18	36	30	1.2
76C-----Sen-Rhoades	14	28	24	1.0
77-----Bowdle	19	38	32	1.3

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Grass-legume hay
	Bu	Bu	Bu	Ton
77B Bowdle	16	32	27	1.1
77C Bowdle-Wabek	10	20	17	0.7
78B Noonan-Flaxton	15	29	25	1.0
79B Moreau	18	36	30	1.2
79C Moreau	13	26	22	1.0
79D Wayden-Moreau	---	---	---	---
81D Cabba	---	---	---	---
81E Cabba	---	---	---	---
82E Cabba-Badland	---	---	---	---
83C Vebar-Cohagen	14	28	23	1.0
83E Cohagen-Vebar	---	---	---	---
84E Cohagen-Vebar-Rock outcrop	---	---	---	---
85 Harriet Variant	---	---	---	---
86E Wabek	---	---	---	---
87C Rhoades-Daglum	---	---	---	---
88 Harriet	---	---	---	---
89E** Ustorthents	---	---	---	---
90C Williams	---	---	---	---
91 Straw	30	60	51	2.2
91B Straw	28	56	48	2.0
92B Noonan-Williams	17	33	29	1.1
93 Falkirk	30	60	51	2.2
94 Makoti	30	60	51	2.2

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Grass-legume hay
	Bu	Bu	Bu	Ton
95------------------------- Flaxton-Williams	24	48	41	1.8
96------------------------- Grassna	32	64	54	2.4
96B------------------------ Grassna	30	60	51	2.2
97B------------------------ Sen	23	47	40	1.6
97C------------------------ Sen	19	38	32	1.3
98E------------------------ Ringling-Cabba	---	---	---	---
100B----------------------- Amor	23	46	39	1.6
100C----------------------- Amor	19	38	32	1.3
101C----------------------- Parshall	18	36	31	1.2
102------------------------ Bowbells	32	64	54	2.4
104------------------------ Magnus	29	58	49	2.1
108------------------------ Belfield-Straw	24	48	41	1.8
109B----------------------- Bowbells-Zahl	24	48	41	1.8
110B----------------------- Belfield	22	44	37	1.5
111**---------------------- Pits	---	---	---	---

* Yields are for drained areas only.
** See map unit description for the composition and behavior of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Soils not listed do not support rangeland vegetation suited to grazing]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
1 Parnell	Wetland	Favorable	5,700	Prairie cordgrass	30
		Normal	5,200	Northern reedgrass	20
		Unfavorable	4,800	Reed canarygrass	20
				Slough sedge	10
				Switchgrass	5
2 Tonka	Wet Meadow	Favorable	4,000	Slim sedge	25
		Normal	3,400	Woolyfruit sedge	25
		Unfavorable	2,800	Straw sedge	5
				Baltic rush	5
				Common spikesedge	5
				Northern reedgrass	5
				Prairie cordgrass	5
3D*:					
Seroco	Thin Sands	Favorable	1,800	Prairie sandreed	25
		Normal	1,500	Needleandthread	25
		Unfavorable	1,200	Pennsylvania sedge	10
				Blue grama	7
				Sand dropseed	5
				Western wheatgrass	5
Telfer	Sands	Favorable	2,500	Needleandthread	25
		Normal	2,100	Prairie sandreed	15
		Unfavorable	1,700	Pennsylvania sedge	10
				Blue grama	8
				Western wheatgrass	5
				Sand dropseed	5
				Sand bluestem	5
				Little bluestem	5
3E*:					
Seroco	Thin Sands	Favorable	1,800	Prairie sandreed	25
		Normal	1,500	Needleandthread	25
		Unfavorable	1,200	Pennsylvania sedge	10
				Blue grama	7
				Sand dropseed	5
				Western wheatgrass	5
Dune land.					
5 Dimmick	Wetland	Favorable	5,650	Slough sedge	35
		Normal	5,200	Rivergrass	30
		Unfavorable	4,750	Prairie cordgrass	5
				Slim sedge	5
7 Straw	Overflow	Favorable	2,900	Big bluestem	30
		Normal	2,600	Kentucky bluegrass	10
		Unfavorable	2,300	Porcupinegrass	7
				Little bluestem	5
				Green needlegrass	5
				Western wheatgrass	5
				Western snowberry	5
8 Grail	Overflow	Favorable	3,300	Big bluestem	25
		Normal	2,900	Green needlegrass	15
		Unfavorable	2,500	Western wheatgrass	10
				Needleandthread	10
				Kentucky bluegrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
8B, 8C: Grail	Silty	Favorable	2,750	Western wheatgrass	20
		Normal	2,350	Needleandthread	15
		Unfavorable	1,950	Green needlegrass	10
				Blue grama	10
				Prairie junegrass	10
				Kentucky bluegrass	5
				Pennsylvania sedge	5
9B, 9C: Regent	Clayey	Favorable	2,150	Western wheatgrass	40
		Normal	1,800	Green needlegrass	10
		Unfavorable	1,450	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5
10: Savage	Clayey	Favorable	2,150	Western wheatgrass	25
		Normal	1,750	Needleandthread	15
		Unfavorable	1,350	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
11C: Cherry	Silty	Favorable	2,150	Western wheatgrass	25
		Normal	1,750	Needleandthread	15
		Unfavorable	1,350	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
14: Havrelon	Overflow	Favorable	3,100	Big bluestem	20
		Normal	2,700	Western wheatgrass	20
		Unfavorable	2,300	Green needlegrass	15
				Needleandthread	5
				Blue grama	5
15: Lawther	Clayey	Favorable	2,100	Western wheatgrass	40
		Normal	1,750	Green needlegrass	10
		Unfavorable	1,400	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5
17: Heil	Closed Depression	Favorable	3,000	Western wheatgrass	40
		Normal	2,600	Prairie cordgrass	15
		Unfavorable	2,200	Common spikesedge	10
				Kentucky bluegrass	5
				Inland saltgrass	5
20: Lohler	Overflow	Favorable	3,100	Big bluestem	20
		Normal	2,700	Western wheatgrass	20
		Unfavorable	2,300	Green needlegrass	15
				Needleandthread	5
				Porcupinegrass	5
				Blue grama	5
				Kentucky bluegrass	5
21B: Lihen	Sands	Favorable	2,500	Prairie sandreed	20
		Normal	2,100	Needleandthread	20
		Unfavorable	1,700	Blue grama	10
				Little bluestem	5
				Sand bluestem	5
				Western wheatgrass	5
				Sand dropseed	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
21D: Telfer	Sands	Favorable	2,500	Needleandthread	25
		Normal	2,100	Prairie sandreed	15
		Unfavorable	1,700	Pennsylvania sedge	10
				Blue grama	8
				Western wheatgrass	5
				Sand dropseed	5
				Sand bluestem	5
				Little bluestem	5
22B, 22D: Krem	Sands	Favorable	2,550	Needleandthread	25
		Normal	2,150	Prairie sandreed	15
		Unfavorable	1,750	Blue grama	8
				Western wheatgrass	5
				Little bluestem	5
				Prairie junegrass	5
				Sand bluestem	5
				Sand dropseed	5
				Pennsylvania sedge	5
				Threadleaf sedge	5
27, 27B: Mandan	Silty	Favorable	2,400	Western wheatgrass	25
		Normal	2,050	Needleandthread	15
		Unfavorable	1,750	Blue grama	13
				Green needlegrass	7
				Prairie junegrass	5
28: Wilton	Silty	Favorable	2,400	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
28B*, 28C*:					
Temvik	Silty	Favorable	2,400	Western wheatgrass	25
		Normal	2,050	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
Williams	Silty	Favorable	2,350	Western wheatgrass	25
		Normal	1,950	Needleandthread	15
		Unfavorable	1,550	Blue grama	13
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
35C*, 35D*:					
Amor	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	1,950	Needleandthread	15
		Unfavorable	1,600	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
Werner	Shallow	Favorable	1,800	Little bluestem	25
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Prairie sandreed	10
				Threadleaf sedge	8
				Western wheatgrass	5
				Blue grama	5
				Plains muhly	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
36, 36B, 36C: Williams	Silty	Favorable	2,350	Western wheatgrass	25
		Normal	1,950	Needleandthread	15
		Unfavorable	1,550	Blue grama	13
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
38C*:					
Williams	Silty	Favorable	2,350	Western wheatgrass	25
		Normal	1,950	Needleandthread	15
		Unfavorable	1,550	Blue grama	13
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
Zahl	Thin Upland	Favorable	2,300	Little bluestem	20
		Normal	1,900	Western wheatgrass	10
		Unfavorable	1,500	Needleandthread	10
				Pennsylvania sedge	8
				Side-oats grama	5
				Plains muhly	5
				Porcupinegrass	5
				Blue grama	5
38D*:					
Zahl	Thin Upland	Favorable	2,300	Little bluestem	20
		Normal	1,900	Western wheatgrass	10
		Unfavorable	1,500	Needleandthread	10
				Pennsylvania sedge	8
				Side-oats grama	5
				Plains muhly	5
				Porcupinegrass	5
				Blue grama	5
Williams	Silty	Favorable	2,350	Western wheatgrass	25
		Normal	1,950	Needleandthread	15
		Unfavorable	1,550	Blue grama	13
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
38E: Zahl	Thin Upland	Favorable	2,300	Little bluestem	20
		Normal	1,900	Western wheatgrass	10
		Unfavorable	1,500	Needleandthread	10
				Pennsylvania sedge	8
				Side-oats grama	5
				Plains muhly	5
				Porcupinegrass	5
				Blue grama	5
40, 40B: Shambo	Silty	Favorable	2,350	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,650	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
41B: Parshall	Sandy	Favorable	2,600	Needleandthread	20
		Normal	2,200	Prairie sandreed	15
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
				Pennsylvania sedge	10
				Prairie junegrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
43: Colvin	Wet Meadow	Favorable	4,500	Slim sedge	40
		Normal	4,000	Prairie cordgrass	15
		Unfavorable	3,300	Northern reedgrass	10
				Fescue sedge	10
				Switchgrass	5
44: Arnegard	Overflow	Favorable	3,200	Big bluestem	20
		Normal	2,800	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	7
				Blue grama	5
				Kentucky bluegrass	5
44B, 44C: Arnegard	Silty	Favorable	2,550	Western wheatgrass	25
		Normal	2,150	Needleandthread	15
		Unfavorable	1,750	Blue grama	13
				Green needlegrass	10
				Kentucky bluegrass	5
47: Havrelon	Overflow	Favorable	3,100	Big bluestem	20
		Normal	2,700	Western wheatgrass	20
		Unfavorable	2,300	Green needlegrass	15
				Needleandthread	5
				Blue grama	5
51: Straw	Overflow	Favorable	2,900	Big bluestem	30
		Normal	2,600	Kentucky bluegrass	10
		Unfavorable	2,300	Porcupinegrass	7
				Little bluestem	5
				Green needlegrass	5
				Western wheatgrass	5
				Western snowberry	5
53: Banks	Overflow	Favorable	3,200	Big bluestem	25
		Normal	2,800	Green needlegrass	15
		Unfavorable	2,400	Western wheatgrass	10
				Needleandthread	10
				Kentucky bluegrass	5
				Porcupinegrass	5
54B: Lihen	Sands	Favorable	2,500	Prairie sandreed	20
		Normal	2,100	Needleandthread	20
		Unfavorable	1,700	Blue grama	10
				Little bluestem	5
				Sand bluestem	5
				Western wheatgrass	5
				Sand dropseed	5
55B, 55C: Vebar	Sandy	Favorable	2,300	Needleandthread	25
		Normal	2,000	Prairie sandreed	15
		Unfavorable	1,700	Western wheatgrass	10
				Blue grama	10
				Pennsylvania sedge	10
				Prairie junegrass	5
56B, 56D: Lefor	Sandy	Favorable	2,400	Prairie sandreed	20
		Normal	2,150	Needleandthread	20
		Unfavorable	1,850	Western wheatgrass	10
				Blue grama	10
				Prairie junegrass	5
57B, 57C: Flaxton	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,000	Prairie sandreed	20
		Unfavorable	1,600	Blue grama	10
				Western wheatgrass	5
				Prairie junegrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
58B*, 58C*, 58D*:					
Flaxton	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,000	Prairie sandreed	20
		Unfavorable	1,600	Blue grama	10
				Western wheatgrass	5
				Prairie junegrass	5
Williams	Silty	Favorable	2,350	Western wheatgrass	25
		Normal	1,950	Needleandthread	15
		Unfavorable	1,550	Blue grama	13
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
59B Parshall	Sandy	Favorable	2,600	Needleandthread	20
		Normal	2,200	Prairie sandreed	15
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
				Pennsylvania sedge	10
				Prairie junegrass	5
62B Velva	Overflow	Favorable	3,100	Big bluestem	20
		Normal	2,700	Western wheatgrass	20
		Unfavorable	2,300	Green needlegrass	15
				Needleandthread	5
				Blue grama	5
67* Straw	Overflow	Favorable	2,900	Big bluestem	30
		Normal	2,600	Kentucky bluegrass	10
		Unfavorable	2,300	Porcupinegrass	7
				Little bluestem	5
				Green needlegrass	5
				Western wheatgrass	5
				Western snowberry	5
71B Searing	Silty	Favorable	2,150	Western wheatgrass	25
		Normal	1,750	Needleandthread	15
		Unfavorable	1,300	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
71C*:					
Searing	Silty	Favorable	2,150	Western wheatgrass	25
		Normal	1,750	Needleandthread	15
		Unfavorable	1,300	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
Ringling	Very Shallow	Favorable	800	Little bluestem	25
		Normal	650	Western wheatgrass	10
		Unfavorable	500	Needleandthread	10
				Prairie sandreed	10
				Sedge	10
				Plains muhly	5
73 Belfield	Clayey	Favorable	2,350	Western wheatgrass	40
		Normal	1,900	Green needlegrass	10
		Unfavorable	1,450	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
74B*, 74C*:					
Regent	Clayey	Favorable	2,150	Western wheatgrass	40
		Normal	1,800	Green needlegrass	10
		Unfavorable	1,450	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5
Rhoades	Thin Claypan	Favorable	800	Western wheatgrass	35
		Normal	600	Blue grama	30
		Unfavorable	400	Sandberg bluegrass	5
				Prairie junegrass	5
				Fringed sagebrush	5
75*, 75B*, 75C*:					
Belfield	Clayey	Favorable	2,350	Western wheatgrass	40
		Normal	1,900	Green needlegrass	10
		Unfavorable	1,450	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5
Daglum	Claypan	Favorable	1,750	Western wheatgrass	30
		Normal	1,400	Blue grama	25
		Unfavorable	1,050	Needleandthread	10
				Prairie junegrass	5
76B*, 76C*:					
Sen	Silty	Favorable	2,150	Western wheatgrass	25
		Normal	1,800	Needleandthread	15
		Unfavorable	1,450	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
Rhoades	Thin Claypan	Favorable	800	Western wheatgrass	35
		Normal	600	Blue grama	30
		Unfavorable	400	Sandberg bluegrass	5
				Prairie junegrass	5
				Fringed sagebrush	5
77, 77B Bowdle	Silty	Favorable	2,880	Green needlegrass	30
		Normal	2,400	Western wheatgrass	25
		Unfavorable	1,680	Needleandthread	25
				Blue grama	10
77C*:					
Bowdle	Silty	Favorable	2,880	Green needlegrass	30
		Normal	2,400	Western wheatgrass	25
		Unfavorable	1,680	Needleandthread	25
				Blue grama	10
Wabek	Very Shallow	Favorable	800	Needleandthread	25
		Normal	700	Blue grama	15
		Unfavorable	600	Western wheatgrass	15
				Threadleaf sedge	8
				Plains muhly	5
				Prairie junegrass	5
				Red threeawn	5
78B*:					
Noonan	Claypan	Favorable	2,000	Western wheatgrass	40
		Normal	1,650	Blue grama	20
		Unfavorable	1,300	Green needlegrass	5
				Needleandthread	5
				Prairie junegrass	5
				Pennsylvania sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
78B*:					
Flaxton	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,000	Prairie sandreed	20
		Unfavorable	1,600	Blue grama	10
				Western wheatgrass	5
				Prairie junegrass	5
79B, 79C Moreau	Clayey	Favorable	2,050	Western wheatgrass	40
		Normal	1,700	Green needlegrass	10
		Unfavorable	1,350	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5
79D*:					
Wayden	Shallow	Favorable	1,500	Little bluestem	25
		Normal	1,200	Needleandthread	10
		Unfavorable	900	Prairie sandreed	10
				Western wheatgrass	7
				Plains muhly	5
				Side-oats grama	5
				Blue grama	5
Moreau	Clayey	Favorable	2,050	Western wheatgrass	40
		Normal	1,700	Green needlegrass	10
		Unfavorable	1,350	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5
81D, 81E Cabba	Shallow	Favorable	1,800	Little bluestem	25
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Prairie sandreed	10
				Threadleaf sedge	8
				Plains muhly	5
				Blue grama	5
				Western wheatgrass	5
82E*:					
Cabba	Shallow	Favorable	1,800	Little bluestem	25
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Prairie sandreed	10
				Threadleaf sedge	8
				Plains muhly	5
				Blue grama	5
				Western wheatgrass	5
Badland.					
83C*:					
Vebar	Sandy	Favorable	2,300	Needleandthread	25
		Normal	2,000	Prairie sandreed	15
		Unfavorable	1,700	Western wheatgrass	10
				Blue grama	10
				Pennsylvania sedge	10
				Prairie junegrass	5
Cohagen	Shallow	Favorable	1,700	Little bluestem	25
		Normal	1,400	Needleandthread	10
		Unfavorable	1,100	Prairie sandreed	10
				Threadleaf sedge	8
				Plains muhly	5
				Blue grama	5
				Western wheatgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
83E*:					
Cohagen	Shallow	Favorable	1,700	Little bluestem	25
		Normal	1,400	Needleandthread	10
		Unfavorable	1,100	Prairie sandreed	10
				Threadleaf sedge	8
				Plains muhly	5
				Blue grama	5
				Western wheatgrass	5
Vebar	Sandy	Favorable	2,300	Needleandthread	25
		Normal	2,000	Prairie sandreed	15
		Unfavorable	1,700	Western wheatgrass	10
				Blue grama	10
				Pennsylvania sedge	10
				Prairie junegrass	5
84E*:					
Cohagen	Shallow	Favorable	1,700	Little bluestem	25
		Normal	1,400	Needleandthread	10
		Unfavorable	1,100	Prairie sandreed	10
				Threadleaf sedge	8
				Plains muhly	5
				Blue grama	5
				Western wheatgrass	5
Vebar	Sandy	Favorable	2,300	Needleandthread	25
		Normal	2,000	Prairie sandreed	15
		Unfavorable	1,700	Western wheatgrass	10
				Blue grama	10
				Pennsylvania sedge	10
				Prairie junegrass	5
Rock outcrop.					
85 Harriet Variant	Saline Lowland	Favorable	2,600	Western wheatgrass	35
		Normal	2,200	Inland saltgrass	20
		Unfavorable	1,800	Nuttall alkaligrass	15
				Slender wheatgrass	5
86E* Wabek	Very Shallow	Favorable	800	Needleandthread	25
		Normal	700	Blue grama	15
		Unfavorable	600	Western wheatgrass	15
				Threadleaf sedge	8
				Plains muhly	5
				Prairie junegrass	5
				Red threeawn	5
87C*:					
Rhoades	Thin Claypan	Favorable	800	Western wheatgrass	35
		Normal	600	Blue grama	30
		Unfavorable	400	Sandberg bluegrass	5
				Prairie junegrass	5
				Fringed sagebrush	5
Daglum	Claypan	Favorable	1,750	Western wheatgrass	30
		Normal	1,400	Blue grama	25
		Unfavorable	1,050	Needleandthread	10
				Prairie junegrass	5
88 Harriet	Saline Lowland	Favorable	2,600	Western wheatgrass	35
		Normal	2,200	Inland saltgrass	20
		Unfavorable	1,800	Nuttall alkaligrass	15
				Slender wheatgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
90C----------------- Williams	Silty-------------------------	Favorable	2,350	Western wheatgrass------------	25
		Normal	1,950	Needleandthread---------------	15
		Unfavorable	1,550	Blue grama--------------------	13
				Green needlegrass-------------	7
				Prairie junegrass-------------	5
				Kentucky bluegrass------------	5
91----------------- Straw	Overflow----------------------	Favorable	2,900	Big bluestem------------------	30
		Normal	2,600	Kentucky bluegrass------------	10
		Unfavorable	2,300	Porcupinegrass----------------	7
				Little bluestem---------------	5
				Green needlegrass-------------	5
				Western wheatgrass------------	5
				Western snowberry-------------	5
91B---------------- Straw	Silty-------------------------	Favorable	2,300	Green needlegrass-------------	15
		Normal	2,000	Western wheatgrass------------	15
		Unfavorable	1,800	Needleandthread---------------	15
				Kentucky bluegrass------------	10
				Porcupinegrass----------------	5
92B*:					
Noonan------------	Claypan-----------------------	Favorable	2,000	Western wheatgrass------------	40
		Normal	1,650	Blue grama--------------------	20
		Unfavorable	1,300	Green needlegrass-------------	5
				Needleandthread---------------	5
				Prairie junegrass-------------	5
				Pennsylvania sedge------------	5
Williams----------	Silty-------------------------	Favorable	2,350	Western wheatgrass------------	25
		Normal	1,950	Needleandthread---------------	15
		Unfavorable	1,550	Blue grama--------------------	13
				Green needlegrass-------------	7
				Prairie junegrass-------------	5
				Kentucky bluegrass------------	5
93----------------- Falkirk	Silty-------------------------	Favorable	2,550	Western wheatgrass------------	20
		Normal	2,150	Needleandthread---------------	15
		Unfavorable	1,750	Green needlegrass-------------	10
				Prairie junegrass-------------	10
				Blue grama--------------------	10
				Kentucky bluegrass------------	5
				Pennsylvania sedge------------	5
94----------------- Makoti	Silty-------------------------	Favorable	2,550	Western wheatgrass------------	20
		Normal	2,150	Needleandthread---------------	15
		Unfavorable	1,750	Green needlegrass-------------	10
				Prairie junegrass-------------	10
				Blue grama--------------------	10
				Kentucky bluegrass------------	5
				Pennsylvania sedge------------	5
95*:					
Flaxton-----------	Sandy-------------------------	Favorable	2,400	Needleandthread---------------	20
		Normal	2,000	Prairie sandreed--------------	20
		Unfavorable	1,600	Blue grama--------------------	10
				Western wheatgrass------------	5
				Prairie junegrass-------------	5
Williams----------	Silty-------------------------	Favorable	2,350	Western wheatgrass------------	25
		Normal	1,950	Needleandthread---------------	15
		Unfavorable	1,550	Blue grama--------------------	13
				Green needlegrass-------------	7
				Prairie junegrass-------------	5
				Kentucky bluegrass------------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
96: Grassna	Overflow	Favorable	3,300	Big bluestem	25
		Normal	2,900	Green needlegrass	15
		Unfavorable	2,500	Western wheatgrass	10
				Needleandthread	10
				Kentucky bluegrass	5
96B: Grassna	Silty	Favorable	2,700	Western wheatgrass	20
		Normal	2,300	Needleandthread	15
		Unfavorable	1,900	Green needlegrass	10
				Blue grama	10
				Kentucky bluegrass	5
				Pennsylvania sedge	5
97B, 97C: Sen	Silty	Favorable	2,150	Western wheatgrass	25
		Normal	1,800	Needleandthread	15
		Unfavorable	1,450	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
98E*:					
Ringling	Very Shallow	Favorable	800	Little bluestem	25
		Normal	650	Western wheatgrass	10
		Unfavorable	500	Needleandthread	10
				Prairie sandreed	10
				Sedge	10
				Plains muhly	5
Cabba	Shallow	Favorable	1,800	Little bluestem	25
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Prairie sandreed	10
				Threadleaf sedge	8
				Plains muhly	5
				Blue grama	5
				Western wheatgrass	5
100B, 100C: Amor	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	1,950	Needleandthread	15
		Unfavorable	1,600	Blue grama	15
				Green needlegrass	7
				Prairie junegrass	5
				Kentucky bluegrass	5
101C: Parshall	Sandy	Favorable	2,600	Needleandthread	20
		Normal	2,200	Prairie sandreed	15
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
				Pennsylvania sedge	10
				Prairie junegrass	5
102: Bowbells	Overflow	Favorable	3,350	Big bluestem	25
		Normal	2,900	Green needlegrass	15
		Unfavorable	2,450	Western wheatgrass	10
				Needleandthread	10
				Kentucky bluegrass	5
				Porcupinegrass	5
104: Magnus	Overflow	Favorable	3,100	Western wheatgrass	20
		Normal	2,700	Big bluestem	20
		Unfavorable	2,300	Green needlegrass	15
				Needleandthread	5
				Blue grama	5
				Kentucky bluegrass	5
				Porcupinegrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
108*:					
Belfield	Clayey	Favorable	2,350	Western wheatgrass	40
		Normal	1,900	Green needlegrass	10
		Unfavorable	1,450	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5
Straw	Overflow	Favorable	2,900	Big bluestem	30
		Normal	2,600	Kentucky bluegrass	10
		Unfavorable	2,300	Porcupinegrass	7
				Little bluestem	5
				Green needlegrass	5
109B*:					
Bowbells	Silty	Favorable	2,800	Western wheatgrass	25
		Normal	2,400	Needleandthread	15
		Unfavorable	2,000	Green needlegrass	10
				Blue grama	10
				Kentucky bluegrass	5
				Pennsylvania sedge	5
Zahl	Thin Upland	Favorable	2,300	Little bluestem	20
		Normal	1,900	Western wheatgrass	10
		Unfavorable	1,500	Needleandthread	10
				Pennsylvania sedge	8
				Side-oats grama	5
				Plains muhly	5
				Porcupinegrass	5
				Blue grama	5
110B Belfield	Clayey	Favorable	2,350	Western wheatgrass	40
		Normal	1,900	Green needlegrass	10
		Unfavorable	1,450	Blue grama	10
				Prairie junegrass	5
				Plains reedgrass	5

* See map unit description for the composition and behavior of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means greater than. Absence of an entry means that trees of the height class do not normally grow on this soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
1. Parnell					
2. Tonka					
3D*: Seroco.					
Telfer	---	Ponderosa pine, eastern redcedar, Rocky Mt. juniper.	---	---	---
3E*: Seroco.					
Dune land.					
5. Dimmick					
7 Straw	---	Eastern redcedar, Rocky Mt. juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm	Eastern cottonwood.
8, 8B Grail	---	Eastern redcedar, Rocky Mt. juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm	Eastern cottonwood.
8C Grail	Tatarian honeysuckle, American plum.	Russian-olive, Siberian peashrub, eastern redcedar, Rocky Mt. juniper.	Siberian elm, green ash, ponderosa pine.	---	---
9B, 9C Regent	---	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, Tatarian honeysuckle.	Siberian elm, American elm, green ash.	---	---
10 Savage	Siberian peashrub, Tatarian honeysuckle, American plum.	Blue spruce, common chokecherry, Rocky Mt. juniper.	American elm, green ash, ponderosa pine, Russian-olive.	Siberian elm	Eastern cottonwood.
11C Cherry	Siberian peashrub, Tatarian honeysuckle, American plum.	Blue spruce, common chokecherry, Rocky Mt. juniper.	American elm, green ash, ponderosa pine, Russian-olive.	Siberian elm	Plains 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
14 Havrelon	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, common chokecherry, eastern redcedar.	Siberian elm	Eastern cottonwood.
15 Lawther	Tatarian honeysuckle.	American elm, ponderosa pine, Rocky Mt. juniper, Russian-olive, Siberian peashrub, common chokecherry, American plum.	Siberian elm, green ash.	---	---
17. Heil					
20 Lohler	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, common chokecherry, eastern redcedar.	Siberian elm	Eastern cottonwood.
21B Linen	Silver buffaloberry.	Siberian peashrub, Russian-olive, Rocky Mt. juniper.	Siberian elm	---	---
21D Telfer	---	Ponderosa pine, eastern redcedar, Rocky Mt. juniper.	---	---	---
22B, 22D Krem	American plum, common chokecherry, lilac, Tatarian honeysuckle.	Green ash, Russian-olive, Siberian peashrub.	Siberian elm, ponderosa pine.	---	---
27, 27B Mandan	---	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, blue spruce.	Siberian elm	---
28 Wilton	---	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, blue spruce.	Siberian elm	---

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
28B*, 28C*:					
Temvik	---	Russian-olive, Siberian peashrub, eastern redcedar, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, blue spruce.	Siberian elm	---
Williams	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm	---
35C*:					
Amor	Tatarian honeysuckle.	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, American plum.	Siberian elm, American elm, green ash, ponderosa pine, blue spruce.	---	---
Werner	Rocky Mt. juniper, Siberian peashrub.	Ponderosa pine, Siberian elm, green ash, Russian-olive.	---	---	---
35D*:					
Amor	Tatarian honeysuckle.	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, American plum.	Siberian elm, American elm, green ash, ponderosa pine, blue spruce.	---	---
Werner.					
36, 36B, 36C Williams	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm	---

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
38C*: Williams	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm	---
Zahl	Siberian peashrub	Ponderosa pine, Siberian elm, green ash, Russian-olive, eastern redcedar, Rocky Mt. juniper.	---	---	---
38D*: Zahl	Siberian peashrub	Ponderosa pine, Siberian elm, green ash, Russian-olive, eastern redcedar, Rocky Mt. juniper.	---	---	---
Williams	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm	---
38E. Zahl					
40, 40B Shambo	---	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm	---
41B Parshall	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, blue spruce, green ash, ponderosa pine, common chokecherry, Rocky Mt. juniper, Russian-olive.	Siberian elm	Eastern cottonwood.
43. Colvin					

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
44, 44B, 44C------ Arnegard	---	Eastern redcedar, Rocky Mt. juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm------	Eastern cottonwood.
47---------------- Havrelon	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, common chokecherry, eastern redcedar.	Siberian elm------	Eastern cottonwood.
51---------------- Straw	---	Eastern redcedar, Rocky Mt. juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm------	Eastern cottonwood.
53---------------- Banks	---	Ponderosa pine, eastern redcedar, Rocky Mt. juniper.	---	---	---
54B--------------- Lihen	Silver buffaloberry.	Siberian peashrub, Russian-olive, Rocky Mt. juniper.	Siberian elm------	---	---
55B, 55C---------- Vebar	---	American elm, green ash, Siberian peashrub, eastern redcedar, common chokecherry, American plum.	Siberian elm, ponderosa pine.	---	---
56B, 56D---------- Lefor	---	Siberian peashrub, eastern redcedar, Rocky Mt. juniper, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, ponderosa pine, American elm, green ash, Russian-olive.	---	---
57B, 57C---------- Flaxton	---	Siberian peashrub, eastern redcedar, Rocky Mt. juniper, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, ponderosa pine, American elm, green ash, Russian-olive.	---	---
58B*, 58C*, 58D*:					
Flaxton----------	---	Siberian peashrub, eastern redcedar, Rocky Mt. juniper, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, ponderosa pine, American elm, green ash, Russian-olive.	---	---

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
58B*, 58C*, 58D*: Williams	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm	---
59B Parshall	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, blue spruce, green ash, ponderosa pine, common chokecherry, Rocky Mt. juniper, Russian-olive.	Siberian elm	Eastern cottonwood.
62B Velva	---	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	Siberian elm, American elm, green ash, ponderosa pine, blue spruce.	---	---
67* Straw	---	---	---	---	---
71B Searing	Common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, Russian-olive, Siberian peashrub, Rocky Mt. juniper.	Siberian elm, ponderosa pine.	---	---
71C*: Searing	Common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, Russian-olive, Siberian peashrub, Rocky Mt. juniper.	Siberian elm, ponderosa pine.	---	---
Ringling.					
73 Belfield	Tatarian honeysuckle, American plum.	American elm, ponderosa pine, Rocky Mt. juniper, Russian-olive, Siberian peashrub, common chokecherry.	Siberian elm, green ash.	---	---
74B*, 74C*: Regent	---	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, Tatarian honeysuckle.	Siberian elm, American elm, green ash.	---	---
Rhoades.					

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
75*, 75B*, 75C*:					
Belfield	Tatarian honeysuckle, American plum.	American elm, ponderosa pine, Rocky Mt. juniper, Russian-olive, Siberian peashrub, common chokecherry.	Siberian elm, green ash.	---	---
Daglum.					
76B*, 76C*:					
Sen	Tatarian honeysuckle.	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, American plum.	Siberian elm, American elm, green ash, ponderosa pine, blue spruce.	---	---
Rhoades.					
77, 77B Bowdle	Siberian peashrub, Tatarian honeysuckle, silver buffaloberry, Peking cotoneaster, lilac.	Ponderosa pine, green ash, Siberian crabapple, common hackberry, Russian-olive, eastern redcedar.	Siberian elm	---	---
77C*:					
Bowdle	Siberian peashrub, Tatarian honeysuckle, silver buffaloberry, Peking cotoneaster, lilac.	Ponderosa pine, green ash, Siberian crabapple, common hackberry, Russian-olive, eastern redcedar.	Siberian elm	---	---
Wabek.					
78B*:					
Noonan.					
Flaxton	---	Siberian peashrub, eastern redcedar, Rocky Mt. juniper, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, ponderosa pine, American elm, green ash, Russian-olive.	---	---
79B, 79C Moreau	---	Eastern redcedar, Rocky Mt. juniper, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, green ash, American elm, ponderosa pine.	---	---
79D*:					
Wayden.					

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
79D*:					
Moreau	---	Eastern redcedar, Rocky Mt. juniper, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, green ash, American elm, ponderosa pine.	---	---
81D, 81E. Cabba					
82E*: Cabba.					
Badland.					
83C*:					
Vebar	---	American elm, green ash, Siberian peashrub, eastern redcedar, common chokecherry, American plum.	Siberian elm, ponderosa pine.	---	---
Cohagen.					
83E*: Cohagen.					
Vebar	---	Ponderosa pine, eastern redcedar, Rocky Mt. juniper.	---	---	---
84E*: Cohagen.					
Vebar	---	Ponderosa pine, eastern redcedar, Rocky Mt. juniper.	---	---	---
Rock outcrop.					
85. Harriet Variant					
86E*. Wabek					
87C*: Rhoades.					
Daglum.					
88. Harriet					
89E*. Ustorthents					

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
90C------ Williams	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm------	---
91, 91B------ Straw	---	Eastern redcedar, Rocky Mt. juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm------	Eastern cottonwood.
92B*: Noonan.					
Williams------	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm------	---
93------ Falkirk	---	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, blue spruce.	Siberian elm------	---
94------ Makoti	---	Eastern redcedar, Russian-olive, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, Black Hills spruce, blue spruce, green ash, ponderosa pine.	Siberian elm------	Eastern cottonwood.
95*: Flaxton------	---	Siberian peashrub, eastern redcedar, Rocky Mt. juniper, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, ponderosa pine, American elm, green ash, Russian-olive.	---	---

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
95*:					
Williams	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine.	Siberian elm	---
96, 96B Grassna	---	Eastern redcedar, Rocky Mt. juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm	Eastern cottonwood.
97B, 97C Sen	Tatarian honeysuckle.	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, American plum.	Siberian elm, American elm, green ash, ponderosa pine, blue spruce.	---	---
98E*:					
Ringling.					
Cabba.					
100B, 100C Amor	Tatarian honeysuckle.	Russian-olive, Siberian peashrub, common chokecherry, Rocky Mt. juniper, American plum.	Siberian elm, American elm, green ash, pon erosa pine, blue spruce.	---	---
101C Parshall	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, blue spruce, green ash, ponderosa pine, common chokecherry, Rocky Mt. juniper, Russian-olive.	Siberian elm	Eastern cottonwood.
102 Bowbells	---	Eastern redcedar, American plum, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm	Eastern cottonwood.
104 Magnus	---	Common chokecherry, Rocky Mt. juniper, Russian-olive, Siberian peashrub, Tatarian honeysuckle.	American elm, Black Hills spruce, blue spruce, green ash, ponderosa pine.	Siberian elm	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
108*:					
Belfield	Tatarian honeysuckle, American plum.	American elm, ponderosa pine, Rocky Mt. juniper, Russian-olive, Siberian peashrub, common chokecherry.	Siberian elm, green ash.	---	---
Straw	---	Eastern redcedar, Rocky Mt. juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm	Eastern cottonwood.
109B*:					
Bowbells	---	Eastern redcedar, American plum, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm	Eastern cottonwood.
Zahl	Siberian peashrub	Ponderosa pine, Siberian elm, green ash, Russian-olive, eastern redcedar, Rocky Mt. juniper.	---	---	---
110B Belfield	Tatarian honeysuckle, American plum.	American elm, ponderosa pine, Rocky Mt. juniper, Russian-olive, Siberian peashrub, common chokecherry.	Siberian elm, green ash.	---	---
111*. Pits					

* See map unit description for the composition and behavior of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1----------------- Parnell	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.
2----------------- Tonka	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
3D*:					
Seroco------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Telfer------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
3E*:					
Seroco------------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Dune land.					
5----------------- Dimmick	Severe: floods, wetness, too clayey.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.
7----------------- Straw	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
8, 8B, 8C--------- Grail	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength.
9B, 9C------------ Regent	Moderate: depth to rock.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
10---------------- Savage	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
11C--------------- Cherry	Slight-----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
14---------------- Havrelon	Slight-----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
15---------------- Lawther	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
17---------------- Heil	Severe: too clayey, wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
20---------------- Lohler	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
21B--------------- Lihen	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
21D--------------- Telfer	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
22B--------------- Krem	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: frost action.
22D--------------- Krem	Moderate: too clayey, slope.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Moderate: frost action, slope.
27---------------- Mandan	Slight-----------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, frost action.
27B--------------- Mandan	Slight-----------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength, frost action.
28---------------- Wilton	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: frost action, low strength.
28B*, 28C*:					
Temvik-----------	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Williams---------	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
35C*:					
Amor-------------	Moderate: depth to rock, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Werner-----------	Severe: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
35D*:					
Amor-------------	Moderate: depth to rock, slope, too clayey.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, depth to rock, slope.	Severe: slope.	Severe: low strength.
Werner-----------	Severe: depth to rock.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, depth to rock, slope.	Severe: slope.	Severe: low strength.
36---------------- Williams	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
36B, 36C---------- Williams	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
38C*:					
Williams----------	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Zahl--------------	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
38D*:					
Zahl--------------	Moderate: slope, too clayey.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
Williams----------	Moderate: slope, too clayey.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
38E--------------- Zahl	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
40---------------- Shambo	Slight-----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
40B--------------- Shambo	Slight-----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
41B--------------- Parshall	Slight-----------	Slight-----------	Slight-----------	Slight------------	Moderate: frost action, low strength.
43---------------- Colvin	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, low strength.
44---------------- Arnegard	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: frost action, low strength.
44B, 44C---------- Arnegard	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Moderate: frost action, low strength.
47---------------- Havrelon	Slight-----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
51---------------- Straw	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, frost action, floods.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
53: Banks	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
54B: Lihen	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
55B, 55C: Vebar	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
56B: Lefor	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, low strength.	Severe: low strength.
56D: Lefor	Moderate: slope, depth to rock.	Moderate: slope, shrink-swell, low strength.	Moderate: shrink-swell, depth to rock, slope.	Severe: slope.	Severe: low strength.
57B: Flaxton	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
57C: Flaxton	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
58B*, 58C*:					
Flaxton	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Williams	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
58D*:					
Flaxton	Moderate: too clayey, slope.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
Williams	Moderate: slope, too clayey.	Moderate: shrink-swell, slope, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
59B: Parshall	Slight	Slight	Slight	Slight	Moderate: frost action, low strength.
62B: Velva	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
67*: Straw	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
71B: Searing	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Moderate: low strength.
71C*:					
Searing	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
71C*: Ringling	Severe: cutbanks cave.	Slight	Slight	Severe: slope.	Slight.
73 Belfield	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
74B*, 74C*: Regent	Moderate: depth to rock.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Rhoades	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
75*, 75B*, 75C*: Belfield	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Daglum	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
76B*, 76C*: Sen	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Rhoades	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
77 Bowdle	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
77B Bowdle	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
77C*: Bowdle	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Wabek	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
78B*: Noonan	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
Flaxton	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
79B, 79C Moreau	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
79D*: Wayden	Severe: depth to rock, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, depth to rock.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
79D*:					
Moreau	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
81D Cabba	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Severe: slope.	Moderate: slope, frost action, depth to rock.
81E Cabba	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
82E*:					
Cabba	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Badland.					
83C*:					
Vebar	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
Cohagen	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.
83E*:					
Cohagen	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Vebar	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
84E*:					
Cohagen	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Vebar	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
Rock outcrop.					
85 Harriet Variant	Severe: wetness, floods.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, wetness.	Severe: low strength, wetness, floods.
86E* Wabek	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
87C*:					
Rhoades	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Daglum	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
88 Harriet	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
89E*. Ustorthents					
90C: Williams	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
91, 91B: Straw	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
92B*:					
Noonan	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
Williams	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
93: Falkirk	Slight	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: low strength, shrink-swell.	Moderate: low strength, frost action.
94: Makoti	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
95*:					
Flaxton	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
Williams	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
96: Grassna	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
96B: Grassna	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
97B, 97C: Sen	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
98E*:					
Ringling	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cabba	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
100B, 100C: Amor	Moderate: depth to rock, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
101C: Parshall	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
102 Bowbells	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
104 Magnus	Severe: too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: shrink-swell, low strength.
108*:					
Belfield	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Straw	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, frost action, floods.
109B*:					
Bowbells	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Severe: low strength.
Zahl	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
110B Belfield	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
111*. Pits					

* See map unit description for the composition and behavior of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means 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
1 Parnell	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness.
2 Tonka	Severe: wetness, floods.	Slight	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey, wetness.
3D*:					
Seroco	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy.
Telfer	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy.
3E*:					
Seroco	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy.
Dune land.					
5 Dimmick	Severe: floods, wetness, percs slowly.	Slight	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
7 Straw	Severe: floods.	Moderate: seepage.	Severe: floods.	Severe: floods.	Fair: too clayey.
8, 8B Grail	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Poor: thin layer.
8C Grail	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Poor: thin layer.
9B Regent	Severe: percs slowly, depth to rock.	Moderate: slope, depth to rock.	Severe: too clayey, depth to rock.	Slight	Poor: area reclaim.
9C Regent	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Slight	Poor: area reclaim.
10 Savage	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
11C Cherry	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
14 Havrelon	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
15 Lawther	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.

See footnote at end of table.

TABLE 9.--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
17 Heil	Severe: percs slowly, wetness, floods.	Slight	Severe: too clayey, wetness, floods.	Severe: floods, wetness.	Poor: too clayey, wetness.
20 Lohler	Severe: percs slowly, wetness.	Slight	Severe: too clayey, wetness.	Moderate: wetness.	Poor: too clayey.
21B Lihen	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
21D Telfer	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy.
22B Krem	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
22D Krem	Severe: percs slowly.	Severe: seepage, slope.	Moderate: too clayey.	Severe: seepage.	Fair: slope, too clayey.
27, 27B Mandan	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
28 Wilton	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
28B*:					
Temvik	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Williams	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
28C*:					
Temvik	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
35C*:					
Amor	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Slight	Poor: area reclaim.
Werner	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
35D*:					
Amor	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: area reclaim.
Werner	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
36, 36B Williams	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 9.--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
36C------------------- Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
38C*:					
Williams-----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Zahl----------------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
38D*:					
Zahl----------------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Williams-----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
38E------------------- Zahl	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
40, 40B------------- Shambo	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
41B------------------- Parshall	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
43--------------------- Colvin	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
44, 44B------------- Arnegard	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Moderate: too clayey.	Fair: too clayey.
44C------------------- Arnegard	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: too clayey.	Fair: too clayey.
47--------------------- Havrelon	Moderate: percs slowly.	Moderate: seepage.	Slight-----------	Slight-----------	Good.
51--------------------- Straw	Moderate: floods, percs slowly.	Moderate: seepage.	Moderate: floods.	Moderate: floods.	Good.
53--------------------- Banks	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Poor: too sandy.
54B------------------- Lihen	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
55B------------------- Vebar	Severe: depth to rock.	Severe: seepage.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: area reclaim.
55C------------------- Vebar	Severe: depth to rock.	Severe: seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: area reclaim.
56B------------------- Lefor	Severe: depth to rock.	Moderate: depth to rock, slope, seepage.	Severe: depth to rock.	Slight-----------	Poor: area reclaim.

See footnote at end of table.

TABLE 9.--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
56D: Lefor	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: area reclaim.
57B: Flaxton	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
57C: Flaxton	Severe: percs slowly.	Severe: seepage, slope.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
58B*:					
Flaxton	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
Williams	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
58C*:					
Flaxton	Severe: percs slowly.	Severe: seepage, slope.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
58D*:					
Flaxton	Severe: percs slowly.	Severe: seepage, slope.	Moderate: too clayey.	Severe: seepage.	Fair: slope, too clayey.
Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
59B: Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
62B: Velva	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Good.
67*: Straw	Severe: floods.	Moderate: seepage.	Severe: floods.	Severe: floods.	Good.
71B: Searing	Severe: depth to rock.	Severe: seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim.
71C*:					
Searing	Severe: depth to rock.	Severe: seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim.
Ringling	Slight	Severe: slope, seepage.	Severe: small stones, seepage.	Severe: seepage.	Poor: small stones, large stones.
73: Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
74B*:					
Regent	Severe: percs slowly, depth to rock.	Moderate: slope, depth to rock.	Severe: too clayey, depth to rock.	Slight	Poor: area reclaim.

See footnote at end of table.

TABLE 9.--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
74B*:					
Rhoades	Severe: percs slowly, depth to rock.	Moderate: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
74C*:					
Regent	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Slight	Poor: area reclaim.
Rhoades	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
75*, 75B*:					
Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Daglum	Severe: percs slowly, depth to rock.	Moderate: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
75C*:					
Belfield	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Daglum	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
76B*:					
Sen	Severe: depth to rock.	Moderate: depth to rock, slope, seepage.	Severe: depth to rock.	Slight	Poor: area reclaim.
Rhoades	Severe: percs slowly, depth to rock.	Moderate: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
76C*:					
Sen	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Slight	Poor: area reclaim.
Rhoades	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
77, 77B Bowdle	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
77C*:					
Bowdle	Slight	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
Wabek	Slight	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
78B*:					
Noonan	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Flaxton	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.

See footnote at end of table.

TABLE 9.--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
79B: Moreau	Severe: percs slowly, depth to rock.	Moderate: slope, depth to rock.	Severe: too clayey.	Slight	Poor: too clayey, area reclaim.
79C: Moreau	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, area reclaim.
79D*:					
Wayden	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: area reclaim.
Moreau	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, area reclaim.
81D: Cabba	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer.
81E: Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer.
82E*:					
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer.
Badland.					
83C*:					
Vebar	Severe: depth to rock.	Severe: seepage.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: area reclaim.
Cohagen	Severe: depth to rock.	Severe: seepage.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: thin layer, area reclaim.
83E*:					
Cohagen	Severe: depth to rock, slope.	Severe: seepage, slope.	Severe: seepage, depth to rock, slope.	Severe: seepage, slope.	Poor: thin layer, slope, area reclaim.
Vebar	Severe: depth to rock.	Severe: seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: area reclaim.
84E*:					
Cohagen	Severe: depth to rock, slope.	Severe: seepage, slope.	Severe: seepage, depth to rock, slope.	Severe: seepage, slope.	Poor: thin layer, slope, area reclaim.
Vebar	Severe: depth to rock.	Severe: seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage.	Poor: area reclaim.
Rock outcrop.					
85: Harriet Variant	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 9.--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
86E*: Wabek	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
87C*:					
Rhoades	Severe: percs slowly, depth to rock.	Moderate: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
Daglum	Severe: percs slowly, depth to rock.	Moderate: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
88: Harriet	Severe: percs slowly, wetness.	Slight	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
89E*. Ustorthents					
90C: Williams	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
91: Straw	Severe: floods.	Moderate: seepage.	Severe: floods.	Severe: floods.	Good.
91B: Straw	Severe: floods.	Moderate: slope, seepage.	Severe: floods.	Severe: floods.	Good.
92B*:					
Noonan	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Williams	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
93: Falkirk	Severe: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
94: Makoti	Severe: percs slowly.	Slight	Severe: wetness.	Slight	Good.
95*:					
Flaxton	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
Williams	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
96, 96B: Grassna	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
97B: Sen	Severe: depth to rock.	Moderate: depth to rock, slope, seepage.	Severe: depth to rock.	Slight	Poor: area reclaim.
97C: Sen	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Slight	Poor: area reclaim.

See footnote at end of table.

TABLE 9.--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
98E*:					
Ringling	Severe: slope.	Severe: slope, seepage.	Severe: slope, seepage, small stones.	Severe: slope, seepage.	Poor: slope, small stones, large stones.
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer.
100B Amor	Severe: depth to rock.	Moderate: depth to rock, slope, seepage.	Severe: depth to rock.	Slight	Poor: area reclaim.
100C Amor	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Slight	Poor: area reclaim.
101C Parshall	Slight	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.
102 Bowbells	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
104 Magnus	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: floods.	Poor: too clayey.
108*:					
Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Straw	Moderate: floods, percs slowly.	Moderate: slope, seepage.	Moderate: floods.	Moderate: floods.	Good.
109B*:					
Bowbells	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
Zahl	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
110B Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
111*. Pits					

* See map unit description for the composition and behavior of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1 Parnell	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
2 Tonka	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
3D*: Seroco	Good	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
Telfer	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: thin layer.
3E*: Seroco	Good	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
Dune land.				
5 Dimmick	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, too clayey.
7 Straw	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
8, 8B, 8C Grail	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
9B, 9C Regent	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
10 Savage	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
11C Cherry	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
14 Havrelon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
15 Lawther	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
17 Heil	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, too clayey, excess salt.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
20: Lohler	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
21B: Lihen	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
21D: Telfer	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: thin layer.
22B: Krem	Poor: low strength.	Poor: thin layer, excess fines.	Unsuited: excess fines.	Fair: too sandy.
22D: Krem	Poor: low strength.	Poor: thin layer, excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
27, 27B: Mandan	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
28: Wilton	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
28B*, 28C*:				
Temvik	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
35C*:				
Amor	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
Werner	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
35D*:				
Amor	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, area reclaim.
Werner	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
36, 36B, 36C: Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
38C*:				
Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Zahl	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
38D*:				
Zahl	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
38E Zahl	Poor: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
40, 40B Shambo	Poor: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
41B Parshall	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
43 Colvin	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
44, 44B, 44C Arnegard	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
47 Havrelon	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
51 Straw	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
53 Banks	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: thin layer.
54B Lihen	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
55B, 55C Vebar	Poor: area reclaim.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Fair: area reclaim.
56B Lefor	Poor: area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
56D Lefor	Poor: area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, slope, area reclaim.
57B, 57C Flaxton	Poor: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
58B*, 58C*: Flaxton	Poor: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
58D*: Flaxton	Poor: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Fair: slope.
Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
59B Parshall	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
62B Velva	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
67* Straw	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
71B Searing	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
71C*:				
Searing	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
Ringling	Poor: large stones.	Unsuited: excess fines.	Unsuited: large stones.	Poor: small stones, large stones.
73 Belfield	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
74B*, 74C*:				
Regent	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Rhoades	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, excess sodium, excess salt.
75*, 75B*, 75C*:				
Belfield	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Daglum	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess sodium.
76B*, 76C*:				
Sen	Poor: low strength, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
Rhoades	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, excess sodium, excess salt.
77, 77B Bowdle	Good	Fair: excess fines.	Fair: excess fines.	Good.
77C*:				
Bowdle	Good	Fair: excess fines.	Fair: excess fines.	Good.
Wabek	Good	Good	Good	Poor: thin layer, small stones.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
78B*:				
Noonan	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
Flaxton	Poor: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
79B, 79C Moreau	Poor: shrink-swell, low strength, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
79D*:				
Wayden	Poor: shrink-swell, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Moreau	Poor: shrink-swell, low strength, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
81D Cabba	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
81E Cabba	Poor: thin layer, area reclaim, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
82E*:				
Cabba	Poor: thin layer, area reclaim, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Badland.				
83C*:				
Vebar	Poor: area reclaim.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Fair: area reclaim.
Cohagen	Poor: thin layer, area reclaim.	Poor: thin layer, excess fines.	Unsuited: excess fines.	Fair: area reclaim.
83E*:				
Cohagen	Poor: slope, thin layer, area reclaim.	Poor: thin layer, excess fines.	Unsuited: excess fines.	Poor: slope.
Vebar	Poor: area reclaim.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Fair: slope, area reclaim.
84E*:				
Cohagen	Poor: slope, thin layer, area reclaim.	Poor: thin layer, excess fines.	Unsuited: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
84E*:				
Vebar	Poor: area reclaim.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Fair: slope, area reclaim.
Rock outcrop.				
85 Harriet Variant	Poor: low strength, wetness, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, excess sodium, wetness.
86E* Wabek	Good	Good	Good	Poor: thin layer, small stones.
87C*:				
Rhoades	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, excess sodium, excess salt.
Daglum	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess sodium.
88 Harriet	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt, excess sodium.
89E*. Ustorthents				
90C Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
91, 91B Straw	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
92B*:				
Noonan	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
93 Falkirk	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
94 Makoti	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
95*:				
Flaxton	Poor: low strength.	Poor: excess fines, thin layer.	Unsuited: excess fines.	Good.
Williams	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
96, 96B Grassna	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
97B, 97C: Sen	Poor: low strength, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
98E*:				
Ringling	Poor: large stones.	Unsuited: excess fines.	Unsuited: large stones.	Poor: slope, small stones, large stones.
Cabba	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
100B, 100C: Amor	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
101C: Parshall	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
102: Bowbells	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
104: Magnus	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
108*:				
Belfield	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Straw	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
109B*:				
Bowbells	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Zahl	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
110B: Belfield	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
111*. Pits				

* See map unit description for the composition and behavior of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1 Parnell	Favorable	Hard to pack	Floods, percs slowly, frost action.	Floods, wetness, slow intake.	Not needed	Wetness, percs slowly.
2 Tonka	Favorable	Hard to pack, wetness.	Frost action, percs slowly.	Wetness, percs slowly, floods.	Not needed	Wetness, percs slowly.
3D*:						
Seroco	Seepage	Piping	Not needed	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Slope, droughty.
Telfer	Seepage	Piping	Not needed	Droughty, fast intake, soil blowing.	Too sandy	Slope, droughty.
3E*:						
Seroco	Seepage	Piping	Not needed	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Dune land.						
5 Dimmick	Favorable	Wetness, hard to pack.	Floods, percs slowly.	Wetness, slow intake, percs slowly.	Not needed	Wetness, percs slowly.
7 Straw	Seepage	Low strength, shrink-swell.	Floods	Floods	Piping, erodes easily.	Erodes easily.
8, 8B Grail	Favorable	Favorable	Not needed	Slow intake, percs slowly.	Percs slowly	Percs slowly, erodes easily.
8C Grail	Favorable	Favorable	Not needed	Slope, slow intake, percs slowly.	Percs slowly	Percs slowly, erodes easily.
9B, 9C Regent	Favorable	Hard to pack	Not needed	Rooting depth, slow intake, percs slowly.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
10 Savage	Favorable	Low strength, shrink-swell, hard to pack.	Slope, percs slowly.	Percs slowly, slow intake, slope.	Percs slowly	Percs slowly.
11C Cherry	Favorable	Favorable	Not needed	Erodes easily, percs slowly, slope.	Percs slowly	Erodes easily, percs slowly.
14 Havrelon	Seepage	Piping	Not needed	Floods, soil blowing.	Not needed	Favorable.
15 Lawther	Favorable	Hard to pack	Not needed	Percs slowly, slow intake.	Percs slowly	Percs slowly.
17 Heil	Favorable	Hard to pack, piping.	Floods, percs slowly, excess salt.	Slow intake, percs slowly, floods.	Not needed	Excess salt, excess sodium, wetness.
20 Lohler	Favorable	Hard to pack	Not needed	Slow intake, percs slowly.	Not needed	Percs slowly.
21B Lihen	Seepage	Piping	Slope, cutbanks cave.	Soil blowing	Too sandy, soil blowing.	Favorable.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
21D------ Telfer	Seepage------	Piping------	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy------	Slope, droughty.
22B------ Krem	Seepage------	Piping------	Not needed-----	Fast intake, soil blowing.	Too sandy, soil blowing.	Erodes easily.
22D------ Krem	Seepage------	Piping------	Not needed-----	Fast intake, soil blowing, slope.	Too sandy, soil blowing.	Slope, erodes easily.
27, 27B------ Mandan	Seepage------	Piping------	Not needed-----	Favorable------	Erodes easily	Erodes easily.
28------ Wilton	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Erodes easily.
28B*:						
Temvik------	Favorable------	Piping------	Not needed-----	Favorable------	Erodes easily	Erodes easily.
Williams------	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Erodes easily.
28C*:						
Temvik------	Favorable------	Piping------	Not needed-----	Slope------	Erodes easily	Erodes easily.
Williams------	Favorable------	Favorable------	Not needed-----	Slope------	Favorable------	Erodes easily.
35C*:						
Amor------	Seepage, depth to rock.	Thin layer-----	Not needed-----	Rooting depth, slope.	Favorable------	Depth to rock.
Werner------	Depth to rock, seepage.	Thin layer-----	Not needed-----	Droughty, rooting depth, slope.	Depth to rock	Droughty, rooting depth.
35D*:						
Amor------	Seepage, depth to rock.	Thin layer-----	Not needed-----	Rooting depth, slope.	Slope------	Slope, depth to rock.
Werner------	Depth to rock, seepage.	Thin layer-----	Not needed-----	Droughty, rooting depth, slope.	Slope, depth to rock.	Slope, droughty, rooting depth.
36, 36B------ Williams	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Erodes easily.
36C------ Williams	Favorable------	Favorable------	Not needed-----	Slope------	Favorable------	Erodes easily.
38C*:						
Williams------	Favorable------	Favorable------	Not needed-----	Slope------	Favorable------	Erodes easily.
Zahl------	Favorable------	Favorable------	Not needed-----	Percs slowly, slope.	Percs slowly---	Erodes easily, percs slowly.
38D*:						
Zahl------	Favorable------	Favorable------	Not needed-----	Percs slowly, slope.	Slope, percs slowly.	Slope, erodes easily, percs slowly.
Williams------	Favorable------	Favorable------	Not needed-----	Slope------	Slope------	Slope, erodes easily.
38E------ Zahl	Favorable------	Favorable------	Not needed-----	Percs slowly, slope.	Slope, percs slowly.	Slope, erodes easily, percs slowly.
40, 40B------ Shambo	Seepage------	Piping------	Not needed-----	Favorable------	Favorable------	Favorable.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
41B: Parshall	Seepage	Seepage, piping.	Not needed	Favorable	Too sandy	Favorable.
43: Colvin	Favorable	Wetness	Frost action	Floods, wetness.	Not needed	Wetness.
44, 44B: Arnegard	Seepage	Piping	Not needed	Favorable	Favorable	Favorable.
44C: Arnegard	Seepage	Piping	Not needed	Slope	Favorable	Favorable.
47: Havrelon	Seepage	Piping	Not needed	Floods, soil blowing.	Not needed	Favorable.
51: Straw	Seepage	Low strength, shrink-swell.	Favorable	Favorable	Piping, erodes easily.	Erodes easily.
53: Banks	Seepage	Seepage, piping.	Not needed	Droughty, floods.	Not needed	Droughty.
54B: Lihen	Seepage	Piping	Slope, cutbanks cave.	Soil blowing	Too sandy, soil blowing.	Favorable.
55B: Vebar	Seepage, depth to rock.	Thin layer	Not needed	Soil blowing, rooting depth.	Depth to rock, soil blowing.	Depth to rock.
55C: Vebar	Seepage, depth to rock.	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Depth to rock, soil blowing.	Depth to rock.
56B: Lefor	Depth to rock, seepage.	Thin layer	Not needed	Soil blowing, rooting depth.	Soil blowing	Depth to rock.
56D: Lefor	Depth to rock, seepage.	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Soil blowing	Slope, depth to rock.
57B: Flaxton	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Erodes easily.
57C: Flaxton	Seepage	Favorable	Not needed	Slope, soil blowing.	Soil blowing	Erodes easily.
58B*:						
Flaxton	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Erodes easily.
Williams	Favorable	Favorable	Not needed	Favorable	Favorable	Erodes easily.
58C*:						
Flaxton	Seepage	Favorable	Not needed	Slope, soil blowing.	Soil blowing	Erodes easily.
Williams	Favorable	Favorable	Not needed	Slope	Favorable	Erodes easily.
58D*:						
Flaxton	Seepage	Favorable	Not needed	Slope, soil blowing.	Slope, soil blowing.	Slope, erodes easily.
Williams	Favorable	Favorable	Not needed	Slope	Slope	Slope, erodes easily.
59B: Parshall	Seepage	Seepage, piping.	Not needed	Soil blowing	Too sandy, soil blowing.	Favorable.
62B: Velva	Seepage	Piping	Not needed	Soil blowing, floods.	Not needed	Favorable.
67*: Straw	Seepage	Low strength, shrink-swell.	Floods	Floods	Piping, erodes easily.	Erodes easily.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
71B Searing	Depth to rock, seepage.	Thin layer	Not needed	Rooting depth	Favorable	Depth to rock.
71C*: Searing	Depth to rock, seepage.	Thin layer	Not needed	Slope, rooting depth.	Favorable	Depth to rock.
Ringling	Seepage, slope.	Seepage	Not needed	Slope, rooting depth.	Slope, large stones.	Slope, droughty.
73 Belfield	Favorable	Hard to pack	Not needed	Slow intake, percs slowly.	Percs slowly	Excess sodium, excess salt.
74B*, 74C*: Regent	Favorable	Hard to pack	Not needed	Rooting depth, slow intake, percs slowly.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Rhoades	Favorable	Hard to pack, piping.	Not needed	Excess sodium, excess salt, slow intake.	Percs slowly	Excess sodium, excess salt.
75*, 75B*: Belfield	Favorable	Hard to pack	Not needed	Slow intake, percs slowly.	Percs slowly	Excess sodium, excess salt.
Daglum	Depth to rock	Hard to pack, piping.	Not needed	Excess sodium, excess salt, slow intake.	Percs slowly	Excess sodium, excess salt, percs slowly.
75C*: Belfield	Favorable	Hard to pack	Not needed	Slow intake, percs slowly, slope.	Percs slowly	Excess sodium, excess salt.
Daglum	Depth to rock	Hard to pack, piping.	Not needed	Excess sodium, excess salt, slow intake.	Percs slowly	Excess sodium, excess salt, percs slowly.
76B*: Sen	Seepage, depth to rock.	Piping, thin layer.	Not needed	Rooting depth	Erodes easily	Erodes easily, depth to rock.
Rhoades	Favorable	Hard to pack, piping.	Not needed	Excess sodium, excess salt, slow intake.	Percs slowly	Excess sodium, excess salt.
76C*: Sen	Seepage, depth to rock.	Piping, thin layer.	Not needed	Rooting depth, slope.	Erodes easily	Erodes easily, depth to rock.
Rhoades	Favorable	Hard to pack, piping.	Not needed	Excess sodium, excess salt, slow intake.	Percs slowly	Excess sodium, excess salt.
77, 77B Bowdle	Seepage	Seepage	Not needed	Droughty	Too sandy	Droughty.
77C*: Bowdle	Seepage	Seepage	Not needed	Slope, droughty.	Too sandy	Droughty.
Wabek	Seepage	Seepage	Not needed	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
78B*: Noonan	Favorable	Piping	Not needed	Percs slowly, excess sodium.	Percs slowly	Excess sodium, percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
78B*:						
Flaxton	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Erodes easily.
79B, 79C Moreau	Favorable	Piping	Not needed	Percs slowly, rooting depth, slow intake.	Depth to rock	Excess salt, excess sodium.
79D*:						
Wayden	Depth to rock	Thin layer, hard to pack.	Not needed	Slow intake, percs slowly, rooting depth.	Slope, depth to rock, percs slowly.	Slope, droughty, rooting depth.
Moreau	Favorable	Piping	Not needed	Percs slowly, rooting depth, slow intake.	Slope, depth to rock.	Slope, excess salt, excess sodium.
81D, 81E Cabba	Slope, depth to rock, seepage.	Thin layer, piping, low strength.	Depth to rock	Rooting depth	Depth to rock, slope, rooting depth.	Rooting depth, slope, droughty.
82E*:						
Cabba	Slope, depth to rock, seepage.	Thin layer, piping, low strength.	Depth to rock	Rooting depth	Depth to rock, slope, rooting depth.	Rooting depth, slope, droughty.
Badland.						
83C*:						
Vebar	Seepage, depth to rock.	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Depth to rock, soil blowing.	Depth to rock.
Cohagen	Seepage	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Depth to rock, soil blowing.	Rooting depth, depth to rock.
83E*:						
Cohagen	Seepage	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Slope, depth to rock, soil blowing.	Slope, rooting depth, depth to rock.
Vebar	Seepage, depth to rock.	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
84E*:						
Cohagen	Seepage	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Slope, depth to rock, soil blowing.	Slope, rooting depth, depth to rock.
Vebar	Seepage, depth to rock.	Thin layer	Not needed	Soil blowing, rooting depth, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Rock outcrop.						
85 Harriet Variant	Favorable	Hard to pack, wetness, piping.	Percs slowly, frost action, excess salt.	Wetness, percs slowly, excess sodium.	Not needed	Wetness, excess salt, excess sodium.
86E* Wabek	Seepage	Seepage	Not needed	Droughty, soil blowing, slope.	Slope, too sandy, soil blowing.	Slope, droughty.
87C*:						
Rhoades	Favorable	Hard to pack, piping.	Not needed	Excess sodium, excess salt, slow intake.	Percs slowly	Excess sodium, excess salt.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
87C*:						
Daglum	Depth to rock	Hard to pack, piping.	Not needed	Excess sodium, excess salt, slow intake.	Percs slowly	Excess sodium, excess salt, percs slowly.
88 Harriet	Favorable	Wetness, piping.	Floods, percs slowly, frost action.	Slow intake, excess sodium, excess salt.	Not needed	Wetness, excess salt, excess sodium.
89E*. Ustorthents						
90C Williams	Favorable	Favorable	Not needed	Favorable	Favorable	Erodes easily.
91 Straw	Seepage	Low strength, shrink-swell.	Floods	Floods	Piping, erodes easily.	Erodes easily.
91B Straw	Seepage	Low strength, shrink-swell.	Slope	Floods	Piping, erodes easily.	Erodes easily.
92B*:						
Noonan	Favorable	Piping	Not needed	Percs slowly, excess sodium.	Percs slowly	Excess sodium, percs slowly.
Williams	Favorable	Favorable	Not needed	Favorable	Favorable	Erodes easily.
93 Falkirk	Favorable	Favorable	Not needed	Favorable	Favorable	Erodes easily.
94 Makoti	Favorable	Piping	Not needed	Favorable	Not needed	Erodes easily.
95*:						
Flaxton	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Erodes easily.
Williams	Favorable	Favorable	Not needed	Favorable	Favorable	Erodes easily.
96, 96B Grassna	Seepage	Piping	Not needed	Favorable	Favorable	Favorable.
97B Sen	Seepage, depth to rock.	Piping, thin layer.	Not needed	Rooting depth	Erodes easily	Erodes easily, depth to rock.
97C Sen	Seepage, depth to rock.	Piping, thin layer.	Not needed	Rooting depth, slope.	Erodes easily	Erodes easily, depth to rock.
98E*:						
Ringling	Seepage, slope.	Seepage	Not needed	Slope, rooting depth.	Slope, large stones.	Slope, droughty.
Cabba	Slope, depth to rock, seepage.	Thin layer, piping, low strength.	Depth to rock	Rooting depth	Depth to rock, slope, rooting depth.	Rooting depth, slope, droughty.
100B Amor	Seepage, depth to rock.	Thin layer	Not needed	Rooting depth	Favorable	Depth to rock.
100C Amor	Seepage, depth to rock.	Thin layer	Not needed	Rooting depth, slope.	Favorable	Depth to rock.
101C Parshall	Seepage	Seepage, piping.	Not needed	Slope, soil blowing.	Too sandy, soil blowing.	Favorable.
102 Bowbells	Favorable	Favorable	Not needed	Favorable	Favorable	Erodes easily.
104 Magnus	Favorable	Hard to pack	Not needed	Percs slowly, slow intake.	Not needed	Percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
108*:						
Belfield----------	Favorable-------	Hard to pack---	Not needed-----	Slow intake, percs slowly.	Percs slowly---	Excess sodium, excess salt.
Straw-------------	Seepage---------	Low strength, shrink-swell.	Slope-----------	Slope-----------	Piping, erodes easily.	Erodes easily.
109B*:						
Bowbells----------	Favorable-------	Favorable-------	Not needed-----	Favorable-------	Favorable-------	Erodes easily.
Zahl--------------	Favorable-------	Favorable-------	Not needed-----	Percs slowly---	Percs slowly---	Erodes easily, percs slowly.
110B-------------- Belfield	Favorable-------	Hard to pack---	Not needed-----	Slow intake, percs slowly.	Percs slowly---	Excess sodium, excess salt.
111*. Pits						

* See map unit description for the composition and behavior of the map unit.

TABLE 12.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1: Parnell	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
2: Tonka	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
3D*:				
Seroco	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
Telfer	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
3E*:				
Seroco	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
Dune land.				
5: Dimmick	Severe: floods, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: floods, wetness, too clayey.	Severe: wetness, too clayey.
7: Straw	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: too clayey.
8, 8B: Grail	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
8C: Grail	Moderate: percs slowly.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
9B: Regent	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
9C: Regent	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
10: Savage	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey, slope.	Moderate: too clayey.
11C: Cherry	Moderate: too clayey.	Slight	Severe: slope.	Slight.
14: Havrelon	Moderate: too clayey.	Moderate: floods.	Moderate: too clayey.	Moderate: floods.
15: Lawther	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
17 Heil	Severe: floods, wetness, percs slowly.	Severe: wetness.	Severe: wetness, floods, percs slowly.	Severe: wetness.
20 Lohler	Severe: too clayey.	Moderate: floods, too clayey.	Severe: too clayey.	Moderate: too clayey, floods.
21B Lihen	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
21D Telfer	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
22B Krem	Moderate: percs slowly, too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
22D Krem	Moderate: slope, percs slowly, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
27, 27B Mandan	Slight	Slight	Moderate: slope.	Slight.
28 Wilton	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
28B*:				
Temvik	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Williams	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
28C*:				
Temvik	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Williams	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
35C*:				
Amor	Slight	Slight	Severe: slope.	Slight.
Werner	Slight	Slight	Severe: slope.	Slight.
35D*:				
Amor	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Werner	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
36, 36B Williams	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
36C Williams	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
38C*:				
Williams	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Zahl	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
38D*:				
Zahl	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
Williams	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
38E Zahl	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
40, 40B Shambo	Slight	Slight	Moderate: slope.	Slight.
41B Parshall	Slight	Slight	Moderate: slope.	Slight.
43 Colvin	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
44, 44B Arnegard	Slight	Slight	Moderate: slope.	Slight.
44C Arnegard	Slight	Slight	Severe: slope.	Slight.
47 Havrelon	Slight	Moderate: floods.	Severe: floods.	Moderate: floods.
51 Straw	Moderate: floods.	Slight	Slight	Slight.
53 Banks	Severe: floods.	Slight	Slight	Slight.
54B Lihen	Slight	Slight	Moderate: slope.	Slight.
55B Vebar	Slight	Slight	Moderate: depth to rock, slope.	Slight.
55C Vebar	Slight	Slight	Severe: slope.	Slight.
56B Lefor	Slight	Slight	Moderate: slope, depth to rock.	Slight.
56D Lefor	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
57B Flaxton	Moderate: percs slowly.	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
57C Flaxton	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
58B*:				
Flaxton	Moderate: percs slowly.	Slight	Moderate: slope.	Slight.
Williams	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
58C*:				
Flaxton	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Williams	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
58D*:				
Flaxton	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
Williams	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
59B Parshall	Slight	Slight	Moderate: slope.	Slight.
62B Velva	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
67* Straw	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
71B Searing	Slight	Slight	Moderate: slope, depth to rock.	Slight.
71C*:				
Searing	Slight	Slight	Severe: slope.	Slight.
Ringling	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Moderate: small stones.
73 Belfield	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
74B*:				
Regent	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
Rhoades	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
74C*:				
Regent	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
Rhoades	Severe: percs slowly.	Slight	Severe: slope, percs slowly.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
75*, 75B*:				
Belfield	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Daglum	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
75C*:				
Belfield	Moderate: percs slowly.	Slight	Severe: slope.	Slight.
Daglum	Severe: percs slowly.	Slight	Severe: slope, percs slowly.	Slight.
76B*:				
Sen	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Rhoades	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
76C*:				
Sen	Slight	Slight	Severe: slope.	Slight.
Rhoades	Severe: percs slowly.	Slight	Severe: slope, percs slowly.	Slight.
77, 77B Bowdle	Slight	Slight	Moderate: slope.	Slight.
77C*:				
Bowdle	Slight	Slight	Severe: slope.	Slight.
Wabek	Slight	Slight	Severe: slope.	Slight.
78B*:				
Noonan	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Flaxton	Moderate: percs slowly.	Slight	Moderate: slope.	Slight.
79B Moreau	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
79C Moreau	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.
79D*:				
Wayden	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope, too clayey, depth to rock.	Moderate: too clayey.
Moreau	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
81D: Cabba	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
81E: Cabba	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
82E*:				
Cabba	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Badland.				
83C*:				
Vebar	Slight	Slight	Severe: slope.	Slight.
Cohagen	Severe: depth to rock.	Slight	Severe: depth to rock, slope.	Slight.
83E*:				
Cohagen	Severe: slope, depth to rock.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.
Vebar	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
84E*:				
Cohagen	Severe: slope, depth to rock.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.
Vebar	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Rock outcrop.				
85: Harriet Variant	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
86E*: Wabek	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
87C*:				
Rhoades	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Daglum	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
88: Harriet	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
89E*. Ustorthents				
90C: Williams	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
91, 91B: Straw	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
92B*:				
Noonan	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Williams	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
93 Falkirk	Slight	Slight	Moderate: slope.	Slight.
94 Makoti	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
95*:				
Flaxton	Moderate: percs slowly.	Slight	Moderate: slope.	Slight.
Williams	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
96, 96B Grassna	Slight	Slight	Moderate: slope.	Slight.
97B Sen	Slight	Slight	Moderate: slope, depth to rock.	Slight.
97C Sen	Slight	Slight	Severe: slope.	Slight.
98E*:				
Ringling	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
Cabba	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
100B Amor	Slight	Slight	Moderate: depth to rock, slope.	Slight.
100C Amor	Slight	Slight	Severe: slope.	Slight.
101C Parshall	Slight	Slight	Severe: slope.	Slight.
102 Bowbells	Slight	Slight	Moderate: slope.	Slight.
104 Magnus	Severe: floods.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
108*:				
Belfield	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Straw	Moderate: floods.	Slight	Moderate: slope.	Slight.
109B*:				
Bowbells	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
109B*:				
Zahl	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
110B Belfield	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
111*. Pits				

* See map unit description for the composition and behavior of the map unit.

TABLE 13.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates 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 herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1: Parnell	Very poor	Very poor	Poor	---	Good	Good	Very poor	Good	---
2: Tonka	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Poor.
3D*:									
Seroco	Poor	Fair	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.
Telfer	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
3E*:									
Seroco	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
Dune land.									
5: Dimmick	Very poor	Poor	Poor	Poor	Poor	Good	Very poor	Fair	Poor.
7: Straw	Good	Good	Good	Good	Good	Fair	Good	Fair	Good.
8, 8B: Grail	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
8C: Grail	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
9B: Regent	Good	Good	Good	Poor	Poor	Very poor	Good	Very poor	Fair.
9C: Regent	Fair	Good	Good	Poor	Poor	Very poor	Fair	Very poor	Fair.
10: Savage	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
11C: Cherry	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
14: Havrelon	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
15: Lawther	Good	Good	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
17: Heil	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
20: Lohler	Good	Good	Poor	Good	Poor	Fair	Fair	Poor	Fair.
21B: Lihen	Fair	Fair	Good	Good	---	---	Fair	---	Good.
21D: Telfer	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
22B: Krem	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
22D Krem	Poor	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
27, 27B Mandan	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
28 Wilton	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
28B*:									
Temvik	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
28C*:									
Temvik	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Williams	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
35C*:									
Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Werner	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
35D*:									
Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Werner	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
36, 36B Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
36C Williams	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
38C*:									
Williams	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Zahl	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
38D*:									
Zahl	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Williams	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
38E Zahl	Very poor	Very poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
40, 40B Shambo	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
41B Parshall	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
43 Colvin	Poor	Fair	Fair	Fair	Good	Good	Poor	Good	Fair.
44 Arnegard	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
44B, 44C Arnegard	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
47 Havrelon	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
51 Straw	Good	Good	Good	Good	Good	Fair	Good	Fair	Good.
53 Banks	Fair	Good	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.
54B Lihen	Fair	Fair	Good	Good	---	---	Fair	---	Good.
55B, 55C Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
56B Lefor	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
56D Lefor	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
57B, 57C Flaxton	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
58B*:									
Flaxton	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
58C*:									
Flaxton	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Williams	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
58D*:									
Flaxton	Poor	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Williams	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
59B Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
62B Velva	Fair	Good	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
67* Straw	Good	Good	Good	Good	Good	Fair	Good	Fair	Good.
71B Searing	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
71C*:									
Searing	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ringling.									
73 Belfield	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
74B*:									
Regent	Good	Good	Good	Poor	Poor	Very poor	Good	Very poor	Fair.
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
74C*:									
Regent	Fair	Good	Good	Poor	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
74C*:									
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
75*:									
Belfield	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Daglum	Fair	Good	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.
75B*, 75C*:									
Belfield	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Daglum	Fair	Good	Fair	Very poor	Poor	Very poor	Fair	Very poor	Poor.
76B*, 76C*:									
Sen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
77, 77B Bowdle	Fair	Fair	Good	---	Very poor	Very poor	Fair	Very poor	Good.
77C*:									
Bowdle	Poor	Fair	Good	---	Very poor	Very poor	Fair	Very poor	Good.
Wabek	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
78B*:									
Noonan	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
Flaxton	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
79B Moreau	Fair	Good	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
79C Moreau	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
79D*:									
Wayden	Poor	Fair	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
Moreau	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
81D Cabba	Poor	Fair	Fair	Fair	---	---	Fair	---	Fair.
81E Cabba	Very poor	Very poor	Fair	Fair	---	---	Poor	---	Fair.
82E*:									
Cabba	Very poor	Very poor	Fair	Fair	---	---	Poor	---	Fair.
Badland.									
83C*:									
Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
Cohagen	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
83E*:									
Cohagen	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Vebar	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Good.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
84E*:									
Cohagen	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Vebar	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Good.
Rock outcrop.									
85 Harriet Variant	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
86E* Wabek	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
87C*:									
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
Daglum	Fair	Good	Fair	Very poor	Poor	Very poor	Fair	Very poor	Poor.
88 Harriet	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
89E*. Ustorthents									
90C Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
91, 91B Straw	Good	Good	Good	Good	Good	Fair	Good	Fair	Good.
92B*:									
Noonan	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
93 Falkirk	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Good.
94 Makoti	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Fair.
95*:									
Flaxton	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
96, 96B Grassna	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
97B, 97C Sen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
98E*:									
Ringling	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Cabba	Very poor	Very poor	Fair	Fair	---	---	Poor	---	Fair.
100B, 100C Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
101C Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
102------------------ Bowbells	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
104------------------ Magnus	Good	Good	Fair	Good	Poor	Poor	Good	Poor	Fair.
108*:									
Belfield-----------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Straw--------------	Good	Good	Good	Good	Good	Fair	Good	Fair	Good.
109B*:									
Bowbells-----------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Zahl---------------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
110B---------------- Belfield	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
111*. Pits									

* See map unit description for the composition and behavior of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1-------------------- Parnell	0-16	Silt loam--------	CL-ML, OL, CL	A-4, A-6	0	100	100	90-100	70-90	25-40	2-10
	16-43	Clay loam, silty clay loam, silty clay.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-80	20-50
	43-60	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	95-100	90-100	80-95	70-95	30-80	15-50
2-------------------- Tonka	0-16	Silt loam, loam	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	16-38	Silty clay loam, clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	38-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	20-50	10-30
3D*: Seroco-------------	0-3	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	---	NP
	3-60	Fine sand, loamy fine sand, loamy sand.	SM	A-2	0	100	100	65-80	20-35	---	NP
Telfer-------------	0-10	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	10-60	Fine sand, loamy fine sand.	SM	A-2	0	100	100	50-80	15-35	---	NP
3E*: Seroco-------------	0-3	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	---	NP
	3-60	Fine sand, loamy fine sand, loamy sand.	SM	A-2	0	100	100	65-80	20-35	---	NP
Dune land.											
5-------------------- Dimmick	0-60	Silty clay, clay	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
7-------------------- Straw	0-20	Silty clay loam	CL	A-6	0	100	100	90-100	70-95	30-40	10-15
	20-46	Loam, silty clay, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
	46-60	Loamy sand, fine sandy loam.	SM	A-2	0	100	100	55-70	15-30	---	NP
8, 8B, 8C----------- Grail	0-12	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	20-45	10-30
	12-26	Silty clay-------	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
	26-60	Loam, silt loam, silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-50	5-25
9B, 9C-------------- Regent	0-38	Silty clay loam	CL, CH	A-6, A-7	0	100	100	90-100	85-95	30-70	15-45
	38-60	Weathered bedrock.									
10------------------- Savage	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	15-30
	8-60	Silty clay loam, silty clay.	CL, MH	A-7	0	100	100	95-100	85-95	40-70	20-45
11C------------------ Cherry	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	75-95	30-50	15-30
	4-36	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	75-95	30-50	15-30
	36-60	Stratified loam to clay.	CL, CH, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-60	5-35

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
14----------------- Havrelon	0-8	Silty clay loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-45	3-28
	8-60	Stratified silty clay loam to very fine sand.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	50-80	20-45	3-28
15----------------- Lawther	0-60	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	80-95	45-70	25-40
17----------------- Heil	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	20-50	10-30
	4-60	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
20----------------- Lohler	0-8	Silty clay-------	CH, CL	A-7	0	100	100	95-100	80-95	45-70	25-50
	8-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	80-95	45-70	25-50
21B---------------- Lihen	0-24	Loamy fine sand	SM	A-2	0	100	100	50-75	15-30	---	NP
	24-60	Sandy loam, loamy fine sand, loamy sand.	SM	A-2, A-4	0	100	100	55-75	20-40	---	NP
21D---------------- Telfer	0-10	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	10-60	Fine sand, loamy fine sand.	SM	A-2	0	100	100	50-80	15-35	---	NP
22B, 22D----------- Krem	0-30	Loamy fine sand	SM	A-2	0-1	95-100	95-100	50-75	15-30	---	NP
	30-60	Clay loam, loam, sandy clay loam.	CL, ML, CL-ML	A-6, A-7, A-4	0-5	95-100	95-100	85-95	60-80	25-50	3-28
27, 27B------------ Mandan	0-30	Silt loam--------	ML, CL	A-4	0	100	100	90-100	80-100	20-40	NP-10
	30-60	Silt loam--------	ML, CL	A-4	0	100	100	90-100	80-100	20-40	NP-10
28----------------- Wilton	0-9	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	90-100	70-90	25-35	5-10
	9-31	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	90-100	70-90	25-35	5-10
	31-60	Loam, clay loam	ML, CL	A-4, A-6, A-7	0-5	90-100	85-100	80-95	60-80	30-50	5-25
28B*:											
Temvik-------------	0-11	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	25-40	NP-10
	11-27	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	25-40	NP-10
	27-60	Clay loam, loam	ML, CL, CL-ML	A-6	0-5	95-100	95-100	80-95	60-80	25-40	3-18
Williams-----------	0-8	Silt loam--------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	8-24	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	24-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
28C*:											
Temvik-------------	0-11	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	25-40	NP-10
	11-29	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	25-40	NP-10
	29-60	Clay loam, loam	ML, CL, CL-ML	A-6	0-5	95-100	95-100	80-95	60-80	25-40	3-18

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
28C*:											
Williams	0-8	Silt loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	8-24	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	24-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
35C*, 35D*:											
Amor	0-8	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	65-85	25-40	3-18
	8-32	Clay loam, loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	75-100	50-80	20-45	2-25
	32-60	Weathered bedrock.									
Werner	0-8	Loam	CL-ML, CL, SM-SC, SC	A-4. A-6	0-5	90-100	85-100	80-95	35-90	25-40	5-20
	8-17	Loam, very fine sandy loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	85-100	80-95	50-90	25-50	5-25
	17-60	Weathered bedrock.									
36, 36B, 36C Williams	0-7	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	7-26	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
38C*:											
Williams	0-6	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-18	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	18-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
Zahl	0-5	Loam	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-60	Clay loam, loam	CL	A-6	0-1	95-100	95-100	80-95	60-80	25-40	10-20
38D*:											
Zahl	0-5	Loam	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-60	Clay loam, loam	CL	A-6	0-1	95-100	95-100	80-95	60-80	25-40	10-20
Williams	0-5	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	5-15	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	15-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
38E Zahl	0-5	Loam	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-60	Clay loam, loam	CL	A-6	0-1	95-100	95-100	80-95	60-80	25-40	10-20
40 Shambo	0-8	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	3-13
	8-24	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
	24-60	Stratified loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
40B Shambo	0-8	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	3-13
	8-24	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
	24-60	Stratified loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
41B Parshall	0-17	Loam	ML	A-4	0	100	100	85-95	60-75	20-40	NP-10
	17-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
43 Colvin	0-60	Silt loam	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	11-30
44, 44B, 44C Arnegard	0-10	Loam	ML	A-4	0	100	100	85-100	60-90	25-35	NP-10
	10-39	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-15
	39-60	Fine sandy loam, loam, clay loam.	SM, ML, CL, SC	A-4, A-6	0	100	100	70-95	40-80	15-40	NP-15
47 Havrelon	0-8	Loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-45	3-28
	8-60	Stratified silty clay loam to very fine sand.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	50-80	20-45	3-28
51 Straw	0-20	Silt loam	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	20-46	Loam, silty clay, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
	46-60	Loamy sand, fine sandy loam.	SM	A-2	0	100	100	55-70	15-30	---	NP
53 Banks	0-10	Loam, very fine sandy loam.	SM, ML	A-4	0	100	100	80-95	45-75	20-40	NP-10
	10-60	Loamy fine sand, fine sand, sand.	SM, SP-SM	A-2	0	100	100	50-70	10-25	---	NP
54B Lihen	0-17	Fine sandy loam	SM	A-2, A-4	0	100	100	65-80	25-50	---	NP
	17-60	Sandy loam, loamy fine sand, loamy sand.	SM	A-2, A-4	0	100	100	55-75	20-40	---	NP
55B, 55C Vebar	0-34	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	34-60	Weathered bedrock.									
56B Lefor	0-13	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	15-25	NP-5
	13-34	Sandy clay loam, loam, clay loam.	SC, CL	A-6	0	100	100	80-90	35-55	20-40	10-25
	34-60	Weathered bedrock.									
56D Lefor	0-13	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	15-25	NP-5
	13-34	Sandy clay loam, loam, clay loam.	SC, CL	A-6	0	100	100	80-90	35-55	20-40	10-25
	34-60	Weathered bedrock.									

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
57B, 57C: Flaxton	0-11	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	<30	NP-5
	11-28	Fine sandy loam	SM	A-2, A-4	0	100	100	60-85	30-45	<30	NP-5
	28-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-80	25-45	5-25
58B*, 58C*, 58D*: Flaxton	0-11	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	<30	NP-5
	11-28	Fine sandy loam	SM	A-2, A-4	0	100	100	60-85	30-45	<30	NP-5
	28-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-80	25-45	5-25
Williams	0-5	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	5-20	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	20-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
59B: Parshall	0-17	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	17-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
62B: Velva	0-6	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	100	100	60-95	35-65	15-25	NP-5
	6-60	Fine sandy loam, loamy fine sand, loam.	ML, SM	A-4	0	100	100	70-95	30-75	20-30	NP-5
67*: Straw	0-20	Silt loam, loam	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	20-46	Loam, silty clay, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
	46-60	Loamy sand, fine sandy loam.	SM	A-2	0	100	100	55-70	15-30	---	NP
71B: Searing	0-6	Loam	ML, CL-ML, CL	A-4, A-6	0	100	100	85-95	65-85	20-35	5-20
	6-18	Loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	85-100	65-85	30-45	10-25
	18-28	Loam, channery loam.	ML, SM, CL, SC	A-2, A-4, A-6	0-5	60-100	40-80	35-75	30-65	20-35	3-15
	28-60	Weathered bedrock.									
71C*: Searing	0-6	Loam	ML, CL-ML, CL	A-4, A-6	0	100	100	85-95	65-85	20-35	5-20
	6-16	Loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	85-100	65-85	30-45	10-25
	16-24	Loam, channery loam.	ML, SM, CL, SC	A-2, A-4, A-6	0-5	60-100	40-80	35-75	30-65	20-35	3-15
	24-60	Weathered bedrock.									
Ringling	0-15	Channery loam	GM	A-4	0-10	60-70	50-75	50-60	35-50	20-40	NP-5
	15-60	Fragmental material.	GP	A-1	80-90	15-25	5-10	0-5	0	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
73----------------- Belfield	0-13	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	80-100	70-90	20-40	3-20
	13-32	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-95	50-70	30-50
	32-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-65	30-50
74B*, 74C*:											
Regent-------------	0-38	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	90-100	85-95	30-70	15-45
	38-60	Weathered bedrock.									
Rhoades------------	0-2	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	2-21	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	21-60	Silty clay, clay loam, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
75*, 75B*, 75C*:											
Belfield-----------	0-13	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	80-100	70-90	20-40	3-20
	13-32	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-95	50-70	30-50
	32-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-65	30-50
Daglum-------------	0-9	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	15-25
	9-18	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	90-100	85-95	40-75	20-45
	18-60	Clay, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	85-95	40-50	20-30
76B*, 76C*:											
Sen----------------	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-85	25-40	3-18
	5-31	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-95	30-50	5-25
	31-60	Weathered bedrock.									
Rhoades------------	0-2	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	2-21	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	21-60	Silty clay, clay loam, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
77, 77B------------ Bowdle	0-7	Loam-------------	ML, CL, CL-ML	A-6, A-4	0	100	95-100	85-95	60-85	25-40	3-18
	7-24	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	80-95	60-80	25-40	3-18
	24-60	Sand and gravel	SM, SP-SM, GM, GP-GM	A-1, A-2, A-3	0	40-80	25-75	15-70	5-30	<30	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
77C*:											
Bowdle	0-5	Loam	ML, CL, CL-ML	A-6, A-4	0	100	95-100	85-95	60-85	25-40	3-18
	5-22	Loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	80-95	60-80	25-40	3-18
	22-60	Sand and gravel	SM, SP-SM, GM, GP-GM	A-1, A-2, A-3	0	40-80	25-75	15-70	5-30	<30	NP-5
Wabek	0-7	Gravelly sandy loam.	SM	A-2, A-4	0-1	85-100	85-100	60-70	30-40	---	NP
	7-13	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam.	SM, GM	A-2, A-4	0-1	50-100	50-95	50-65	20-40	---	NP
	13-60	Very gravelly coarse sand, gravelly loamy coarse sand, sand.	SM, SP, GM, GP	A-1, A-2	0-1	50-100	50-95	10-40	2-35	---	NP
78B*:											
Noonan	0-9	Fine sandy loam	CL, CL-ML	A-4, A-6	0-1	95-100	95-100	80-95	55-75	20-40	5-25
	9-29	Clay loam	CL, CH	A-6, A-7	0-1	95-100	95-100	85-95	65-80	25-60	10-35
	29-50	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-1	95-100	95-100	80-95	60-80	25-50	5-25
Flaxton	0-11	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	<30	NP-5
	11-38	Fine sandy loam	SM	A-2, A-4	0	100	100	60-85	30-45	<30	NP-5
	38-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-80	25-45	5-25
79B, 79C Moreau	0-7	Silty clay	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	7-21	Clay, silty clay	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	21-28	Clay, silty clay	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	28-60	Weathered bedrock.									
79D*:											
Wayden	0-12	Silty clay	CH, CL	A-7	0	100	100	90-100	85-95	40-75	20-50
	12-60	Weathered bedrock.									
Moreau	0-7	Silty clay	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	7-21	Clay, silty clay	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	21-28	Clay, silty clay	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	28-60	Weathered bedrock.									
81D Cabba	0-4	Loam	SM-SC, CL-ML, SM, ML	A-4	0	100	100	95-100	45-70	25-40	5-10
	4-18	Loam, silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	90-100	70-95	30-50	5-30
	18-60	Weathered bedrock.									
81E Cabba	0-8	Loam	SM-SC, CL-ML, SM, ML	A-4	0	100	100	95-100	45-70	25-40	5-10
	8-16	Loam, silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	90-100	70-95	30-50	5-30
	16-60	Weathered bedrock.									

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
82E*:											
Cabba	0-8	Loam	SM-SC, CL-ML, SM, ML	A-4	0	100	100	95-100	45-70	25-40	5-10
	8-16	Loam, silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	90-100	70-95	30-50	5-30
	16-60	Weathered bedrock.									
Badland.											
83C*:											
Vebar	0-25	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	25-60	Weathered bedrock.									
Cohagen	0-14	Fine sandy loam	SM	A-2, A-4	0	100	95-100	60-85	30-50	---	NP
	14-60	Weathered bedrock.									
83E*:											
Cohagen	0-14	Fine sandy loam	SM	A-2, A-4	0	100	95-100	60-85	30-50	---	NP
	14-60	Weathered bedrock.									
Vebar	0-25	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	25-60	Weathered bedrock.									
84E*:											
Cohagen	0-14	Fine sandy loam	SM	A-2, A-4	0	100	95-100	60-85	30-50	---	NP
	14-60	Weathered bedrock.									
Vebar	0-25	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	25-60	Weathered bedrock.									
Rock outcrop.											
85 Harriet Variant	0-6	Silt loam	CL	A-6	0	100	100	90-100	70-90	20-40	10-20
	6-19	Silt loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	15-30
	19-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-90	25-55	15-30
86E* Wabek	0-7	Gravelly sandy loam.	SM	A-2, A-4	0-1	85-100	85-100	60-70	30-40	---	NP
	7-13	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam.	SM, GM	A-2, A-4	0-1	50-100	50-95	50-65	20-40	---	NP
	13-60	Very gravelly coarse sand, gravelly loamy coarse sand, sand.	SM, SP, GM, GP	A-1, A-2	0-1	50-100	50-95	10-40	2-35	---	NP
87C*:											
Rhoades	0-2	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	2-21	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	21-60	Silty clay, silty clay loam, loam, silt.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
87C*:											
Daglum	0-7	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	15-25
	7-15	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	90-100	85-95	40-75	20-45
	15-60	Clay, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	85-95	40-50	20-30
88 Harriet	0-1	Loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-90	25-45	5-20
	1-20	Clay loam, clay, silty clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-70	15-50
	20-60	Very fine sandy loam, loam, clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-95	55-80	20-45	5-25
89E*. Ustorthents											
90C Williams	0-7	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	7-26	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
91, 91B Straw	0-20	Loam	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	20-46	Loam, silty clay, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
	46-60	Loamy sand, fine sandy loam.	SM	A-2	0	100	100	55-70	15-30	---	NP
92B*:											
Noonan	0-7	Loam	CL, CL-ML	A-4, A-6	0-1	95-100	95-100	80-95	55-75	20-40	5-25
	7-30	Clay loam	CL, CH	A-6, A-7	0-1	95-100	95-100	85-95	65-80	25-60	10-35
	30-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-1	95-100	95-100	80-95	60-80	25-50	5-25
Williams	0-7	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	7-26	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
93 Falkirk	0-13	Loam	ML	A-4	0	100	100	85-95	60-75	20-40	NP-10
	13-18	Loam	ML	A-4	0	100	100	85-95	60-75	20-40	NP-10
	18-26	Gravelly loam	ML, SM	A-4	0-5	65-95	65-90	55-80	40-70	20-40	NP-10
	26-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	90-100	85-100	80-95	60-80	25-50	5-30
94 Makoti	0-11	Silt loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	20-45	3-25
	11-22	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	20-45	3-28
	22-60	Stratified very fine sandy loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-45	3-28

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
95*:											
Flaxton------------	0-11	Loam-------------	SM, ML	A-4	0	100	100	70-85	40-55	<30	NP-5
	11-28	Fine sandy loam	SM	A-2, A-4	0	100	100	60-85	30-45	<30	NP-5
	28-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-80	25-45	5-25
Williams-----------	0-5	Loam-------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	5-20	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
	20-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-95	60-80	30-50	10-30
96, 96B------------ Grassna	0-17	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-90	20-45	3-25
	17-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-95	20-45	3-25
97B, 97C----------- Sen	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	70-85	25-40	3-18
	5-31	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-95	30-50	5-25
	31-60	Weathered bedrock.									
98E*:											
Ringling-----------	0-15	Channery loam----	GM	A-4	0-10	60-70	50-75	50-60	35-50	20-40	NP-5
	15-60	Fragmental material.	GP	A-1	80-90	15-25	5-10	0-5	0	---	NP
Cabba--------------	0-2	Loam-------------	SM-SC, CL-ML, SM, ML	A-4	0	100	100	95-100	45-70	25-40	5-10
	2-16	Loam, silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	90-100	70-95	30-50	5-30
	16-60	Weathered bedrock.									
100B, 100C--------- Amor	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	65-85	25-40	3-18
	8-32	Clay loam, loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	75-100	50-80	20-45	2-25
	32-60	Weathered bedrock.									
101C--------------- Parshall	0-17	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	17-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
102---------------- Bowbells	0-11	Loam-------------	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-90	20-40	3-23
	11-34	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	34-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
104---------------- Magnus	0-16	Silty clay loam, silty clay.	CH, CL	A-6, A-7	0	100	100	95-100	85-95	35-60	20-40
	16-29	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	100	90-100	75-95	45-75	20-50
	29-60	Stratified silt loam to silty clay.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	30-60	15-40

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
108*:											
Belfield----------	0-8	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	80-100	70-90	20-40	3-20
	8-30	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-95	50-70	30-50
	30-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-65	30-50
Straw-------------	0-27	Silt loam--------	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	27-54	Loam, silty clay, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
	54-66	Loamy sand-------	SM	A-2	0	100	100	55-70	15-30	---	NP
109B*:											
Bowbells----------	0-8	Loam-------------	CL, ML, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-90	20-40	3-23
	8-28	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	28-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	60-80	20-45	10-25
Zahl--------------	0-5	Loam-------------	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-60	Clay loam, loam	CL	A-6	0-1	95-100	95-100	80-95	60-80	25-40	10-20
110B-------------- Belfield	0-16	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	80-100	70-90	20-40	3-20
	16-32	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-95	50-70	30-50
	32-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-65	30-50
111*. Pits											

* See map unit description for the composition and behavior of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
1	0-16	0.6-2.0	0.22-0.24	6.1-7.8	<2	Low	High	Low	6
Parnell	16-43	0.06-0.2	0.13-0.19	6.6-7.8	<2	High	High	Low	
	43-60	0.06-0.2	0.11-0.19	6.6-8.4	<2	High	High	Low	
2	0-16	0.6-2.0	0.18-0.23	5.6-6.5	<2	Low	High	Low	6
Tonka	16-38	0.06-0.2	0.14-0.19	5.6-7.3	<2	High	High	Low	
	38-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	High	Low	
3D*:									
Seroco	0-3	6.0-20	0.10-0.12	6.1-7.3	<2	Low	Low	Low	2
	3-60	6.0-20	0.06-0.08	6.6-7.8	<2	Low	Low	Low	
Telfer	0-10	6.0-20.0	0.10-0.12	6.6-7.3	<2	Low	Moderate	Low	2
	10-60	6.0-20.0	0.06-0.10	6.6-7.8	<2	Low	Moderate	Low	
3E*:									
Seroco	0-3	6.0-20	0.10-0.12	6.1-7.3	<2	Low	Low	Low	2
	3-60	6.0-20	0.06-0.08	6.6-7.8	<2	Low	Low	Low	
Dune land.									
5	0-60	<0.06	0.13-0.18	6.6-7.8	<2	High	High	Low	4
Dimmick									
7	0-20	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	High	Moderate	6
Straw	20-46	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	High	Moderate	
	46-60	2.0-6.0	0.06-0.09	7.4-8.4	<2	Low	High	Moderate	
8, 8B, 8C	0-12	0.2-0.6	0.18-0.23	6.6-7.3	<2	Moderate	High	Low	7
Grail	12-26	0.06-0.6	0.14-0.17	6.6-7.3	<2	High	High	Low	
	26-60	0.06-0.6	0.13-0.22	7.9-8.4	<2	Moderate	High	Low	
9B, 9C	0-38	0.06-0.2	0.17-0.20	6.6-8.4	<8	High	High	Moderate	7
Regent	38-60	---	---	---	---	---	---	---	
10	0-8	0.6-2.0	0.18-0.23	7.4-7.8	<2	Moderate	High	Moderate	---
Savage	8-60	0.06-0.2	0.15-0.20	7.4-8.4	<8	High	High	Moderate	
11C	0-4	0.2-0.6	0.19-0.22	6.6-7.8	<2	Moderate	High	Moderate	7
Cherry	4-36	0.06-0.6	0.14-0.18	7.9-9.0	<2	Moderate	High	Moderate	
	36-60	0.06-0.6	0.14-0.18	7.9-9.0	<8	Moderate	High	Moderate	
14	0-8	0.6-2.0	0.20-0.24	7.4-7.8	<2	Moderate	High	Low	4L
Havrelon	8-60	0.6-2.0	0.15-0.19	7.4-7.8	<2	Moderate	High	Low	
15	0-60	0.06-0.2	0.14-0.17	7.4-9.0	<8	High	High	Moderate	4
Lawther									
17	0-4	<0.06	0.15-0.24	5.6-7.3	<2	Moderate	High	Moderate	7
Heil	4-60	<0.06	0.13-0.18	6.6-9.0	4-16	High	High	Moderate	
20	0-8	0.06-0.6	0.15-0.18	7.4-7.8	<2	High	High	Low	4
Lohler	8-60	0.06-0.6	0.13-0.17	7.4-8.4	<2	High	High	Low	
21B	0-24	6.0-20	0.06-0.12	6.6-7.8	<2	Low	High	Low	2
Lihen	24-60	6.0-20	0.08-0.16	7.4-8.4	<2	Low	High	Low	
21D	0-10	6.0-20.0	0.10-0.12	6.6-7.3	<2	Low	Moderate	Low	2
Telfer	10-60	6.0-20.0	0.06-0.10	6.6-7.8	<2	Low	Moderate	Low	
22B, 22D	0-30	6.0-20	0.09-0.12	6.6-7.3	<2	Low	Moderate	Low	2
Krem	30-60	0.2-2.0	0.15-0.19	7.4-8.4	<2	Moderate	High	Low	
27, 27B	0-30	0.6-2.0	0.22-0.24	6.1-7.3	<2	Low	Moderate	Low	5
Mandan	30-60	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low	Moderate	Low	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Wind erodi-bility group
	In	In/hr	In/in	pH	Mmhos/cm				
28------------------ Wilton	0-9	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low-------	Moderate-----	Low----------	6
	9-31	0.6-2.0	0.20-0.22	6.6-7.8	<2	Low-------	Moderate-----	Low----------	
	31-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
28B*:									
Temvik------------	0-11	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low-------	Moderate-----	Low----------	6
	11-27	0.6-2.0	0.20-0.22	6.6-7.8	<2	Low-------	Moderate-----	Low----------	
	27-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
Williams----------	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low-------	High---------	Low----------	6
	8-24	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High---------	Low----------	
	24-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High---------	Low----------	
28C*:									
Temvik------------	0-11	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low-------	Moderate-----	Low----------	6
	11-29	0.6-2.0	0.20-0.22	6.6-7.8	<2	Low-------	Moderate-----	Low----------	
	29-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
Williams----------	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low-------	High---------	Low----------	6
	8-24	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High---------	Low----------	
	24-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High---------	Low----------	
35C*, 35D*:									
Amor--------------	0-8	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	High---------	Moderate-----	6
	8-32	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	High---------	Moderate-----	
	32-60	---	---	---	---	----------	-------------	-------------	
Werner------------	0-8	0.6-2.0	0.14-0.22	6.6-7.8	<2	Moderate	High---------	Low----------	6
	8-17	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	High---------	Low----------	
	17-60	---	---	---	---	----------	-------------	-------------	
36, 36B, 36C------- Williams	0-7	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low-------	High---------	Low----------	6
	7-26	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High---------	Low----------	
	26-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High---------	Low----------	
38C*:									
Williams----------	0-6	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low-------	High---------	Low----------	6
	6-18	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High---------	Low----------	
	18-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High---------	Low----------	
Zahl--------------	0-5	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	Moderate-----	Low----------	4L
	5-60	0.06-2.0	0.15-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
38D*:									
Zahl--------------	0-5	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	Moderate-----	Low----------	4L
	5-60	0.06-2.0	0.15-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
Williams----------	0-5	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low-------	High---------	Low----------	6
	5-15	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High---------	Low----------	
	15-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High---------	Low----------	
38E---------------- Zahl	0-5	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	Moderate-----	Low----------	4L
	5-60	0.06-2.0	0.15-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
40----------------- Shambo	0-8	0.6-2.0	0.20-0.22	6.6-7.3	<2	Low-------	Moderate-----	Low----------	6
	8-24	0.6-2.0	0.17-0.19	6.6-8.4	<2	Moderate	Moderate-----	Low----------	
	24-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
40B---------------- Shambo	0-8	0.6-2.0	0.20-0.22	6.6-7.3	<2	Low-------	Moderate-----	Low----------	6
	8-24	0.6-2.0	0.17-0.19	6.6-8.4	<2	Moderate	Moderate-----	Low----------	
	24-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Wind erodibility group
							Uncoated steel	Concrete	
	In	In/hr	In/in	pH	Mmhos/cm				
41B---------------- Parshall	0-17	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low-------	Moderate-----	Low----------	5
	17-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low-------	Moderate-----	Low----------	
43---------------- Colvin	0-60	0.2-2.0	0.16-0.22	7.4-9.0	<2	High------	High---------	Low----------	4L
44, 44B, 44C------- Arnegard	0-10	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-------	High---------	Low----------	6
	10-39	0.6-2.0	0.16-0.22	6.6-7.3	<2	Low-------	High---------	Low----------	
	39-60	0.6-2.0	0.14-0.18	6.6-8.4	<2	Low-------	High---------	Low----------	
47---------------- Havrelon	0-8	0.6-2.0	0.20-0.24	7.4-7.8	<2	Moderate	High---------	Low----------	4L
	8-60	0.6-2.0	0.15-0.19	7.4-7.8	<2	Moderate	High---------	Low----------	
51---------------- Straw	0-20	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low-------	High---------	Moderate-----	5
	20-46	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	High---------	Moderate-----	
	46-60	2.0-6.0	0.06-0.09	7.4-8.4	<2	Low-------	High---------	Moderate-----	
53---------------- Banks	0-10	2.0-20	0.14-0.21	6.6-7.8	<2	Low-------	Moderate-----	Low----------	5
	10-60	6.0-20	0.07-0.09	7.4-8.4	<2	Low-------	Moderate-----	Low----------	
54B---------------- Lihen	0-17	6.0-20	0.06-0.12	6.6-7.8	<2	Low-------	High---------	Low----------	2
	17-60	6.0-20	0.08-0.16	7.4-8.4	<2	Low-------	High---------	Low----------	
55B, 55C----------- Vebar	0-34	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low-------	Moderate-----	Low----------	3
	34-60	---	---	---	---	----------	-------------	-------------	
56B---------------- Lefor	0-13	2.0-6.0	0.16-0.18	5.1-7.3	<2	Low-------	Moderate-----	Low----------	3
	13-34	0.6-2.0	0.15-0.17	6.6-7.8	<2	Moderate	Moderate-----	Low----------	
	34-60	---	---	---	---	----------	-------------	-------------	
56D---------------- Lefor	0-13	2.0-6.0	0.16-0.18	5.1-7.3	<2	Low-------	Moderate-----	Low----------	3
	13-34	0.6-2.0	0.15-0.17	6.6-7.8	<2	Moderate	Moderate-----	Low----------	
	34-60	---	---	---	---	----------	-------------	-------------	
57B, 57C----------- Flaxton	0-11	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low-------	High---------	Low----------	3
	11-28	2.0-6.0	0.15-0.17	6.6-7.3	<2	Low-------	High---------	Low----------	
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	High---------	Low----------	
58B*, 58C*, 58D*:									
Flaxton-----------	0-11	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low-------	High---------	Low----------	3
	11-28	2.0-6.0	0.15-0.17	6.6-7.3	<2	Low-------	High---------	Low----------	
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	High---------	Low----------	
Williams----------	0-5	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low-------	High---------	Low----------	6
	5-20	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High---------	Low----------	
	20-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High---------	Low----------	
59B---------------- Parshall	0-17	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low-------	Moderate-----	Low----------	3
	17-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low-------	Moderate-----	Low----------	
62B---------------- Velva	0-6	0.6-6.0	0.13-0.22	6.6-7.3	<2	Low-------	High---------	Low----------	3
	6-60	0.6-6.0	0.16-0.22	7.4-8.4	<2	Low-------	High---------	Low----------	
67*---------------- Straw	0-20	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low-------	High---------	Moderate-----	5
	20-46	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	High---------	Moderate-----	
	46-60	2.0-6.0	0.06-0.09	7.4-8.4	<2	Low-------	High---------	Moderate-----	
71B---------------- Searing	0-6	0.6-2.0	0.20-0.23	6.1-7.3	<2	Low-------	High---------	Moderate-----	6
	6-18	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	High---------	Moderate-----	
	18-28	0.6-6.0	0.16-0.18	7.4-8.4	<2	Low-------	High---------	Moderate-----	
	28-60	---	---	---	---	----------	-------------	-------------	
71C*:									
Searing-----------	0-6	0.6-2.0	0.20-0.23	6.1-7.3	<2	Low-------	High---------	Moderate-----	6
	6-16	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	High---------	Moderate-----	
	16-24	0.6-6.0	0.16-0.18	7.4-8.4	<2	Low-------	High---------	Moderate-----	
	24-60	---	---	---	---	----------	-------------	-------------	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
71C*:									
Ringling	0-15	0.6-20	0.12-0.16	6.6-7.3	<2	Low	Moderate	Low	8
	15-60	0.6->20	0.04-0.07	6.6-7.3	<2	Low	Moderate	Low	
73	0-13	0.2-2.0	0.20-0.23	6.1-7.3	<2	Moderate	High	Low	6
Belfield	13-32	0.2-0.6	0.14-0.18	6.6-7.8	<2	High	High	Moderate	
	32-60	0.06-0.6	0.13-0.16	7.9-9.0	4-16	High	High	Low	
74B*, 74C*:									
Regent	0-38	0.06-0.2	0.17-0.20	6.6-8.4	<8	High	High	Moderate	7
	38-60	---	---	---	---	---	---	---	
Rhoades	0-2	0.6-2.0	0.15-0.17	6.1-7.3	<2	Moderate	High	Low	6
	2-21	<0.2	0.10-0.12	7.4-9.0	2-16	High	High	Low	
	21-60	<0.2	0.10-0.12	7.9-9.0	8-16	High	High	Low	
75*, 75B*, 75C*:									
Belfield	0-13	0.2-2.0	0.20-0.23	6.1-7.3	<2	Moderate	High	Low	6
	13-32	0.2-0.6	0.14-0.18	6.6-7.8	<2	High	High	Moderate	
	32-60	0.06-0.6	0.13-0.16	7.9-9.0	4-16	High	High	Low	
Daglum	0-9	0.6-2.0	0.16-0.18	6.1-7.3	<2	Moderate	High	Low	6
	9-18	<0.2	0.12-0.14	7.4-9.0	2-8	High	High	Low	
	18-60	<0.2	0.12-0.14	7.9-9.0	8-16	High	High	Low	
76B*, 76C*:									
Sen	0-5	0.6-2.0	0.20-0.23	6.6-7.8	<2	Moderate	High	Moderate	6
	5-31	0.6-2.0	0.16-0.20	7.4-9.0	<2	Moderate	High	Moderate	
	31-60	---	---	---	---	---	---	---	
Rhoades	0-2	0.6-2.0	0.15-0.17	6.1-7.3	<2	Moderate	High	Low	6
	2-21	<0.2	0.10-0.12	7.4-9.0	2-16	High	High	Low	
	21-60	<0.2	0.10-0.12	7.9-9.0	8-16	High	High	Low	
77, 77B	0-7	0.6-2.0	0.18-0.20	6.6-7.3	<2	Low	Moderate	Low	6
Bowdle	7-24	0.6-2.0	0.18-0.20	6.6-7.3	<2	Low	Moderate	Low	
	24-60	6.0-20	0.03-0.06	7.4-7.8	<2	Low	Moderate	Low	
77C*:									
Bowdle	0-5	0.6-2.0	0.18-0.20	6.6-7.3	<2	Low	Moderate	Low	6
	5-22	0.6-2.0	0.18-0.20	6.6-7.3	<2	Low	Moderate	Low	
	22-60	6.0-20	0.03-0.06	7.4-7.8	<2	Low	Moderate	Low	
Wabek	0-7	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low	Moderate	Low	3
	7-13	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	Moderate	Low	
	13-60	>20	0.02-0.04	7.4-7.8	<2	Low	Moderate	Low	
78B*:									
Noonan	0-9	0.6-2.0	0.20-0.22	6.6-7.3	<2	Moderate	Moderate	Low	6
	9-29	0.06-0.2	0.12-0.14	7.4-9.0	<2	High	High	Moderate	
	29-50	0.06-0.2	0.10-0.14	7.9-9.0	2-8	Moderate	High	Moderate	
Flaxton	0-11	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low	High	Low	3
	11-38	2.0-6.0	0.15-0.17	6.6-7.3	<2	Low	High	Low	
	38-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	High	Low	
79B, 79C	0-7	0.06-0.2	0.15-0.18	7.4-8.4	<2	High	Moderate	Low	4L
Moreau	7-21	0.06-0.2	0.14-0.17	7.9-9.0	<4	High	Moderate	Low	
	21-29	0.06-0.2	0.13-0.15	7.9-9.0	4-16	High	Moderate	Low	
	29-60	---	---	---	---	---	---	---	
79D*:									
Wayden	0-12	0.06-0.2	0.14-0.19	7.4-8.4	<8	High	High	Moderate	4L
	12-60	---	---	---	---	---	---	---	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
79D*:									
Moreau	0-7	0.06-0.2	0.15-0.18	7.4-8.4	<2	High	Moderate	Low	4L
	7-21	0.06-0.2	0.14-0.17	7.9-9.0	<4	High	Moderate	Low	
	21-28	0.06-0.2	0.13-0.15	7.9-9.0	4-16	High	Moderate	Low	
	28-60	---	---	---	---	---	---	---	
81D Cabba	0-4	0.06-2.0	0.16-0.24	6.6-7.8	<4	Low	High	Moderate	6
	4-18	0.06-2.0	0.15-0.22	7.9-8.4	2-8	Moderate	High	Moderate	
	18-60	---	---	---	---	---	---	---	
81E Cabba	0-8	0.06-2.0	0.16-0.24	6.6-7.8	<4	Low	High	Moderate	6
	8-16	0.06-2.0	0.15-0.22	7.9-8.4	2-8	Moderate	High	Moderate	
	16-60	---	---	---	---	---	---	---	
82E*:									
Cabba	0-8	0.06-2.0	0.16-0.24	6.6-7.8	<4	Low	High	Moderate	6
	8-16	0.06-2.0	0.15-0.22	7.9-8.4	2-8	Moderate	High	Moderate	
	16-60	---	---	---	---	---	---	---	
Badland.									
83C*:									
Vebar	0-25	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low	Moderate	Low	3
	25-60	---	---	---	---	---	---	---	
Cohagen	0-14	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low	Moderate	Low	3
	14-60	---	---	---	---	---	---	---	
83E*:									
Cohagen	0-14	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low	Moderate	Low	3
	14-60	---	---	---	---	---	---	---	
Vebar	0-25	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low	Moderate	Low	3
	25-60	---	---	---	---	---	---	---	
84E*:									
Cohagen	0-14	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low	Moderate	Low	3
	14-60	---	---	---	---	---	---	---	
Vebar	0-25	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low	Moderate	Low	3
	25-60	---	---	---	---	---	---	---	
Rock outcrop.									
85 Harriet Variant	0-6	0.2-2.0	0.13-0.15	7.9-9.0	4-16	Moderate	High	High	4L
	6-19	0.06-2.0	0.08-0.14	8.5-9.0	4-16	High	High	High	
	19-60	0.06-0.6	0.08-0.14	8.5-9.0	4-16	High	High	High	
86E* Wabek	0-7	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low	Moderate	Low	3
	7-13	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	Moderate	Low	
	13-60	>20	0.02-0.04	7.4-7.8	<2	Low	Moderate	Low	
87C*:									
Rhoades	0-2	0.6-2.0	0.15-0.17	6.1-7.3	<2	Moderate	High	Low	6
	2-21	<0.2	0.10-0.12	7.4-9.0	2-16	High	High	Low	
	21-60	<0.2	0.10-0.12	7.9-9.0	8-16	High	High	Low	
Daglum	0-7	0.6-2.0	0.16-0.18	6.1-7.3	<2	Moderate	High	Low	6
	7-15	<0.2	0.12-0.14	7.4-9.0	2-8	High	High	Low	
	15-60	<0.2	0.12-0.14	7.9-9.0	8-16	High	High	Low	
88 Harriet	0-1	0.06-0.2	0.20-0.24	6.6-8.4	<2	Moderate	High	Moderate	6
	1-20	0.06-0.2	0.15-0.23	8.5-9.0	4-12	High	High	Moderate	
	20-60	0.06-0.2	0.14-0.18	8.5-9.0	4-12	Moderate	High	Moderate	
89E*. Ustorthents									

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
90C: Williams	0-7	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low	High	Low	6
	7-26	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High	Low	
	26-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High	Low	
91, 91B: Straw	0-20	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low	High	Moderate	5
	20-46	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	High	Moderate	
	46-60	2.0-6.0	0.06-0.09	7.4-8.4	<2	Low	High	Moderate	
92B*:									
Noonan	0-7	0.6-2.0	0.20-0.22	6.6-7.3	<2	Moderate	Moderate	Low	6
	7-30	0.06-0.2	0.12-0.14	7.4-9.0	<2	High	High	Moderate	
	30-60	0.06-0.2	0.10-0.14	7.9-9.0	2-8	Moderate	High	Moderate	
Williams	0-7	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low	High	Low	6
	7-26	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High	Low	
	26-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High	Low	
93: Falkirk	0-13	0.6-2.0	0.20-0.22	6.6-7.3	<2	Low	Moderate	Low	6
	13-18	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low	Moderate	Low	
	18-26	0.6-2.0	0.13-0.17	7.4-7.8	<2	Low	Moderate	Low	
	26-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	Moderate	Low	
94: Makoti	0-11	0.2-0.6	0.22-0.24	6.6-7.3	<2	Moderate	High	Low	6
	11-22	0.2-0.6	0.16-0.24	6.1-7.8	<2	Moderate	High	Low	
	22-60	0.2-0.6	0.16-0.22	7.4-8.4	<2	Moderate	High	Low	
95*:									
Flaxton	0-11	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low	High	Low	3
	11-28	2.0-6.0	0.15-0.17	6.6-7.3	<2	Low	High	Low	
	28-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	High	Low	
Williams	0-5	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low	High	Low	6
	5-20	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	High	Low	
	20-60	0.2-0.6	0.15-0.18	7.9-8.4	<2	Moderate	High	Low	
96, 96B: Grassna	0-17	0.6-2.0	0.22-0.24	6.6-7.3	<2	Moderate	High	Low	6
	17-60	0.6-2.0	0.16-0.22	6.6-8.4	<2	Moderate	High	Low	
97B, 97C: Sen	0-5	0.6-2.0	0.20-0.23	6.6-7.8	<2	Moderate	High	Moderate	6
	5-31	0.6-2.0	0.16-0.20	7.4-9.0	<2	Moderate	High	Moderate	
	31-60	---	---	---	---	---	---	---	
98E*:									
Ringling	0-15	0.6-20	0.12-0.16	6.6-7.3	<2	Low	Moderate	Low	8
	15-60	>20	0.01-0.03	6.6-7.3	<2	Low	Low	Low	
Cabba	0-2	0.06-2.0	0.16-0.24	6.6-7.8	<4	Low	High	Moderate	6
	2-16	0.06-2.0	0.15-0.22	7.9-8.4	2-8	Moderate	High	Moderate	
	16-60	---	---	---	---	---	---	---	
100B, 100C: Amor	0-8	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	High	Moderate	6
	8-32	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	High	Moderate	
	32-60	---	---	---	---	---	---	---	
101C: Parshall	0-17	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low	Moderate	Low	3
	17-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low	Moderate	Low	
102: Bowbells	0-11	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low	High	Low	6
	11-34	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate	High	Low	
	34-60	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate	High	Low	
104: Magnus	0-16	0.06-0.6	0.16-0.23	6.6-8.4	<2	High	High	Low	7
	16-29	0.06-0.6	0.14-0.18	7.4-8.4	<2	High	High	Low	
	29-60	0.06-0.6	0.13-0.22	7.4-8.4	<2	High	High	Low	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Risk of corrosion		Wind erodi- bility group
							Uncoated steel	Concrete	
	In	In/hr	In/in	pH	Mmhos/cm				
108*:									
Belfield----------	0-8	0.2-2.0	0.20-0.23	6.1-7.3	<2	Moderate	High---------	Low----------	6
	8-30	0.2-0.6	0.14-0.18	6.6-7.8	<2	High------	High---------	Moderate-----	
	30-60	0.06-0.6	0.13-0.16	7.9-9.0	4-16	High------	High---------	Low----------	
Straw-------------	0-27	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low-------	High---------	Moderate-----	5
	27-54	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	High---------	Moderate-----	
	54-66	2.0-6.0	0.06-0.09	7.4-8.4	<2	Low-------	High---------	Moderate-----	
109B*:									
Bowbells----------	0-8	0.6-2.0	0.17-0.24	6.1-7.3	<2	Low-------	High---------	Low----------	6
	8-28	0.6-2.0	0.16-0.22	6.1-7.3	<2	Moderate	High---------	Low----------	
	28-60	0.2-0.6	0.14-0.18	7.9-8.4	<2	Moderate	High---------	Low----------	
Zahl--------------	0-5	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	Moderate-----	Low----------	4L
	5-60	0.06-2.0	0.15-0.19	7.4-8.4	<2	Moderate	Moderate-----	Low----------	
110B--------------- Belfield	0-16	0.2-2.0	0.20-0.23	6.1-7.3	<2	Moderate	High---------	Low----------	6
	16-32	0.2-0.6	0.14-0.18	6.6-7.8	<2	High------	High---------	Moderate-----	
	32-60	0.06-0.6	0.13-0.16	7.9-9.0	4-16	High------	High---------	Low----------	
111*. Pits									

* See map unit description for the composition and behavior of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	
					Ft			In		
1------------------ Parnell	C/D	Frequent----	Long-------	Apr-Nov	0-2.0	Apparent	Jan-Dec	>60	---	High.
2------------------ Tonka	C/D	Common-------	Long-------	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	High.
3D*:										
Seroco------------	A	None---------	---	---	>6.0	---	---	>60	---	Low.
Telfer------------	A	None---------	---	---	>6.0	---	---	>60	---	Low.
3E*:										
Seroco------------	A	None---------	---	---	>6.0	---	---	>60	---	Low.
Dune land.										
5------------------ Dimmick	D	Frequent----	Long-------	Apr-Jun	0-3.0	Apparent	Sep-Jun	>60	---	Moderate.
7------------------ Straw	B	Rare to common.	Brief------	Mar-May	>6.0	---	---	>60	---	Moderate.
8, 8B, 8C---------- Grail	C	None---------	---	---	>6.0	---	---	>60	---	Moderate.
9B, 9C------------- Regent	C	None---------	---	---	>6.0	---	---	20-40	Rippable	Low.
10----------------- Savage	C	None---------	---	---	>6.0	---	---	>60	---	Low.
11C---------------- Cherry	C	None---------	---	---	>6.0	---	---	>60	---	Moderate.
14----------------- Havrelon	B	None to common.	Brief------	Apr-Jun	>6.0	---	---	>60	---	Moderate.
15----------------- Lawther	D	None---------	---	---	>6.0	---	---	>60	---	Low.
17----------------- Heil	D	Frequent----	Long-------	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	Moderate.
20----------------- Lohler	C	None to common	Brief------	Apr-Jun	3.0-5.0	Apparent	Sep-Jun	>60	---	Moderate.
21B---------------- Lihen	A	None---------	---	---	>6.0	---	---	>60	---	Low.
21D---------------- Telfer	A	None---------	---	---	>6.0	---	---	>60	---	Low.
22B, 22D----------- Krem	A	None---------	---	---	>6.0	---	---	>60	---	Moderate.
27, 27B------------ Mandan	B	None---------	---	---	>6.0	---	---	>60	---	Moderate.
28----------------- Wilton	B	None---------	---	---	>6.0	---	---	>60	---	Moderate.
28B*, 28C*:										
Temvik------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate.

See footnote 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
					Ft			In		
28B*, 28C*:										
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
35C*, 35D*:										
Amor	B	None	---	---	>6.0	---	---	20-40	Rippable	Moderate.
Werner	D	None	---	---	>6.0	---	---	7-20	Rippable	Moderate.
36, 36B, 36C Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
38C*:										
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Zahl	B	None	---	---	>6.0	---	---	>60	---	Moderate.
38D*:										
Zahl	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
38E Zahl	B	None	---	---	>6.0	---	---	>60	---	Moderate.
40, 40B Shambo	B	None	---	---	>6.0	---	---	>60	---	Moderate.
41B Parshall	B	None	---	---	>6.0	---	---	>60	---	Moderate.
43 Colvin	C/D	Frequent	Long	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	High.
44, 44B, 44C Arnegard	B	None	---	---	>6.0	---	---	>60	---	Moderate.
47 Havrelon	B	None to common.	Brief	Apr-Jun	>6.0	---	---	>60	---	Moderate.
51 Straw	B	Rare to common.	Brief	Mar-May	>6.0	---	---	>60	---	Moderate.
53 Banks	A	Common	Brief	Mar-Jun	>6.0	---	---	>60	---	Low.
54B Lihen	A	None	---	---	>6.0	---	---	>60	---	Low.
55B, 55C Vebar	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.
56B, 56D Lefor	B	None	---	---	>6.0	---	---	20-40	Rippable	Moderate.
57B, 57C Flaxton	B	None	---	---	>6.0	---	---	>60	---	Moderate.
58B*, 58C*, 58D*:										
Flaxton	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
59B Parshall	B	None	---	---	>6.0	---	---	>60	---	Moderate.
62B Velva	B	Common	Very brief to brief.	Mar-Jun	>6.0	---	---	>60	---	Moderate.

See footnote 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
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	
					Ft			In		
67*: Straw	B	Rare to common.	Brief	Mar-May	>6.0	---	---	>60	---	Moderate.
71B: Searing	B	None	---	---	>6.0	---	---	20-40	Rippable	Moderate.
71C*:										
Searing	B	None	---	---	>6.0	---	---	20-40	Rippable	Moderate.
Ringling	A	None	---	---	>6.0	---	---	>60	---	Low.
73: Belfield	C	None	---	---	>6.0	---	---	>60	---	Low.
74B*, 74C*:										
Regent	C	None	---	---	>6.0	---	---	20-40	Rippable	Low.
Rhoades	D	None	---	---	>6.0	---	---	>40	Rippable	Low.
75*, 75B*, 75C*:										
Belfield	C	None	---	---	>6.0	---	---	>60	---	Low.
Daglum	D	None	---	---	>6.0	---	---	>40	Rippable	Moderate.
76B*, 76C*:										
Sen	B	None	---	---	>6.0	---	---	20-40	Rippable	Moderate.
Rhoades	D	None	---	---	>6.0	---	---	>40	Rippable	Low.
77, 77B: Bowdle	B	None	---	---	>6.0	---	---	>60	---	Low.
77C*:										
Bowdle	B	None	---	---	>6.0	---	---	>60	---	Low.
Wabek	A	None	---	---	>6.0	---	---	>60	---	Low.
78B*:										
Noonan	D	None	---	---	>6.0	---	---	>60	---	Moderate.
Flaxton	B	None	---	---	>6.0	---	---	>60	---	Moderate.
79B, 79C: Moreau	D	None	---	---	>6.0	---	---	20-40	Rippable	Low.
79D*:										
Wayden	D	None	---	---	>6.0	---	---	10-20	Rippable	Low.
Moreau	D	None	---	---	>6.0	---	---	20-40	Rippable	Low.
81D, 81E: Cabba	C	None	---	---	>6.0	---	---	10-20	Rippable	Moderate.
82E*:										
Cabba	C	None	---	---	>6.0	---	---	10-20	Rippable	Moderate.
Badland.										
83C*:										
Vebar	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.
Cohagen	D	None	---	---	>6.0	---	---	4-20	Rippable	Moderate.
83E*:										
Cohagen	D	None	---	---	>6.0	---	---	4-20	Rippable	Moderate.
Vebar	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.

See footnote 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
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	
					Ft			In		
84E*:										
Cohagen	D	None	---	---	>6.0	---	---	4-20	Rippable	Moderate.
Vebar	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.
Rock outcrop.										
85 Harriet Variant	C	Frequent	Brief	Apr-Jun	0-1.0	Apparent	Jun-Nov	>60	---	High.
86E* Wabek	A	None	---	---	>6.0	---	---	>60	---	Low.
87C*:										
Rhoades	D	None	---	---	>6.0	---	---	>40	Rippable	Low.
Daglum	D	None	---	---	>6.0	---	---	>40	Rippable	Moderate.
88 Harriet	D	Occasional	Long	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	High.
89E*. Ustorthents										
90C Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
91, 91B Straw	B	Rare to common.	Brief	Mar-May	>6.0	---	---	>60	---	Moderate.
92B*:										
Noonan	D	None	---	---	>6.0	---	---	>60	---	Moderate.
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
93 Falkirk	B	None	---	---	>6.0	---	---	>60	---	Moderate.
94 Makoti	B	None	---	---	5.0-6.0	Apparent	Sep-Jun	>60	---	Moderate.
95*:										
Flaxton	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Williams	B	None	---	---	>6.0	---	---	>60	---	Moderate.
96, 96B Grassna	B	None	---	---	>6.0	---	---	>60	---	Moderate.
97B, 97C Sen	B	None	---	---	>6.0	---	---	20-40	Rippable	Moderate.
98E*:										
Ringling	A	None	---	---	>6.0	---	---	>60	---	Low.
Cabba	C	None	---	---	>6.0	---	---	10-20	Rippable	Moderate.
100B, 100C Amor	B	None	---	---	>6.0	---	---	20-40	Rippable	Moderate.
101C Parshall	B	None	---	---	>6.0	---	---	>60	---	Moderate.
102 Bowbells	B	None	---	---	>6.0	---	---	>60	---	Moderate.

See footnote 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
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	
					Ft			In		
104----------------- Magnus	C	Rare to common.	Very brief to brief.	Mar-Jun	>6.0	---	---	>60	---	Moderate.
108*:										
Belfield----------	C	None----------	---	---	>6.0	---	---	>60	---	Low.
Straw-------------	B	Rare to common.	Brief------	Mar-May	>6.0	---	---	>60	---	Moderate.
109B*:										
Bowbells----------	B	None----------	---	---	>6.0	---	---	>60	---	Moderate.
Zahl--------------	B	None----------	---	---	>6.0	---	---	>60	---	Moderate.
110B---------------- Belfield	C	None----------	---	---	>6.0	---	---	>60	---	Low.
111*. Pits										

* See map unit description for the composition and behavior of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Amor	Fine-loamy, mixed Typic Haploborolls
Arnegard	Fine-loamy, mixed Pachic Haploborolls
Banks	Sandy, mixed, frigid Typic Ustifluvents
Belfield	Fine, montmorillonitic Glossic Natriborolls
Bowbells	Fine-loamy, mixed Pachic Argiborolls
Bowdle	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Haploborolls
Cabba	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Cherry	Fine-silty, mixed, frigid Typic Ustochrepts
Cohagen	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Colvin	Fine-silty, frigid Typic Calciaquolls
Daglum	Fine, montmorillonitic Typic Natriborolls
Dimmick	Fine, montmorillonitic, frigid Vertic Haplaquolls
Falkirk	Fine-loamy, mixed Pachic Haploborolls
Flaxton	Fine-loamy, mixed Pachic Argiborolls
Grail	Fine, montmorillonitic Pachic Argiborolls
Grassna	Fine-silty, mixed Pachic Haploborolls
Harriet	Fine, mixed, frigid Typic Natraquolls
Harriet Variant	Fine-loamy, mixed, frigid Typic Halaquepts
*Havrelon	Fine-loamy, mixed (calcareous), frigid Typic Ustifluvents
Heil	Fine, montmorillonitic, frigid Typic Natraquolls
Krem	Sandy over loamy, mixed Typic Argiborolls
Lawther	Fine, montmorillonitic Vertic Haploborolls
Lefor	Fine-loamy, mixed Typic Argiborolls
Lihen	Sandy, mixed Entic Haploborolls
Lohler	Fine, montmorillonitic (calcareous), frigid Typic Ustifluvents
Magnus	Fine, montmorillonitic Cumulic Haploborolls
Makoti	Fine-silty, mixed Pachic Haploborolls
Mandan	Coarse-silty, mixed Pachic Haploborolls
Moreau	Fine, montmorillonitic Typic Haploborolls
Noonan	Fine-loamy, mixed Typic Natriborolls
Parnell	Fine, montmorillonitic, frigid Typic Argiaquolls
Parshall	Coarse-loamy, mixed Pachic Haploborolls
Regent	Fine, montmorillonitic Typic Argiborolls
Rhoades	Fine, montmorillonitic Leptic Natriborolls
Ringling	Fragmental, mixed Typic Haploborolls
Savage	Fine, montmorillonitic Typic Argiborolls
Searing	Fine-loamy, mixed Typic Haploborolls
Sen	Fine-silty, mixed Typic Haploborolls
Seroco	Mixed, frigid Typic Ustipsamments
Shambo	Fine-loamy, mixed Typic Haploborolls
Straw	Fine-loamy, mixed Cumulic Haploborolls
Telfer	Sandy, mixed Entic Haploborolls
Temvik	Fine-silty, mixed Typic Haploborolls
Tonka	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Ustorthents	Fine, montmorillonitic, frigid Ustorthents
Vebar	Coarse-loamy, mixed Typic Haploborolls
Velva	Coarse-loamy, mixed Fluventic Haploborolls
Wabek	Sandy-skeletal, mixed Entic Haploborolls
Wayden	Clayey, montmorillonitic (calcareous), frigid, shallow Typic Ustorthents
Werner	Loamy, mixed, shallow Entic Haploborolls
Williams	Fine-loamy, mixed Typic Argiborolls
Wilton	Fine-silty, mixed Pachic Haploborolls
Zahl	Fine-loamy, mixed Entic Haploborolls

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